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THEORY- AND EVIDENCE-BASED STRATEGIES TO PROMOTE REGULAR EYE
EXAMINATIONS FOR ELDERLY CENTRE MEMBERS IN HONG KONG

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PhD

The Hong Kong Polytechnic University

2025

The Hong Kong Polytechnic University

School of Optometry

Theory- and Evidence-Based Strategies to Promote Regular Eye Examinations for Elderly
Centre Members in Hong Kong

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A thesis submitted in partial fulfilment of the requirements for the degree of Doctor of
Philosophy

April 2024

CERTIFICATE OF ORIGINALITY

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LAU WING YAN

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Abstract

Background and aim

Regular preventive eye examination allows monitoring of visual wellbeing, facilitate early detection of age-related eye diseases and timely treatment if needed. However, suboptimal uptake of preventive eye examination by the older adults has been an on-going issue that is yet to be addressed by effective intervention strategies. To maximise the likelihood of implementing effective strategies, the current project proposes evidence-based, theory-driven, and preference-informed intervention strategies to encourage the uptake of such services.

Methods and Results

This was a **mixed-method study** consisting of three stages. All the older adults who participated were recruited from the elderly centre population.

In **Stage 1**, semi-structured interviews were conducted with twenty-five older adults to explore their preventive eye examination utilisation decision-making process. Results were analysed using a grounded theory approach. This study found that older adults encountered barriers in prioritizing preventive eye health among the on-going healthcare needs. These were due to perceived low needs for a preventive eye examination, perceived low self-efficacy to use such service and the unmet expectation for service delivery.

In **Stage 2**, an intervention was developed based on the qualitative evidence and guided by the Capability-Motivation-Opportunity Behaviour Model and the Behaviour Change Wheel framework. The theory-driven development followed a holistic approach to consider how behavioural drivers could be addressed by the proposed strategy. Opinions from the advisory group were incorporated to ensure prospective feasibility of the proposed strategy. The intervention strategy proposed will require collective effort from elderly centre and the service provider to empower the older adults to undergo regular eye examination.

In **Stage 3**, a discrete choice experiment survey was conducted to determine whether the older adults have a preference for the proposed intervention design which was described in five attributes: service location, specified fee range, appointment booking, appointment reminder,

and a supportive environment to facilitate informed decision-making. The results collected from 93 subjects were analysed using the conditional logit model and the potential uptake for the preferred strategy was estimated. The findings revealed that older adults have a preferred level for all five attributes. They preferred to receive a mobile service eye examination at the elderly centre to the optometric clinics, preferred having a specified service fee range to no specified fee range, preferred appointment booked by the service provider to booking by the users themselves and preferred an appointment reminder to no appointment reminder. They also preferred having a supportive environment to empower them with necessary information to facilitate decision-making to having no supportive environment. A strategy with the preferred levels has an estimated potential uptake of 90.6% supporting its potential usefulness in improving preventive eye examination by the older adults.

Conclusion

This thesis provided an explanation for the suboptimal uptake of preventive eye examination. Collective efforts are required from the community and service provider to motivate the older adults to engage in such services. The proposed intervention strategy demonstrated potential in improving service uptake, and therefore could be considered to implement to the older adults from the elderly centre population.

(word count, including sub-headings: 495)

Publication arising from the thesis

Published

Lau, W. Y., Liao, Q., Lian, J., & Yap, M. (2024). Barriers in older adults' decision-making process to use routine eye examinations in Hong Kong. *Clinical & experimental optometry*, 107(4), 442–448. doi: 10.1080/08164622.2023.2237971

Manuscript under revision

Lau, W. Y., Lian, J. & Yap, M. (2024) The effectiveness of interventions used to improve general health check uptake by the older adult population: a systematic review and meta-analysis. Manuscript under revision

Acknowledgements

I would like to express my sincere gratitude and deepest appreciation towards my Chief supervisor Dr Tina Lian for her invaluable guidance, patience and understanding which have helped me grow and overcome the hurdles I encountered during the completion of this programme. It has been such a positive and enjoyable experience to complete this PhD under her supervision.

I am extremely grateful to my co-supervisor Professor Maurice Yap, who initiated the discussion of the possibility of me pursuing a PhD back in 2019. I appreciated his guidance and support and sharing his invaluable expertise which have broaden my horizons.

I would also like to thank my co-supervisor, Professor Andrew Lam, for his assistance in subject recruitment for my compulsory coursework module, and for his support, invaluable opinions and guidance during the intervention development and throughout the completion of this programme.

I could not have completed this project without the support and guidance from experienced researchers, staff and volunteers. First, I would like to thank Dr Julie Liao for her guidance and support in the completion of the qualitative study. I would like to extend my gratitude to Prof Sarah McGhee for her guidance during the design of the DCE study. I would also like to thank Dr Rita Sum, Dr Vincent Ng, and Ms Queenie Lau for their time to share their expertise and opinions during the intervention development stage of this project. Additionally, I would like to thank the IAA volunteers who participated in the pilot questionnaire and discussion of the intervention strategy proposal.

The data collection would not have gone so smoothly without the support from the elderly neighbourhood centres. I would like to acknowledge the centre staffs for their assistance in subject recruitment and logistic discussion. Special thanks to the elders who have participated in the individual interviews and the questionnaire for their time and support.

I am also thankful to my team members for their support, especially to Mr Jason So for his guidance and discussion during the data analysis stage; Angel for her assistance in the

systematic review screening; and Mengke for her emotional support during the last six months of completing the PhD programme.

Lastly, I would also like to thank my family members and friends for their genuine support. I am grateful to my parents for not doubting any of my decisions and have confidence in anything I pursue in life. I would like to thank Bravo (my pet but also my little brother) for his companion and emotional support. Many thanks to my dearest friends, especially Shannon, Crystal, Christy, Serena, Steph, Vicky, Tegan, Phyllis, and Samki who have been witnessing my academic journey and personal growth since our teenage years.

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Chapter 1 Introduction

Safeguarding the health of the older adult has become an important public health issue under the impact of ageing population. Adopting appropriate preventive behaviours, especially those that safeguard the wellbeing of the older adults through comprehensive assessment, are of great importance. Vision, being an important functionality throughout the life course, decline inevitably as we age. Maintaining good vision has great importance to increase the likelihood to experience a successful ageing for the older adults (Swenor et al., 2020).

Eliminating avoidable blindness is a global initiative that has been working towards for decades among different regions across the world. The significant impact of visual impairment and blindness has been advocated by World Health Organisation (WHO) since 1954. Followed by this was the official establishment of the WHO Programme for the Prevention of Blindness in 1978. Later in 1999, The Vision 2020, a global eye health initiative was launched which strive to have avoidable blindness eliminated by 2020. Although the prevalence of visual impairment has reduced over the past 30 years (Bourne et al., 2021), it was yet to achieve the target goal of 25% reduction by 2019. Ageing population will continue to pose challenges in achieving the goal of eliminating avoidable blindness (Ackland et al., 2017; Bourne et al., 2021).

The global eye health initiative continues to refine in response to the ageing population. Recent focus of such initiative has been on advocating for a better integration of eye care into the general healthcare system as well as the need for strategies to reduce avoidable blindness (World Health Organization, 2019a). The latest approach being advocated is the “integrated people-centre eye care” framework, emphasising the role of the people themselves being actively involved in taking good care of themselves with the help of better integrated healthcare system (World Health Organization, 2019b). The International Agency for the Prevention of Blindness (2021) later published a strategic initiative report which reiterated the importance of coordinated effort from individual, the community as well as from the service level to policy-level to eliminate avoidable visual impairment.

In Hong Kong, the population is also ageing. It was estimated that by 2046, the older adult population would reach 2.74 million from 1.45 million in 2021, accounting for more than 30% of the Hong Kong total population (Census and Statistics Department, 2022). With the expected

growth of older adult population, more older adults in Hong Kong will require preventive service to safeguard their well-being. The impact of ageing population on the healthcare system has been recognised by the Hong Kong Special Administrative Region (HKSAR) Government. With that, the healthcare was reformed in 2008 which has since been focusing on promoting a preventive-orientated healthcare model by strengthening primary care (Food and Health Bureau, 2008b). The Primary Healthcare Blueprint was released in 2022 which focuses on strategies that are “prevention-orientated”, “community-based”, “family-centric” and focusing on “early detection and timely intervention” (Health Bureau, 2022). The aim of the blueprint was to address the challenges accompanies with ageing population, which includes the increase in chronic disease prevalence. As shown above, preventive healthcare has become an important public health topic. Yet, the attention from local government has been limited. As regular eye examination holds an important role in maintaining visual health, it is of great importance to understand how to encourage more older adults to engage in this type of preventive service,

This thesis focuses on preventive eye examination utilisation behaviour of the older adults (aged 65 years or above) – a preventive health service seeking behaviour that allow regular monitoring of visual wellbeing through comprehensive assessment and thereby aid timely treatment if needed.

This chapter discusses the significance of visual loss and the need for regular monitoring of eye health using preventive eye examination. Together, these highlight the rationales for conducting this PhD project.

1.1 Background

Vision is an important sensory function that allow one to connect to the external world, perform daily tasks and live independently. However, vision decline is inevitable with ageing (Chen et al., 2024). The prevalence of visual impairment was associated with older age in different older adult population around the world such as the United States (Killeen et al., 2023), Mainland China (Xu et al., 2020; Ye et al., 2022) and in Hong Kong (Qi Sheng You et al., 2020). A meta-analysis of populational-based survey on eye disease between 1980 to 2018 revealed that the global most leading causes of avoidable visual impairment were cataract, glaucoma, uncorrected refractive error, age-related macular degeneration (AMD), followed by diabetic retinopathy (DR) (Steinmetz et al., 2021). In Hong Kong, cataract, uncorrected refractive error and AMD were the top three factors contributing to visual impairment in 2018 (Qi Sheng You

et al., 2020). Other Asian regions also reported similar causes of vision impairment (Afarid et al., 2020; Hsu et al., 2004; Xu et al., 2020).

Vision plays a crucial role in the maintaining health well-being. Across all age groups, blindness and vision loss were listed as the ninth cause for global all-cause years lived with disability in 2021 (Ferrari et al., 2024). Maintaining eyesight allows the older adults to live independently by allowing an individual to move around without great difficulties, and to engage in social activities (Klauke et al., 2023). Older adults with visual impairment faced greater odds of all-cause mortality (Ehrlich et al., 2021). Furthermore, vision loss has been found to impact many aspects of the older adult life. Visual impairment has been found to be associated with cognitive decline (Cao et al., 2023; Nagarajan et al., 2022; Shang et al., 2021). A meta-analysis of 16 studies focusing on cognitive impairment and dementia found significant association between visual impairment and these two cognitive outcomes. Comparing those without visual impairment, people with visual impairment were 1.41 times more likely to have cognitive impairment and 1.44 times likely to have dementia (Cao et al., 2023).

Research have also found that having visual impairment were more likely to experience depression (Hashemi et al., 2024; Virgili et al., 2022) and anxiety (Hashemi et al., 2024). The impact of visual impairment of mental health was recognised by scholars which reflected in an increase of research investigation on psychological interventions for people with visual impairment (Demmin & Silverstein, 2020). The subjective impact of vision loss on those with visual impairment was also captured by qualitative studies. A meta-synthesis of qualitative studies on people suffered from AMD revealed people have reported feeling isolated and facing stigma having to disclose their conditions to others (Bennion et al., 2012).

In addition to having adverse effect on psychological health wellbeing, older adults with vision loss were more likely to experience fall injuries (Hong et al., 2014; Saftari & Kwon, 2018). A study found that older adults who had reduced visual functions, notably with difficulties perceiving depth, were 3.4 times more likely to experience fall more specifically reduced function in depth perception (Mehta et al., 2022).

Visual impairment also resulted in greater economic burden. Those who had severe visual impairment, there would be additional cost to caregiving. In the long term, people may require rehabilitation services or even domestic modification to live with the eye disease. Having visual impairment did not only impact on the patients themselves but also their caregivers (Köberlein

et al., 2013). Depending on the severity of visual impairment and the way economic burden was estimated, the estimated burden could vary (Köberlein et al., 2013; Marques et al., 2022) nonetheless, having visual impairment can still pose challenges to those with visual impairment and people around them.

Given the impact on psychological, social, physical wellbeing, along with long-term economic burden, it is of great importance to ensure early detection of any visual needs or ocular abnormalities to ensure timely treatment is received.

Undergoing preventive eye examination regularly is an effective way to monitor one's visual and ocular health and allow early detection of eye disorder or early signs of age-related eye diseases (Irving et al., 2016). This type of examination includes a series of assessment to examine the visual health such as visual acuity, visual function, and ocular health (e.g., whether there are signs of common eye diseases such as cataract, glaucoma, AMD). Uncorrected refractive error and cataract are preventable and correctable through early and cost-effective intervention, such as through spectacle provision or undergoing cataract surgery (Ginel et al., 2023; World Health Organization, 2019b). While AMD has no cure, early detection of it enables patients to receive timely care that may increase the chance of receiving better disease management that help stabilise disease progression (Loewenstein, 2007; Schwartz & Loewenstein, 2015).

The interval for receiving eye examination has been under debate mainly due to the insufficient evidence to justify its impact on improving health outcome (Chou et al., 2022). However, Nonetheless, there is a consensus among clinical guidelines which recommend older adults aged 65 or above should undergo comprehensive eye examination at least every one to two years, with more frequent examination interval given to those with higher risk, such as family history of glaucoma (American Academy of Ophthalmology, 2015; American Optometric Association, 2015; Centers for Disease Control and Prevention, 2020; Health Direct, n.d.; National Health Services, 2023; Optometrists and Opticians Board, 2018b, 2020; The College of Optometrists, n.d.). Regular uptake of eye examination has been found to increase early detection of ocular issues (Irving et al., 2016), which aligns with the function of preventive services, that is to allow early detection to increase the chance to receive timely treatment or intervention accordingly.

While vision health has started to gain more attention in the global health agenda and the importance of eye care utilisation has been increasingly recognised (Forrest et al., 2023), there is no official statistical target/aim to determine what an “optimal” eye examination utilisation rate should be. Nonetheless, the eye examination utilisation rate being quoted as “suboptimal” or “low” in the literature mainly falls under 70% (Lee et al., 2009; Morka et al., 2020; Vela et al., 2012), while other scholars considered a “high” eye examination utilisation as 60% to 70% (Gupta et al., 2020). A systematic review published in 2012 reported that only 16% of the older adult population have received an eye examination within 24 months (Vela et al., 2012). Although there is no other recent systematic review focused on global eye examination utilisation since the last review was published in 2012, recent reported eye examination utilisation rate from other published literatures all fell below an uptake rate of 70% (Assaye et al., 2023; Atta et al., 2022; Bazargan et al., 2020; Foreman et al., 2018; Gupta et al., 2020). The overall low utilisation of eye examination is alarming because this implies that people are not demanding the care they need. According to a report by Lancet Global Health Commission on Global Eye Health, around 90% of the visual impairment could have been prevented or treated (Burton et al., 2021). Increasing the utilisation of eye examination to allow regular monitoring to aid early detection of ocular issues will play an important role in reducing avoidable visual impairment.

Similar to the international eye examination uptake statistics, a population-based survey revealed that 38.4 % of the surveyed Hong Kong older adults did not undergo an eye examination every two years even under the eligible financial incentive voucher scheme (Sum et al., 2022). Reasons for not utilising the eye examination has not been widely investigated in Hong Kong while extensive studies were found in non-Hong Kong regions (Elam & Lee, 2013; Malik et al., 2022; Solomon et al., 2022; Wagner & Rein, 2013). Considering the differences in healthcare system and healthcare provision, the generalisability of the results remained unclear. The reasons for not using preventive eye examination by the older adults require further investigation under the Hong Kong context. Addressing this knowledge gap will have great implication on putting forward potential solutions to address the low uptake rate and benefit the older adults for the local context.

While there have been studies investigating the factors influencing preventive eye examination, there have been a few studies among the literature that investigated the interventions to improve preventive eye examination utilisation (Dan et al., 2015; Ellish et al., 2011; Katibeh et al., 2020;

Owsley et al., 2013). This implies that the findings of factors related to preventive eye examination utilisation have not been fully utilised to support intervention development. This also raises questions about how to incorporate evidence to guide the intervention development to improve eye examination utilisation.

The rest of the thesis chapters discuss the steps taken to put forward theory- and evidence-based strategies to improve the use of eye examination by applying the Behaviour Change Wheel framework to guide the intervention development process and using Discrete Choice Experiment to collect information on the preference of the older adults for the intervention design.

1.2 Thesis outline

This thesis consists of eight chapters.

Chapter 2 consists of the relevant literature review topics: 1) utilisation of eye examination service by the older adult population and its associated factors; 2) a review on the interventions to improve the use of eye examination; 3) theories to design behaviour change intervention; 4) an introduction to the Behaviour Change Wheel (BCW); and lastly, 5) using Discrete Choice Experiment (DCE) to elicit preference. Together, these reviews provide the justifications on the need of current research and the knowledge required to understand the methods and results reported in subsequent chapters.

Chapter 3 provides the aims and objectives of this thesis.

Chapter 4 reports a qualitative study to understand the decision-making process of the older adults on using preventive eye examination. Key barriers in the decision-making have been identified and is to be used to inform the study in Chapter 5.

Chapter 5 reports a systematic review on general health check conducted to provide evidence on effectiveness of intervention to improve uptake of general health check and the associated behaviour change techniques used in these studies. The justification for synthesising evidence from general health check, instead of preventive eye examination is also discussed. This chapter contributes to part of the evidence used to support intervention development reported in Chapter 6.

Chapter 6 reports the application of the BCW to develop an intervention specifically targeting at the barriers identified in Chapter 4 to improve the uptake of preventive eye examination. A holistic intervention has been proposed and was be used to inform the study to elicit user preference reported in Chapter 7.

Chapter 7 reports a DCE study which investigated the preference of the older adults on the characteristics of the established intervention in Chapter 6.

Chapter 8 provides an overall discussion on all the results reported from Chapter 5 to Chapter 7, followed by a discussion on the overall limitations, implications, and future directions.

Chapter 2 Literature reviews

2.1 Chapter overview

This chapter summarises and discusses the literature on the relevant topics of this thesis. This project aims to bring forward theory- and evidence-based intervention to improve the use of eye examination by the older adults. To address this overarching aim, five literature reviews were conducted on the following topics.

1. Utilisation of eye examination service by the older adult population and b) its associated factors
2. A review of the interventions to improve the use of eye examination
3. Theories to design behaviour change intervention
4. An introduction to the Behaviour Change Wheel
5. Using Discrete Choice Experiment to elicit preference: an introduction

At the end of this literature review chapter, this thesis argues that there is currently a lack of intervention being investigated to address the issue of suboptimal preventive eye examination uptake and that the use of theoretical framework should be used to guide intervention development process.

2.2 Definitions

Health care seeking behaviour is part of healthcare utilisation - people seeking healthcare contribute to the health service utilisation rate. Healthcare utilisation can be defined as “ *the quantification or description of the use of services by persons for the purpose of preventing and ... promoting maintenance of health and well-being, or obtaining information about one’s health status* ” (Carrasquillo Chief, 2020). Understanding how people make decision to use a healthcare service can assist proposal on useful strategies to improve service uptake. When it comes to preventive service seeking behaviour, it focuses on the behaviour where an individual perceives himself or herself to be healthy but seeks service for preventive purposes.

Preventive eye examination conducted at primary healthcare level has an important preventive role. Gilbert et al. (2021) stated that primary eye health care is no different from primary health

care and should be seen “an integrated part” of the latter. With reference to the WHO’s definition of primary healthcare, the definition of **primary eye health care** has been operationalized by Gilbert et al. (2021) as:

“Like primary healthcare, it includes primary eye care and essential public health functions [...]. It also includes two broader eye health promotions measures: policies and action that reduce eye conditions and increase access to eye services and educating and supporting communities so that they know how to prevent eye conditions and are able to seek eye care services when needed”.

Primary eye care has been defined as (Gilbert et al., 2021):

“Clinical eye care services delivered by healthcare personnel working in, or attached to, community or primary care facilities. It involves detecting and managing simple eye conditions; and detecting and referring patients with complex eye conditions to secondary level.”

This thesis focuses on preventive eye examination utilisation by older adults aged 65 years or above. This type of eye examination focuses on providing an overall assessment of visual health, usually including a dilated eye examination. In Hong Kong, this service is provided by the Part I optometrists in the primary care setting.

2.3 Eye examination utilisation rate in the older adult population

Regular uptake of preventive eye examination is recommended to older adults to maintain their visual health wellbeing. According to evidence-based guideline, older adults (aged 65 or above) should undergo a comprehensive eye examination at least annually (Feder et al., 2016; Robinson et al., 2012), or at least every one to two year, or with more frequent examination interval depends on the presence of risk factors such as family history of glaucoma (American Academy of Ophthalmology, 2015; American Optometric Association, 2015; Centers for Disease Control and Prevention, 2020; Health Direct, n.d.; National Health Services, 2023; Optometrists and Opticians Board, 2018b, 2020). It is important to get contact with an eyecare provider to receive the appropriate recommendation that best suits an individual. The service providers responsible for delivering eye examination services differ among regions which operates different eye care system (Gilbert et al., 2021).

Despite the significance of regular preventive eye examination in avoiding preventable blindness by increasing the chances of early detection of ocular abnormalities (Irving et al., 2016; Robinson et al., 2012), the uptake of such service has been reported suboptimal worldwide. Vela et al. (2012) conducted a systematic review using World Health Survey data collected from 52 countries between 2002 to 2003. The review found that eye examination utilisation rate within one year ranged from 10% to 37%; and 9% to 27% within a two-year interval (Vela et al., 2012). A cross-sectional country-based study published in 2019, based on data collected from six low- to middle-income countries (China, Ghana, Russia, South Africa, and Mexico) between 2007 and 2010, reported an eye examination utilisation rate within past two years between 15% to 53% (Ehrlich et al., 2019). Another meta-analysis on US-based studies which was based on data collected from three different surveys found that the eye examination utilisation within two years ranged from 45.5% to 84.8% (Wagner & Rein, 2013). This review found a higher utilisation uptake rate than the ones reported in previous systematic review (Ehrlich et al., 2019; Vela et al., 2012) which US was not included as one of the high-income countries. Nonetheless, this highlighted that the eye examination utilisation rate differs among regions. Cross-sectional studies conducted between 2013 to 2023 (Assaye et al., 2023; Bazargan et al., 2020; Gupta et al., 2020; Lee et al., 2018; Merga et al., 2023; Morka et al., 2020) revealed that suboptimal eye examination utilisation rate still exists within different population groups in both developing and developed regions. The issues of suboptimal eye examination continue to be a challenge to be addressed.

While there has been ample evidence related to eye care utilisation, several issues in reporting eye care utilisation were observed which have an impact on understanding preventive eye examination utilisation behaviour. First, the definition of eye care utilisation lacked clear description of the purpose of the eye examination being measured. This will have an impact on understanding and interpretation of the barriers that are related to the type of eye examination utilisation of interest. In contrast, an operationalised definition should include the purpose of the eye examination and service provider. This will facilitate the interpretation of barriers to eye examination utilisation and would facilitate translating knowledge that are applicable to setting with similar healthcare system and/or primary eye care policy.

1. *“Eye care service utilization: The use of eye care services by persons for the purpose of preventing and curing eye problems, promoting maintenance of eye health and*

well-being, or obtaining information about one's eye health status and prognosis at least once in the last 2 years." (Merga et al., 2023)

2. *"If the individual reported that he/she had visited eye care service providing a centre for eye checkup/ examination or for eye problem at least once, within the past 2 years, it was considered as he/she utilized eye care service for this study."* (Morka et al., 2020)

Besides the insufficient reporting of service provider and purpose of eye examination in the outcome measurement, it was also observed that various outcome measurements of eye examination interval were reported. The typical reported utilisation rate was within two years (Assaye et al., 2023; Ezinne et al., 2023; Merga et al., 2023; Morka et al., 2020) or within one year being commonly reported within the literature (Bazargan et al., 2020). The different outcome measurement interval being reported could be attributed to the research objectives. Nonetheless, the varied examination intervals reported had made comparison between regions and factors influencing eye examination utilisation behaviour more challenging. This is especially true for quantitative studies which relied on certain time interval to calculate the association between influencing factors and eye examination utilisation.

Consider the above, the discussion on factors related to eye examination in the subsequent section would be based on two-years interval, or one year interval whenever evidence is available. Otherwise, clear description is provided to facilitate interpretation and discussion of the identified factors on influencing eye examination utilisation by the older adults.

2.4 Factors associated with eye examination utilisation by the older adults

Understanding the factors associated with eye care service utilisation enable researchers to determine at who, for what reason and how intervention strategies should be proposed. These details will help pinpoint how the intervention should be designed to target specific factors. Existing systematic review and meta-analysis on eye examination utilisation have already indicated that factors associated with individual characteristics (e.g. socioeconomic status) and service-related factors (Elam & Lee, 2013; Solomon et al., 2022; Vela et al., 2012; Wagner & Rein, 2013). This section further discusses the up-to-date literature on the factors related to preventive eye examination utilisation, defined as the utilisation of eye examination provided by eye care providers (either ophthalmologist, optometrist, or both) for non-treatment

orientated purposes. The scoping of relevant literature was based on five key terms: “factors”, “barriers”, “facilitators”, “eye care utilisation” and “eye care access”.

Overall, a range of objective indicators and self-reported barriers have been investigated and identified. Individual characteristics being commonly investigated included age, sex, socioeconomic status educational attainment, income status, insurance status, race/ethnicity, area of residency. Other factors being investigated were subjective health perception, cost-related factors, proximity to service, service provision.

Self-reported barriers were mainly investigated quantitatively using structured questionnaires (Assaye et al., 2023; Ehrlich et al., 2019; Ezinne et al., 2023; Gupta et al., 2020; Wright et al., 2019), and qualitatively using focus group discussions and interviews (Arinze et al., 2015; Biddyr & Jones, 2015; Neyhouser et al., 2018; Shickle & Griffin, 2014). While the quantitative studies provided descriptive statistics that could reflect the relative importance of barriers among the collected factors that influence eye examination utilisation behaviour, qualitative studies offered potential explanations to enhance the understanding of factors influencing eye examination utilisation. Furthermore, the Andersen’s healthcare utilisation model (Andersen & Newman, 2005) were used in studies in structuring the factors the themes of factors and guided the analysis (Bazargan et al., 2020; Jiang et al., 2017; McClure et al., 2016). This model describes the predisposing, enabling and need factors that influence service utilisation behaviour.

The following section summarises and discusses the specific factors being investigated in the literature regarding eye examination utilisation.

2.4.1 Age and sex

Age has been consistently found to be associated with eye examination utilisation (Aljied et al., 2018; Bazargan et al., 2020; Ezinne et al., 2023; Goyal et al., 2022; Gupta et al., 2020; Jiang et al., 2017; Varadaraj et al., 2019; Vela et al., 2012).

When compared to younger adults (those aged below 60 years), older adults aged 60 or above were associated with higher eye examination utilisation (Goyal et al., 2022; Gupta et al., 2020; Morka et al., 2020). This association was supported by studies conducted in various population subgroups including those in rural and urban settings, and countries of different income levels were also investigated (Goyal et al., 2022; Morka et al., 2020). Research conducted in

Singapore by Gupta et al. (2020) found that people who self-reported to have an eye examination within less than a year or never had one before were significantly younger (mean age = 67.4, SD = 10.6) than those who had an eye examination at least annually (mean age = 70.4, SD = 9.9). A US-based study on underserved urban community found that people from the 65 or above age group were 1.71 times more likely than those from the 40 – 64 age group to undergo an eye examination within two years period (Goyal et al., 2022). Supportive evidence was also found in low-income countries. Multiple community-based surveys conducted in Ethiopia found that adults aged 65 year or above were 3.4 times to 4 times more likely than people in the 40 – 54 age group to engage in eye examination utilisation (Merga et al., 2023; Morka et al., 2020).

However, when age was being investigated under specific population groups with different healthcare needs, the findings were not consistent. Being older (aged 64 to 94) within the ageing population predicted a delay in eye examination utilisation rate, as supported by evidence from population with chronic conditions (including hypertension, diabetes, stroke and health condition) (Bazargan et al., 2020). In contrast, no significant association was found between age and eye examination utilisation within two years in visually impaired population (Assaye et al., 2023). A meta-analysis using retrieved data from four different US-based surveys on a non-institutionalised population found there was no significant association between being older (aged 65 year or above) and higher eye examination utilisation when compared to younger adults from the 40 to 64 age group (Wagner & Rein, 2013). This study used age stratification to control for the confounding variables which implied that when controlling variables such as age it had no impact on service utilisation. The inconsistent finding suggest that health care needs is a factor influencing eye examination utilisation.

Sex is another demographic factor that consistently found to be associated with eye examination utilisation. In general, females were found to engage in eye examination more than males within a two-year period (Arinze et al., 2015; Bazargan et al., 2020; Foreman et al., 2018; Jiang et al., 2017; Lee et al., 2009; McClure et al., 2016; Varadaraj et al., 2019). Only a few studies reported that sex was not a significant factor associated with eye examination utilisation (Ezinne et al., 2023; Morka et al., 2020).

Qualitative studies provided potential explanation on the inconsistent findings, especially when female was found to be less likely to undergoing an eye examination. The reasons can be attributed to cultural background. A qualitative study conducted by in Cambodia found that

women reported they had to seek approval from male family members before accessing eye care services (Neyhouser et al., 2018). Women also faced other factors that reduced their likelihood to engage in an eye examination, one of which is social support for taking care of children (Ahmad et al., 2015). Previous study also found that while both male and female all faced with increasing challenges to access eye care services as they age, female in generally faced more barriers as they aged as females have been dependent on others such as being economic dependence throughout their lives (Barman & Mishra, 2020). These studies exemplified how cultural differences, especially intersectionality, could influence eye examination utilisation for different gender groups.

2.4.2 Socioeconomic status

Lower socioeconomic status was associated to suboptimal eye examination utilisation. The markers for socioeconomic status which have been investigated included educational attainment, income level (Atta et al., 2022; Ezinne et al., 2023; Vela et al., 2012; Wagner & Rein, 2013). The indicator of SES status was also related to accessibility, affordability of eye examination services, such as the cost to access the service, understanding the significance of regular eye examination on safeguarding eyesight.

Less educated individuals were associated with lower eye examination utilisation (Aljied et al., 2018; Bazargan et al., 2020; Ezinne et al., 2023; Lee et al., 2018; Wagner & Rein, 2013). The measurement of educational attainment varied among regions. Most found that individual who had secondary school education or less were associated with lower eye examination utilisation (Bazargan et al., 2020; Goyal et al., 2022; Jiang et al., 2017; Lee et al., 2018; McClure et al., 2016). A cross-national survey found that among the low- and middle-income countries, education attainment were not always a significant factor associated with eye examination utilisation (Ehrlich et al., 2019). Among six included countries (China, Ghana, India, Mexico, Russia, and South Africa), only Russia found non-significant association ($p = 0.17$) (Ehrlich et al., 2019). Despite this, most evidence within the literature reported that lower educational attainment was a consistent factor associated with lower eye examination utilisation.

Income is another investigated indicator of SES and was found to be associated with eye examination utilisation (Morka et al., 2020; Wagner & Rein, 2013). A systematic review including low-, middle- and high- income countries found that the utilisation rate varied widely, with low-income country reporting an eye examination rate of 9% and high income reported

27% (Vela et al., 2012). In a more recent review by Ehrlich et al. (2019) which used wealth index to categorise the household income group found that only China found that wealth index was a significant factor to eye examination utilisation and not for the other five countries (Ghana, India, Mexico, Russia and South Africa). Overall, people from the lower income bracket were associated with lower eye examination utilisation.

2.4.3 Insurance status

Insurance status was consistently found to be significantly associated with eye examination utilisation (Arinze et al., 2015; Atta et al., 2022; Ehrlich et al., 2019; Elam & Lee, 2013; Jiang et al., 2017; Lee et al., 2018; McClure et al., 2016; Solomon et al., 2022; Varadaraj et al., 2019; Wasser et al., 2023; Williams & Sahel, 2022). Insurance has been studied in the literature in terms of insurance types (public or private insurance) and insurance coverage (medical insurance and/or vision insurance). It has also been studied as an enable factor in the Andersen model of healthcare utilisation which reflected that having insurance status would have facilitated the older adults to seek preventive eye care as the financial burden reduced (Jiang et al., 2017; McClure et al., 2016).

Having no insurance were self-perceived to be a barrier to use an eye examination by the older adults (Goyal et al., 2022). Studies have found supporting evidence that people who were insured were associated with higher eye examination utilisation (Atta et al., 2022; Jiang et al., 2017). Specifically, the magnitude of prediction for eye examination utilisation was even higher for those with vision health insurance (OR = 7.46) than having general health insurance (OR = 5.00) (Atta et al., 2022). This finding suggests that having a more indicative insurance coverage can encourage eye examination utilisation uptake. Having vision health insurance were also reporting having less concern about glasses affordability (Varadaraj et al., 2019).

The association or the influence of insurance on eye examination utilisation would depend on the insurance system being investigated (Ehrlich et al., 2019). While insurance status has been investigated in previous studies as a variable collected specifically to address a research question, studies conducted in Canada has investigated the impact of insurance status on eye examination utilisation when the insurance was taken away from the former beneficiaries. Studies conducted in Canada has provided valuable information as there has been a period where routine eye examination was delisted from the healthcare insurance. Canada-based studies found that insured individual were significantly associated with higher utilisation of

eye examination (van Staden, 2020). Not all the province in Canada were covered by the insurance. A study investigated two regions within Canada that have insured or not insured respectively (Lee et al., 2018). This study found that among the people who lived in insured regions of Canada, those with higher income were also associated with higher eye examination utilisation in high-income countries as well (Lee et al., 2018). This suggests that insurance status plays a different role in influencing eye examination utilisation behaviour especially those with the lower socioeconomic bracket.

While insurance was seen as a facilitator to improve eye examination uptake, other barriers can occur for the older adults which lower their motivation to utilise the insurance to cover the eye examination service fee. A qualitative study revealed that having insurance also meant that the patient must navigate themselves within the insurance system and that sometimes it could be difficult or required understanding to fully benefit from the insurance (Zaback et al., 2020). This also implies that how people make use of available resources to increase uptake of preventive eye examination is an important issue to study.

2.4.4 Ethnicity and race

Ethnicity refers to a group of people sharing the same culture that are related to ancestry and history (American Psychological Association, n.d.-a). Races, on the other hand, refers a group of people with a shared physical feature and the categorisation can be socially constructed (American Psychological Association, n.d.-b).

It is well-documented that health inequality exists within the ethnic minorities and that these groups of people faced more barriers to eye examination uptake. An individual's healthcare seeking behaviour can be influenced by their cultural beliefs. However, this association with eye examination utilisation was not consistent across studies. For the western society, based on US-based meta-analysis which compared Black, White, Latino and Hispanic (Wagner & Rein, 2013). This study found that the eye examination utilisation among those aged 65 years or above was not associated with higher eye examination utilisation when compared to the white population. However, such association was significant for people from a younger age group (i.e. 40 – 64 age group) (Wagner & Rein, 2013). In contrast, other studies conducted in Asia also found supporting evidence that ethnicity played a significant role in influencing eye examination utilisation. A population-based study studied among the three major ethnicities in Singapore found that there were significantly more Malay ethnicity individuals (57.4%)

reported not having an eye examination, or not having an eye examination annually than those who reported to be Chinese (23.8%) and Indian (18.8%) (Gupta et al., 2020). Being Malay were around two time more likely than Indian and Chinese to report not having an eye examination or not having annual eye examination (Gupta et al., 2020). A study conducted in South Africa found that in comparison to African, people who were white, mixed race, and Indian had significant higher eye examination utilisation (Akuffo et al., 2020).

Being in a minor ethnicity could mean that they can face language barrier when accessing a healthcare service. A study was conducted on Chinese Americans in the US studied the factors related to the use of eye examination (Jiang et al., 2017). It was found that people who preferred to use English were more likely to self-report an eye examination in the past 12-month. People who preferred “mostly or only English” were 2.11 times more likely than those who preferred using “only Asian” to have an eye examination with the past 12-month (Jiang et al., 2017).

2.4.5 Subjective health perception and existing healthcare needs

Preventive health belief describes how an individual picture themselves in terms of staying healthy through the use of preventive service (Rosenstock, 1974a). With this, the preventive eye health, in terms of eye examination the older adult would have to believe that utilizing the eye examination regularly would benefit them, that is safeguarding their eyesight (Rosenstock, 1974a). The extent to which they perceived they could be a risk or being susceptible to a potential illness or disease. To reach this perception, several factors were attributed to it.

People generally valued immediate health gain (gratification) or were motivated by a sense of urgency (Meertens et al., 2013), and less focused on benefit that were relevant in a long-term (benefit that are delayed). In most cases, people made sense of their health status mainly based on symptom occurrence and symptom severity, a mindset described by the Common Sense Model of Self-regulation (Leventhal et al., 2016). In a similar line, the Health Belief Model describes that people’s health behaviour is influenced by perception of susceptibility, severity, perceived benefits and barriers to service, as well as self-efficacy and cues to action (Rosenstock, 1974b).

Furthermore, from the perspective of the Andersen model of health service utilisation (Andersen & Newman, 2005), “need” factors influence the motivation to engage in a health care service of which consist of subjective need perception and on-going healthcare needs. Research have constantly found that feeling “needed” to get an eye examination was associated

to higher eye examination utilisation rate (Arinze et al., 2015; Morka et al., 2020). Quantitative study reported that “no problem with the eyes” were most common self-reported reason (54.1%) for not engaging in preventive eye examination (Morka et al., 2020). Such subjective perception was often studied in qualitative study where older adults expressed having noticing changes in their vision as a facilitator to get an eye examination (Arinze et al., 2015). People who were aware of changes in the vision were significantly more likely to engage in an eye examination than those who did not notice a change in vision (OR = 41.55, $p < 0.001$). A study conducted in Nigeria especially studied the reasons for not engaging in eye examination for people who noticed a change in vision and those who did not (Arinze et al., 2015). This study found that 15.7% those who did notice changes in vision were thought to be a “minor” issue and therefore did not seek an eye examination (Arinze et al., 2015).

Age-related perception was also found to have predisposed older adults to the decision to not undergo an eye examination regularly. Such perception was surrounding the idea that older adult perceived it to be “part of the ageing process” (Biddyr & Jones, 2015; Leamon et al., 2014; Neyhouser et al., 2018). A qualitative interview study, involving 28 individual aged 40 years or above, was conducted to understand the whole eye care seeking process which also reported that subjective perception (e.g. did not believe that symptom will lead to blindness) has caused delay in seeking timely treatment (Zaback et al., 2020). This highlights that subjective perception plays a role in health seeking behaviour and potentially in seeking preventive eye examination, especially in the early stage where eye disease can be asymptomatic.

Subjective perception of needs does not only link to symptom occurrence. Psychological feeling toward using an eye examination service were also found to influence the motivation to use such service. Older adults reported feeling a sense of “fear” resulting from having to bear more financial pressure on purchasing spectacles (a potential consequence after getting an eye examination) (Biddyr & Jones, 2015); while others in general were more reluctant to get their eyes checked to avoid having to face any potential “negative news” (i.e. such as losing their vision, diagnosing new eye diseases or going blind) (Ahmad et al., 2015; Shickle & Griffin, 2014). A few have been related to the fear and discomfort during eye examination – mainly related to the dilated eye drop (Ellish et al., 2007). In contrast to this, according to a UK-based qualitative study, those who had family member previously suffer from eye disease, shared that undergo regular eye examination led to a sense of “reassurance” and “reduced anxiety”. This

further highlight how knowledge on eye disease impact on one's emotion and thereby influencing motivation to seek eye care services. However, quantitative study found that family history of eye disease was not a consistent factor that were significantly associated with eye examination utilisation (Arinze et al., 2015; Morka et al., 2020). A study conducted in low-income country found that those reported have a family history of eye disease were 4.07 times more likely to engage in eye examination utilisation (Arinze et al., 2015). The study that reported no association included a portion of the surveyed individual who reported "don't know", however, it was unsure how this could have impacted the results (Morka et al., 2020). This also highlighted that the potential impact of intergenerational relationship such as those with family member may have an impact on the uptake of eye examination uptake. However, no study has ever investigated this aspect.

Apart from subjective health belief, quantitative study found evidence that people with healthcare needs such as systemic diseases, required spectacles, or having visual impairment, family history of eye diseases were associated with higher eye examination utilisation (Arinze et al., 2015; Assaye et al., 2023; Ezinne et al., 2023; Jiang et al., 2017). This was aligned with the Anderson model of healthcare utilisation that people with existing need would be more likely to use a healthcare service.

Similarly, for those with vision impairment, duration of diagnosis is also found to be a significant factor to eye examination service utilisation. In Assaye et al. (2023) study, the finding found that compared to those who had vision impairment for four years or more, those who had vision impairment less than a year were 2.5 times more likely to engage in an eye examination. Similarly, those who had vision impairment between one to four years were 2.7 times more likely to engage in this service, which was slightly more than those of less than one year duration of vision impairment. This study also found that those with difficulties performing near vision tasks were 2.9 times more likely to utilize an eye care service (Assaye et al., 2023). The relationship between visual status and visual impairment diagnosis duration on eye examination utilisation behaviour, while not investigated fully, the author believed it had to do with how vision impairment had an impact on daily activities (Assaye et al., 2023).

Research conducted among people with disabilities have also found supporting evidence how inconvenience arise from performing different daily task could have an impact on eye examination. People with disabilities were likely to face more disadvantages when accessing eye care services (Chan & Yap, 2016). A survey study conducted in Taiwan including 1726

older adults which were classified into two types daily living disabilities: 1) (basic) activity of daily living disabilities and instrumental activity of daily living disability (Fang et al., 2012). The study found that activity of daily living disability is associated with lower eye examination utilisation but not instrumental activity of daily activities. The differences between the two types of daily activities are that instrumental type includes more complex activity which allow an older adult to live independently without assistance (Edemekong et al., 2023), for example shopping for grocery, preparing a meal, taking medication or handling finance. On the other hand, basic activity of daily living includes broader category such as ambulating, dressing, feeding, personal hygiene, continence, and toileting. This suggests that the role of vision in handling basic daily activities have a more direct impact on an individual's health belief.

Together, the above findings suggest that health belief and healthcare needs are important factors to consider and that the reasons for not engaging in eye examination services could vary depends on context.

2.4.6 Cost-related factors

Cost is a commonly cited barrier to eye examination uptake. Cost-related barriers can be directly target at paying for the eye care services or accessing to the service. Transportation availability and associated cost, location and accessibility of the service have also been found to impact on the financial barriers to use eye examination services by the older adults (Holmes et al., 2018; Neyhouser et al., 2018).

Based on the recent literature publications, cost-related barriers have been mainly captured using qualitative studies, with a few studies published the proportion of people self-reporting cost as a barrier to service. Cost was self-reported as a barrier by 14.4 % (Morka et al., 2020) to 30.8% of the older adults in the low-income settings (Assaye et al., 2023; Ezinne et al., 2023).

Other cost-related barriers includes the cost to afford glasses (Biddyr & Jones, 2015; Holmes et al., 2018; Shickle & Griffin, 2014), and transportation cost though it was a less common factor (Assaye et al., 2023). These factors were identified in developed and developing countries. In the UK, where eye examination is funded, cost-related barrier remained, especially those related to purchase of glasses (Shickle & Griffin, 2014). This suggest that cost plays an important role in initiating service access as well as post-service utilisation. A focus group discussion conducted in Sri Lanka reported that the participants shared the concerns of having additional financial cost for the people who accompanied them to the service location

(Holmes et al., 2018). This again shows that factors influencing the uptake of eye examination is interrelated. While social companions may increase the motivation to use the service, other financial-related barriers have occurred and may deter the intention to use the eye examination services.

2.4.7 Proximity to service

Proximity to service concerns how service is available to the service users, especially regarding the issues of accessibility in terms of spatial proximity. This concerns *how* the service user access the services, which would depend on several factors including the location of residency (Foreman et al., 2018; Lee et al., 2018) and the means of transportation.

Several studies have found that residency area was a significant factor associated with eye examination utilisation. Cross-sectional surveys conducted in low- to middle-income countries have found evidence supporting that older adults residing in the rural area were associated with low eye examination utilisation (Ehrlich et al., 2019). The countries found significant association included China, Ghana, India and Mexico, while Russia found no statistical association ($p = 0.22$) (Ehrlich et al., 2019). People who dwelled in urban area in Canada also found have a higher examination utilisation comparing those living in the rural area, however, this finding was not statistically significant (Lee et al., 2018).

In developed region like the UK, car availability was investigated for its potential impact on eye examination uptake. A UK population-based retrospective study to examined the relationship between eye examination uptake and the access to car and drive time (Wright et al., 2019), found that service accessibility is a key factor influencing eye examination service utilisation, more specially it found that car ownership was associated with greater eye examination service utilisation (Wright et al., 2019). For those who did not own a car, there was a higher chance they preferred using eye care service within a walkable distance as suggested by results of having a decreased uptake in eye care service among those exceeding 1.5 miles distance. In other developing regions, geographical barrier related to transportation and other infrastructure are often cited (Ezinne et al., 2023).

People dwelling in rural areas of the low- and middle countries were associated with lower eye examination utilisation (Ehrlich et al., 2019) however study conducted in the UK found that it was not a significant factor (Lee et al., 2018). This may suggest the potential context-specific factors that influence eye examination utilisation.

2.4.8 Provision of eye examination services

There were also attitudinal factors involved in how service users perceived the service was delivered or have been provided by an eye examination service provider. Qualitative studies have found that the attitude or perception towards the service provider also found to be a factor influencing eye examination utilisation (Biddyr & Jones, 2015; Elam & Lee, 2014; Holmes et al., 2018; Shickle & Griffin, 2014). Some older adults have shared that negative experience would have prevented them from engaging in eye examination service in the future. Negative experience mainly focussed on the commercial side of optometric services, such as purchasing glasses with a sense of being “hard sell” by the optometrists (Biddyr & Jones, 2015; Shickle & Griffin, 2014). In contrast, receiving eye examination recommendation from an eyecare professional has also been associated with greater utilisation of eye examination in the past two years (Goyal et al., 2022). The findings from the attitude factors towards service provider also highlight that the factors influencing eye examination occur along a healthcare seeking behaviour pathway, i.e. before, during and after eye examination.

2.4.9 Discussion on factors associated with eye examination utilisation

Research concerning barriers to eye examination uptake were mostly studied under a wide age range which made it difficult to distinguish the impact of each barrier on the eye care seeking behaviour of the older adults (aged 65 years or above). Moreover, studies differed in terms of how eye examination utilisation were defined, it was difficult to determine the factors that were related to non-treatment orientated service as eye examination utilisation included a mix level of eye care service (Pershing et al., 2020).

In addition to this, it was also found that the time frame or the context of which these barriers were encountered were not specified in most studies. The ones that were specifically focused on barriers that were encountered in the last eye examination (or the most recent eye examination), of which could be within two years or even longer. The studies were mainly cross-sectional therefore it remained unclear whether the identified barriers would be time-specific, i.e. whether the impact of certain barriers would diminish after a certain time point or along the pathway of seeking eye examination.

Qualitative evidence is useful to supplement quantitative findings by providing in-depth understanding regarding the topic of interest. It can provide detailed explanation to enrich the understanding of the reason why a behaviour may or may not occur. The details obtained in the

conversation are key to justify the inclusion of specific content within an intervention. However, existing qualitative research have been dominantly conducted to explore reasons for not using eye examination regularly in regions where eye examination service is fully subsidized and in developing regions (Biddyr & Jones, 2015). The extent to which existing qualitative evidence can be generalized to Hong Kong and contribute to the evidence base used to support intervention development is questionable. The implication of these findings also highlighted how individual characteristics, such as age and socioeconomic status, can have an impact on eye examination utilisation. This implies that when intervention was to be designed, a clear target group should be pinpointed as various barriers could arise and influence their motivation to undergo a preventive eye examination.

2.5 Strategies to improve uptake of preventive eye examination by the older adults

Existing reviews have been conducted on understand how intervention strategies could improve the primary eye care in low- to middle-income regions (Lee et al., 2023), high-income countries (Solomon et al., 2022). and Indigenous people in the high-income countries (Burn et al., 2021). While these reviews have pinpointed the potential picture of how eye examination utilisation can be improved through improving access to service, none of these reviews summarises the effectiveness of intervention strategies design to improve the eye examination utilisation behaviour. Reviewing the existing evidence of strategies help understand what components of the intervention may or may not be effective in encouraging such health service utilisation behaviour. The findings would be crucial to inform the intervention design for subsequent stage of the current project.

2.5.1 Strategies to improve the uptake of preventive eye examination: randomized controlled trial evidence

The literature focused on interventions strategies to improve the uptake of preventive eye examination by the older adults (aged 65 or above) was scoped in PubMed using the following key terms: uptake, utilisation, eye examination, preventive vision screening, older adults. This literature review was conducted to understand (1) what strategies have been investigated in previous studies, (2) how intervention was developed, specifically focusing on the theory and evidence involvement in the development process and (3) the effectiveness in improving eye examination uptake.

2.5.1.1 The types of investigated intervention strategies to improve uptake of preventive eye examination

Among the literature, four RCTs were conducted to investigate the intervention to increase preventive eye examination utilisation of the general older adult population. These RCTs were conducted in the United States (Ellish et al., 2011; Owsley et al., 2013), Mainland China (Dan et al., 2015) and Iran (Katibeh et al., 2020), respectively. Subjects were recruited from the community (Ellish et al., 2011; Katibeh et al., 2020; Owsley et al., 2013) or hospital setting (Dan et al., 2015), with a sample size ranging from 177 (Owsley et al., 2013) to 3312 (Katibeh et al., 2020). Two types of intervention had been investigated, including health education

intervention (Dan et al., 2015; Ellish et al., 2011; Owsley et al., 2013) and service provision mode (Katibeh et al., 2020). The health education aimed to improve knowledge and awareness of the older adults while the service provision intervention aimed to facilitate timely access to eye examination service. A summary of these interventions is presented in Table 2.1.

Educational interventions focused on providing the target group with the relevant information to improve knowledge and awareness; the format of these educational materials being disseminated varied across RCTs (e.g. video-based, presentation format or printed format) (Dan et al., 2015; Ellish et al., 2011; Owsley et al., 2013).

The Dan et al. (2015) study investigated the use of multi-educational intervention on eye examination utilisation, which involved playing videos consisted of educational messages regarding the significance of eye examination during the asymptomatic stage and emphasizing the message that regular uptake of eye examination could improve early detection of age-related eye diseases.

Ellish et al. (2011) conducted an RCT on two different intervention groups: tailored intervention and targeted intervention. Both interventions provided information in a printed format, with an overall framework covering six different aspects: 1) introduction, 2) factual section, 3) testimonial, 4) ask the doctor section, 5) barrier table, and 6) conclusion. The intervention arms differed in the message content provided, with targeted covering the general information under the stated six aspects, while tailored intervention included specific and tailored information obtained from the baseline questionnaire before group randomization.

Owsley et al. (2013) investigated the *InCHARGE* programme which focused on improving education and awareness of eye health for African Americans. This education intervention involved delivering a 30-minute presentation. Although the information was provided in the form of presentation through “displaying key points” to convey important eye health messages, the author mentioned that the presentation was designed to be “highly interactive” (Owsley et al., 2013; Owsley et al., 2009). The design emphasised on mutual interactions between the participants and the presenter.

Katibeh et al. (2020) described a three-arm cluster RCT which included mobile screening, conventional screening, and control screening arm. The method used to collect clinical data varied between the intervention and control arms. The mobile arm involved the use of mobile devices to obtain the results at home by primary healthcare workers— Peek Vision invented

application was used (*Peek Acuity* and *Peek Retina* software). The conventional arm participants were invited in person (“door-to-door enrolment process”) and the participants would receive an eye examination performed at local facilities. The control arm received no screening tests. The baseline measurement was self-reported eye examination utilisation within one year. The utilisation rate at follow-up was based on the self-reported utilisation by people who were advised for referral and had visited an optometrist or ophthalmologist for an eye examination within three months.

2.5.1.2 How the above interventions were developed

All of the educational interventions were theory- and/or evidence-based (Dan et al., 2015; Ellish et al., 2011; Owsley et al., 2013). For studies that mentioned a theory-based intervention development, multiple theories were mentioned by the authors.

Among the three trials investigating educational intervention, two of them were explicitly stated that the intervention was theory-based. In Owsley et al. (2013) study, before the intervention development and trials phase, focus group discussion (qualitative evidence) were conducted to learn about the specific barriers for older African Americans to eye care utilisation and service providers (Owsley et al., 2006). Three health theories were used to inform the intervention design i.e. Theories of health behaviour, Empowerment Model, Health Belief Model and Social Learning Theory. In the Ellish et al. (2011) study reported that four theories were used to inform intervention design, yet the rationale for selecting these theories were not explicitly elaborated. The rationale for developing the intervention that targeted the information provided was based on the rationale how individual processes the information with a specific focus on testing how the material should be customized and for what audience. In contrast, Dan et al. (2015) did not mention whether the development of intervention was theory-based, nor evidence-based, although there were mention of focus group discussions revealing the knowledge of the significance of eye examination was not appreciated by the service users in rural China.

As for the trials investigating service provision mode, the details of the programme development by Katibeh et al. (2020) was reported elsewhere (Katibeh et al., 2019). The screening programme was developed using a participatory action approach which highlighted the involvement from various stakeholders in identifying issues of a topic of interest (problem-focused). Especially this approach focused on reflecting how practice could be improved with

iterative rounds of reflections and discussions among the stakeholders in the community-setting (Katibeh et al., 2019; Leykum et al., 2009). The intervention was implemented after it had been piloted (Katibeh et al., 2019).

2.5.1.3 The effectiveness of the above intervention in improving preventive eye examination uptake

The findings from two of the health educational RCTs revealed that the existing intervention strategies aimed to improve the knowledge were not effective in improving the uptake of eye examination (Dan et al., 2015; Owsley et al., 2013). Another study also revealed that educational intervention aimed at improving information customization for individual were not any better than those materials targeting at a specific group (Ellish et al., 2011).

First, two RCTs found no statistically significant differences in the intervention to improve preventive eye examination when compared to the control condition. Owsley et al. (2013) investigated the effect of a health education programme *InCHARGE* programme on improving the uptake of preventive eye examination through increasing the knowledge and awareness of the older adults using interactive presentation. The uptake of preventive eye examination after receiving the *InCHARGE* programme was 33.3% while the control condition was 44.7% ($p = 0.218$). Despite being theory and evidence-based, this study was unable to find supportive evidence for health education in improving eye examination utilisation rate. This study highlighted that while having the perception attitude that regular eye examination was important (which is described as a “positive attitude” by the authors), other factors persisted that hindered the actual eye examination utilisation.

On the other hand, there was some evidence suggesting that improving the content of the information delivered to the service user could encourage older adults to use preventive eye examination. In Ellish et al. (2011) study, two health educational interventions were examined of which they differed in the content of information being delivered. One was based on subgroup characteristics (targeted health education intervention) and the individual-level characteristics (tailored health education intervention). The rationale behind the design of the intervention was already enhanced from the generic information provision. The finding suggested that the enhanced intervention in term of the level of information provision were comparable for tailored (40.2%) and targeted intervention (37.6%) (Ellish et al., 2011). However, this study by Ellish et al. (2011) lacked a control condition (without the health

education component), and it was unsure how the two interventions would have been any better than the control condition.

Second, for the RCT which reported an uptake rate of 70% for both control and intervention arm, there was no statistical significance improvement between the intervention groups. Dan et al. (2015) found that the health education intervention (73.0%) using multi-media intervention to improve knowledge, and awareness showed no evidence supporting that the uptake rate was significantly different than the control condition (72.9%). Rather, the intervention only improved knowledge and awareness, which suggest that providing health information alone was not effective enough to motivate the older adults to engage in preventive eye examination. The comparatively higher uptake rate reported in Dan et al. (2015) study may be due to the potential contextual factors as the other RCTs were conducted in the US (Ellish et al., 2011; Owsley et al., 2013), while Dan et al. (2015) was conducted in rural China.

In contrast, a RCT conducted in Iran investigated the effect of mobile service screening programme that took place at the home of the trial participants. The study found that those engaged in the mobile service condition were more significantly more likely to engage in an eye examination at three-month follow up when referral advice was provided. The uptake rate of the mHealth arm (with referral advice) were 35.6%, and the conventional methods (eye examination performed at a local health centre with referral advice) was 32.7% , compared to the control group (no screening and no referral advice) of 4.5% (Katibeh et al., 2020). While there was a significant improvement in the intervention condition, the reported uptake rate was still considered suboptimal. The eye examination utilisation being measured were arguably leading towards referral behaviour rather than preventive eye examination behaviour.

2.5.1.4 Discussion the available evidence on intervention to improve preventive eye examination uptake

Limited number of high-quality evidence were available, with a total of four RCTs identified that focus on improving uptake of preventive eye examination. These RCTs mainly focused on health educational while one RCT investigated the mode of service provision. The investigation of health educational within the literature could be explained by the development process underlying these interventions.

Guided by health behaviour theories and supported by qualitative evidence, the educational intervention generally held a premise that the lack of education and awareness would influence

eye examination behaviours. While the interventions were developed and were motivated by different health behaviour theories, the rationales for selecting specific theories were not mentioned. With such limited description on the theory-based process, it was also unsure how the theories were utilized and the extent to which the theory has been utilized in the decision to guide intervention development. This led to a question of which theory should be used to guide intervention development.

Of these educational intervention RCTs, only Ellish et al. (2011) found some evidence for the effectiveness of printed health education intervention in improving the uptake of eye examination services. The finding suggested that both interventions were comparable in their effectiveness in improving eye examination service utilisation. This trial provided supportive evidence in eye health information to a message-based intervention regardless of whether it was targeted at a group or tailored for an individual were equally effective. However, in Ellish et al. (2011) study, the design of the intervention was not explicitly supported by empirical evidence, it was difficult to interpret how the intervention design could be adopted. One of the implications of this result was given the comparable effect, the study suggested that both tailored and targeted message could be considered in the future. This finding revealed that the design of the intervention would be an important factor to consider in intervention design. Another issue highlighted by the author was that the design of the intervention also linked to issues related to implementation which often required effort and cost to delivery specific intervention programme.

Despite the lack of evidence regarding the effectiveness of financial intervention on increasing eye examination utilisation, two RCTs were able to reveal some valuable insight on addressing the cost barriers for older adults. The *InCHARGE* programme involved a framework that addressed the cost barrier by improving information to the participants (Owsley et al., 2013). The information included insurance coverage as well as other resources available for non-insured individuals. Results found that the concern related to cost statistically increased after the intervention was implemented. This implied that providing information alone would increase cost-related concerns possibly due to a clearer understanding regarding service provision. Yet, regardless of insurance status, there are different out-of-pocket payments the US-based users are required to bear. Therefore, providing information did not mitigate the cost-related barrier (Owsley et al., 2013). However, this was not the case found in Ellish et al. (2011) study, which also involved mentioning Medicare coverage as part of the intervention but found

supportive evidence of the interventions being effective in improving eye examination uptake. This questions the reasons for the inconsistency found between studies. One possible explanation could be the cost of the eye examination.

In contrast to having education intervention to deliver information regarding financial support availability (Owsley et al., 2013), the eye examination services being investigated by Dan et al. (2015) were part of a local project aiming to provide rural-dwelling individuals in Mainland China with affordable services. The participating subjects of this trial, depending on their chosen hospital, could receive an eye examination at a specific service fee, ranging from free of charge to US\$8 (around 10 Chinese Yuan) per eye examination. This study found that when service was provided free, the uptake of eye examination was almost perfect (e.g., 98%). This implied that a combination of providing information on (affordable) service availability, and actual cost reduction in service could increase uptake of eye examination. This further highlights that economic strategies which can mitigate the cost barriers might have an additive effect beyond information provision in encouraging older adults to engage in eye examination service utilisation. More importantly, this further highlights the need to consider multiple strategies to improve the use of eye examination services for the eye examination. This suggestion was grounded in the evidence that barriers do not exist alone; multiple barriers have been identified in individual, community and service-level (Andoh et al., 2023; Williams & Sahel, 2022).

Of the identified RCTs, only the service provision related intervention found supportive evidence in improving the uptake of eye examination. One of the explanation for the successful improvement in service uptake reported in Katibeh et al. (2020) study may be due to the various evidence collated from various stakeholders during the intervention development, despite not having guided by any health behaviour change theories. The approach in which the intervention was used, i.e. the participatory action approach, followed a structured process to develop, and refine intervention. This may be a factor that contribute to the improvement in service uptake.

However, it should be noted that the uptake rate remained below 40%, the extent to which the intervention in improving uptake that can benefit more older adults is questionable. In Katibeh et al. (2020) study, reasons for not utilising eye examination despite referral advice were also collected for all two intervention arms. Among the 686 patients required referral, nine different barriers to comply with the referral advice were mentioned. Of these, “unfelt need” was the dominant barrier to eye examination utilisation (37.3%), followed by “lack of money” (24.0%), “lack of time” (17.6%) and “transportation problem” (17.4%). The results from this study

suggested that mobile service was an effective intervention to improve utilisation rate compared to the control condition (no screening and no referral advice). There were also evidence suggesting that referral advice sent via SMS were also associated with higher eye examination utilisation within three months. However, as the statistics reported for barriers to utilisation was aggregated for both intervention arms, it was unsure how different the barriers were between the two intervention arms (mHealth versus conventional arm). The effectiveness of the intervention needs to be carefully interpreted. First, the mode of referral advice provision was different in both intervention arms. The mobile service relied on SMS to deliver the information while the conventional arm allowed individual to discuss results in person or on the phone. No information was reported regarding how participants from the conventional arm received the referral advice and therefore it was not possible to understand how this factor may influence eye examination utilisation. Second, although the follow-up advice of two months was set by expert consensus and that the follow-up utilisation rate was measured at three-month period, using such short interval to determine the effectiveness of intervention may lead to biased results, especially prone to be influenced by contextual and practical barriers. Referring to the statistics reported for barrier to utilisation, it showed that 17.6% of the participants did not comply to the referral advice due to lack of time (Katibeh et al., 2020). It was unsure whether extending the follow-up period to six-month would result in higher utilisation rate which would have an impact on the result on intervention effectiveness. Although the results could be applied to inform the intervention design to increase accessibility of the eye examination service at community level, the eye examination utilisation rate was still considered suboptimal. This suggests that increasing accessibility using mobile service alone may not be sufficient to improve the service utilisation as other barriers persisted.

Other investigation of health education intervention was evident; yet it was a non-RCT study which means that causality cannot be drawn between the intervention and uptake of preventive eye examination (outcome). However, it is worth discussing as it provided information on what strategies have been considered previously by scholars. An eye health education intervention was tested in a prospective cross-sectional interventional study in Vietnam, where a survey study was conducted to investigate the effect of an intervention on improving health literacy and eye examination utilisation (Paudel et al., 2022). In Paudel et al. (2022) study, four interventions were investigated which can be grouped in three major types 1) eye health presentation in the community, 2) mass-media health promotion, i.e. loudspeaker broadcasting, and 3) printed health intervention (i.e. poste display or brochure distribution). All these

interventions focused on increasing knowledge and awareness of six common eye diseases. Intervention was delivered to participants in two geographical districts (in rural or urban districts) for one month long. Although this study revealed that health educational intervention improved eye examination utilisation post-intervention compared between intervention group and control group, the way the intervention was delivered could not determine which of the four interventions could improve eye examination utilisation. Despite this, this study provided several potential useful strategies to be considered if future intervention aims to improve eye examination through increasing health literacy.

As discussed in literature review regarding factors associated with eye examination utilisation, rural residency was found to be a factor influencing eye examination. Disadvantaged populations such as those residing in the rural areas often face multiple barriers to accessing appropriate eye care. Previous studies have investigated strategies focused on increasing the ease of access to services by offering more accessible services in the form of outreach programmes, while some considered community strategies to screen for those who required further eye care/ treatment. An eye care programme ran by medical students at the community centre provided vision screenings for those residing in the rural areas in the US (Tsui et al., 2015), this cross-sectional survey study found that these students achieved a 97% on correctly identifying people who require secondary eye care or other primary-level care (refractive error). These findings are particularly valuable, as it highlighted the factors that one must consider in the strategies to improve the follow-up after such screening. In Mainland China, where there was a lack of eye care professionals to provide appropriate eye examination, village doctors were the key healthcare providers to deliver eye care, though their willingness to take up this responsibility was found to be low (Huang et al., 2022). This suggests service providers' input in intervention design should be considered during intervention development to ensure successful implementation.

To further overcome barriers related to accessibility, discussion start to surround the topic of the use of telehealth to overcome the barriers regarding geographic inequality as well as improving service access of the hard-to-teach groups (Massie et al., 2022). While supportive evidence was available on these strategies, they were only focused on a small subgroup of a population (Maa et al., 2017). Especially, there have been debates over whether telehealth would create other age-specific barriers especially for older adults who were not familiar with electronic devices than the younger generations (Elam et al., 2022). However, the effectiveness

of using tele-optometry service in improving service utilisation remained unclear and requires further investigation to understand how these specific strategies could be designed appropriately that are user friendly for the target group and whether the effectiveness of these strategies in improving behaviour change would be promising.

To conclude, within the literature, there was limited evidence supporting the effectiveness intervention to encourage the uptake of preventive eye examination by the older adult. In addition, no empirical evidence was identified that was conducted in Hong Kong. This indicates there is an opportunity to investigate different strategies to improve the uptake rate further.

Table 2.1 Summary of intervention designed to improve the uptake of preventive eye examination for the older adults

Author (year); Region	Intervention type (sub-type)	Theory-based	Evidence-based	How does the intervention aim to improve screening uptake?	Intervention component
Elish et al. (2011); US	Education intervention, printed	<ul style="list-style-type: none"> Health belief model Transtheoretical model Precaution adoption process model (PAPM) Information processing theory (mentioned in the rationale for designing a message-based intervention) 	<ul style="list-style-type: none"> Not explicitly stated In the introduction section, resources were cited that supported the use of theory, these resources included literature review and empirical evidence on the use of tailored messages on weight-loss educational materials 	<ul style="list-style-type: none"> Not explicitly state in the published paper 	<ul style="list-style-type: none"> Four-page newsletter with six sections (1) introduction, (2) factual section, (3) testimonial, (4) ask the doctor section, (5) barrier table, and (6) conclusion. Medicare coverage for eye examination were also mentioned. Tailored intervention: the specific information presented depends on the information collected in initiate baseline questionnaire Targeted intervention provided the same framework with sex sections, with no tailored information.
Owsley et al. (2013); US	Education intervention, video-based	<ul style="list-style-type: none"> Empowerment model Health belief model Social learning theory 	<ul style="list-style-type: none"> Focus group discussion with the older African American in different areas of US, with a focus on exploring the factors related to barriers to care, and their attitude and belief about eye care Focus group discussion with service provider including optometrist and ophthalmologist in the community in which the focus group discussion took place 	<ul style="list-style-type: none"> by educating about the importance of routine preventive care communicating strategies for removing perceived barriers to eye care 	<ul style="list-style-type: none"> Intervention is named INCHARGE programme: 30-minute presentation, with interactive session, participants were given booklet after the session (with summary on the key points) Control presentation was about physical activity content
Dan et al. (2015); Mainland China	Education intervention, multimedia	<ul style="list-style-type: none"> No mention of what theory was used to inform the intervention development. The programme itself was based on a service model where emphasis place on providing affordable eye examination in rural Chia 	<ul style="list-style-type: none"> Not explicitly stated Focus group discussion was cited to show that the knowledge of the patients was insufficient regarding the significance of eye examination during asymptomatic stage 	<ul style="list-style-type: none"> Not explicitly state in the published paper But mentioned about the aim of the RCT was to evaluate impact of the watching educational video on acceptance of CEE 	<ul style="list-style-type: none"> 10-minute eye health video delivered in local dialect accordingly. Messages focused on glaucoma and diabetic retinopathy Significance of timely detection of eye diseases Affordable service available for participant to choose
Katibeh et al. (2020); Iran	Service provision, mobile service	<ul style="list-style-type: none"> Not mentioned 	<ul style="list-style-type: none"> Not explicitly state in the published paper but referred to another publication which detailed the development process (Katibeh et al., 2019) 	<ul style="list-style-type: none"> Did not explicitly state in the published paper 	<ul style="list-style-type: none"> Mobile screening <ol style="list-style-type: none"> Using mobile application to perform assessment Images taken in mobile application were sent to retinal specialist to evaluate, all done via online

			<ul style="list-style-type: none"> • Adopted a participatory action approach • Focus group discussion was conducted where a screening programme was developed • Pilot was conducted for improvement 		<p>3. Participants then result their examination result by text</p> <ul style="list-style-type: none"> • Conventional screening <ol style="list-style-type: none"> 1. Participants were invited in-person using door-to-door approach 2. Eye examinations were done in local facilities 3. Examination results were saved on a CD and sent to the same retina specialists for evaluation 4. Participants were informed about their results via phone calls or in-person • Control (no intervention, only completed baseline information)
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2.5.2 Policy level strategies

Recognising the importance of eye health, the WHO has advocated the need for integrating the eyecare as part of universal health care. Within the integrated personal eye care framework, four strategies were highlighted (World Health Organization, 2022). The framework highlights the importance of creating an enabling environment characterised with efficient collaboration between key stakeholders and government to provide eye care under the model where primary and community care service are the priorities. Strategies should focus on “engaging and empowering people and communities” to allow individuals to have universal access to the eye care services they needed (Table 2.2). Guideline proposed by the WHO were useful to guide government or stakeholders to better consider strategies to address health inequity. Furthermore, it provided a goal to increase the engagement of primary eye care services by the service users. As motivated by public health initiative, many regions/ jurisdictions have recognized the needs to improve primary healthcare to enable universal health coverage (van Staden, 2020) and effort in address these under different SES regions were also observed (Goodman et al., 2023; Lee et al., 2023).

Table 2.2 Summary of strategies proposed in integrated people-centred eye care (IPEC) by the World Health Organisation

Strategy	Goal(s)	Approaches	How
1. Engaging and empowering people and communities	<ul style="list-style-type: none"> Address eye care needs for every population, including those living in geographical remote areas and socially disadvantaged population Delivering eye care programme align with the need of the target population Regular collection of routine data on service coverage 	1. Enhancing health literacy to empower individual to	<ul style="list-style-type: none"> Consider incorporating eye care into other healthcare programme Widening the target of health education intervention to other lay referral networks (friends and/or families) and should not limited to the key group
		2. Universal access to eye care should cover those living in underserved area.	<ul style="list-style-type: none"> To identify those in need To provide cultural appropriate services to them To implement outreach group To conduct regular review on service equity
2. Reorienting the model of care to prioritize primary and community care services	<ul style="list-style-type: none"> Primary eye care should be integrated within the primary healthcare system. Well-establish framework to guide the development of model reorientation There should not be differences in eye care delivery among population groups and those reside in different geographical area 	1. Strengthen the integration of primary eye care into the healthcare system, in order to achieve universal health coverage; approach would depend on the ability of the healthcare system in achieving such aims	<ul style="list-style-type: none"> Well-considered resource allocation (eye care service as well as human resorucess0 for primary eye care Improve referral from primary eye care level
		2. Taking a life-course approach to prioritise the eye care needs	<ul style="list-style-type: none"> Make use of WHO publication to guide the decision-making ("WHO package of Eye care intervention")
		3. Reaching individual living in geographical remote regions with innovative technology for better information dissemination and exercising service quality monitoring	<ul style="list-style-type: none"> Considering utilizing mobile services or electronic health to improve health communication and eye care service uptake
3. Coordinating services within and across sector	<ul style="list-style-type: none"> All health sectors should hold the same level of understandability of the idea of person-centre care Eye care services should be highly adaptable and can be tailored for specific group of population according to their needs Stakeholder involvement in programme planner and implementation should be available at national level Multidisciplinary care should be available 	1. Focus on individual's coordination of care	<ul style="list-style-type: none"> Delivering care based on individual needs
		2. Bring together a wide range of programme providers to ensure both provision of eye health services, to reduce the barriers caused by administrative difficulties or funding constraint	<ul style="list-style-type: none"> Coordination should consider from screening during infancy, childhood as well as adults (e.g. for non-communicable diseases for the ageing population)
		3. Enhancing multi-sector coordination on relevant health programme	<ul style="list-style-type: none"> Strengthening the collaboration between education system (children), labour as well as the involvement of private sector to provide quality primary eye care service (offering optometric service and related service such as glass prescriptions)

Strategy	Goal(s)	Approaches	How
4. Creating an enabling environment	<ul style="list-style-type: none"> Involvement of important stakeholders to create an environment that would allow the implementation of strategy #1 – 3 	1. Strengthening eye care governance and leadership of the government through the help from stakeholders	<ul style="list-style-type: none"> Allow eye care being part of the health policy Establish regular monitoring and evaluation of healthcare framework Increasing opportunities for strategic collaboration for eye care (through partnership, networks and alliance)
		2. Health information system should be strengthen allowing integration of eye care services into the healthcare system	<ul style="list-style-type: none"> Make use of the WHO publication – WHO eye care indicators menu for inclusion of key indicators to guide the establish of health information system for eye care
		3. Workforce improvement to ensure efficient eyecare workforce are available to deliver eye care services to different population. This also means to enhance their work through innovative approach	<ul style="list-style-type: none"> Make use of the WHO publication – WHO eye care competency framework to guide the evaluation on the potential issues or barrier faced by the system to deliver quality primary eye care.

2.5.3 Evidence from disease-specific screening literature

The current literature on intervention to improve preventive eye examination is limited, mainly to health education intervention. Yet these interventions could not effectively improve the preventive eye examination uptake. Multiple factors were found to influence eye examination utilisation. More importantly, health authorities have laid on different recommendations to promote preventive eye and vision care of which multiple approaches have been mentioned. This suggests that other strategies should be considered. Given the limited evidence that could be used to inform the design of evidence-based strategies to improve preventive eye examination, scoping of intervention used to improve disease-specific eye examination that could be performed in primary care level should be considered.

In this section, literature on the intervention used to improve DR screening uptake rate were scoped. DR screening shares parallel function as preventive eye examination. Both are performed to allow early detection of ocular abnormalities, and the examination can be performed at primary care level.

The investigation of different intervention types on increasing DR screening has been conducted widely in the literature. Example of effective intervention strategies include community worker involvement intervention (Bush et al., 2014), appointment booking for DR screening (Pizzi et al., 2015), telemedicine (Conlin et al., 2006; Mansberger et al., 2015), service delivery model to address access barriers related to geographical factors (Davis et al., 2003), financial incentive (Lian et al., 2013) and behaviour intervention (Weiss et al., 2015). Synthesising evidence from DR screening literature can supplement the evidence base that may be able to apply in preventive eye care.

A systematic review by (Lawrenson, Graham-Rowe, Lorencatto, Rice, et al., 2018) included 66 RCTs, found that behaviour change interventions targeted at patients and healthcare professionals were effective in improving DR screening uptake by 12% when compared to usual care. More importantly, this review found that compared to a control with a simple component, interventions being further enriched with more components (described by the author as “intensive”) were found to have an overall 5% increase in DR screening uptake rate. This further supports the idea that multicomponent intervention should be considered when designing intervention to improve eye examination utilisation. This review also utilized a behaviour change framework (called the Behaviour Change Technique Taxonomy) to describe

the content which allowed further analysis of intervention content. This has enabled researchers to understand what made an intervention effective. This approach to understanding intervention design and its components has not been used in studies of preventive eye examination uptake. The findings found effective strategies which include the following:

- Setting concrete behavioural goals for patients to follow (e.g. informing the patient of the DR screening interval)
- Informing the patient of the screening outcome after DR screening
- Enriching the social environment by introducing other community workers to remind the patient to attend the DR screening
- Communicating the health-related information designed or delivered by credible sources (such as the health authorities).

To identify any potential useful RCTs that were published after this systematic review, the simplified search strategy which the author used (“screen OR test OR exam OR Ophthalmoscopy OR digital OR imaging OR fundus OR telemedicine OR telemonitor OR telescreen OR telehealth) AND diabetic retinopathy”) was executed in PubMed to search for any potentially relevant studies that focused on improving DR screening uptake of the older adults (Lawrenson, Graham-Rowe, Lorencatto, Rice, et al., 2018).

Since the publication of the systematic review in 2018, several relevant studies have been published. Overall, three types of strategies have been examined: health education (Chariwala et al., 2020; Raj et al., 2020; Ramagiri et al., 2020; Singh et al., 2020), financial incentive (Chariwala et al., 2020; Judah et al., 2018; Lian et al., 2021) and screening location (Singh et al., 2020).

For financial incentive, studies have investigated the type and the level of incentive on uptake of DR screening. For studies that examined the type of incentive, it was found that when providing a financial incentive to a group of non-attendees (as defined as those who have repeated non-attendance over 2 or more years) in the form of a fixed monetary incentive (cash) or a probabilistic incentive (lottery) did not significantly increase screening uptake when compared to those in the control group who received invitation letter to screening (Judah et al., 2018; Judah et al., 2017). The uptake rate for control group was 7.8% compared to the uptake rate of those received cash (5.5%) and lottery (3.3%). In contrast, when the financial incentive was examined in term of service fee subsidy, study has found supportive evidence for the use

of financial incentive to improve service uptake. Lian et al. (2021) examined the impact of three levels of financial incentive in terms of service fee (i.e. HKD 0, HKD 150 and HKD 300) on the uptake of DR screening service provided in the private sector. The findings supported those subjects being offered the service at HKD 150 had a higher uptake rate than those offered at HKD 300. When comparing the uptake between the group HKD 0 and HKD 150, the uptake rate did not differ significantly (Lian et al., 2021). This implied that providing the service free-of-charge would not further improve the uptake of those receiving the service at HKD 150. It is worth noting that the fixed incentive described in Judah et al. (2018) was provided in cash, while the service fee incentive described in Lian et al. (2021) was also provided to the subject as a “fixed” incentive, though as a quoted service fee. The inconsistent finding between these two studies further highlighted the importance of considering the design components of an intervention and how strategies should be implemented as its impact on the screening behaviour can vary noticeably. The importance of implementation strategies can also be demonstrated in a non-randomised controlled trial which employed a phase-wise design to test how control condition, health education and financial incentive had an impact on DR screening uptake (Chariwala et al., 2020). What differentiate this study from the above two financial incentive studies was that the financial incentive was given to the Accredited Social Health Activities workers who were responsible for referring the subject for a DR screening (Chariwala et al., 2020). It was found that the uptake rate was significantly higher in second phase which consisted of incentivising the workers to refer subjects for DR screening. Here this study demonstrated how different intervention types could be implemented, and the target of the intervention could include not only the service user.

For health education intervention, compared to those with preventive eye examination, health educational interventions investigated in DR screening literature were different in the content delivered to the target population. A cross-sectional survey study conducted on 267 individuals aged between 7 to 80 years (Ramagiri et al., 2020) investigated the effectiveness of two health education interventions: pamphlets versus a video session delivering the health message, on improving uptake of a “free” DR screening. The result suggested that under the circumstance where the DR screening was provided free of charge, educational videos were more effective than the pamphlets in improving the DR screening uptake rate. The information on DR screening was delivered through a storytelling session where the story was relevant to the target group to motivate the patient to attend the DR screening. They invited “an ophthalmologist from a reputed eye hospital” to give an ending message before all the other basic information

such as DR-related information and service provision location information were given. However, most participants were from the 40 – 59 age group, it was unsure whether the results would be generalisable to the elderly from the older age group. Moreover, the author reported that the educational level of those who received video intervention was higher than the pamphlet group (Ramagiri et al., 2020). This might have biased the results as more educated individuals were associated with higher eye examination utilisation. Nonetheless, this study demonstrated the mode of delivery of intervention is another factor that could be considered, and that the content of the intervention is also important.

Another study, which also involved the accredited social health activist to provide health education, tested how service location (providing transportation to the clinic from the village) might also have an impact on DR screening uptake (Singh et al., 2020). This study examined four different combinations of health education and service location (community health centre and primary health centre) (Singh et al., 2020). The primary health centre being investigated in this study was closer to the village than the community health centre. The findings showed that the uptake rate of the combination including health education by the workers was all significantly higher than those without such components (Singh et al., 2020). With health education provided and transportation to the screening location at the primary health centre, this combination reported the highest uptake rate of 31.7% in comparison to the group receiving no health education and no transportation to the community health centre (9.5%) (Singh et al., 2020).

The findings in the DR screening literature supported the use of health education to improve screening uptake. This was inconsistent with the preventive eye examination. One of the differences was that the way the education component was provided. In the preventive eye examination, the materials were printed and delivered in video-based or via presentation (Dan et al., 2015; Elish et al., 2011; Owsley et al., 2013). In contrast, for the health education interventions to improve DR screening uptake, there were workers involved in the delivery of the health education component (Singh et al., 2020). It was unclear how the mode of implementing health education materials (i.e. being communicated through natural communication or through printed information) might have an impact on uptake rate improvement. However, based on the observation, it seems that those involving personal interaction were more frequently reported to be effective .

While the DR screening literature has afforded a list of potentially useful strategies for future consideration, these strategies should be carefully selected when it comes to the design of a new intervention. Especially, the target group of the intervention and the implementation strategies should be considered. Based on the health belief model, people based on their perceived needs to determine their health behaviour (Rosenstock, 1974a, 1974b). Individuals with diabetes are usually involved in regular monitoring of the disease and therefore would have a different motivation to engage in preventive behaviour. Therefore, some of the strategies identified in the DR screening literature may be more useful for those who already have the health motivation to engage in preventive eye examination. To avoid selecting inappropriate strategies, future studies should be conducted to understand how people decide to use preventive eye examination, which can provide relevant evidence to facilitate the selection of interventions that are appropriate for the context and target group.

2.6 Efforts to improve uptake of preventive eye examination in Hong Kong

Hong Kong currently does not have a population-based scheme to encourage regular preventive eye examination for the older adults. Although there is no HK-based RCT evidence published within the literature for intervention to improve uptake of preventive eye examination, other strategies have been implemented and observed at the community level aiming to overcome some of the common barriers to service access. This include providing a one-off financial subsidy to facilitate use of preventive eye examination, or healthcare voucher to reduce the financial barriers to preventive service utilisation.

Hong Kong has a financial incentive scheme called the Elderly Healthcare Voucher which can be seen as a way reduce financial barriers to the use of preventive eye examinations by older adults. Each eligible recipient is given HKD 2000 every year to be spent on a range of preventive service in the private sector. Under this voucher scheme, older adults can choose to spend the voucher on preventive eye service, of which they have a maximum of HK 2000 to spend on optometric services every two years (which covers the eye examination service performed by Part I optometrists). However, with the non-designated usage for this voucher scheme, it is up to the users to decide how they would want to spend the funds on a range of primary care services (Lai et al., 2018). Previous studies have frequently found that service users preferred to spend the voucher on curative care such as private doctor consultations for

acute or episodic illnesses (Liao et al., 2021; Yam et al., 2019). With this voucher utilisation habit, service users often shared that the amount that could be spend on preventive healthcare was limited and insufficient for preventive eye examination (Liao et al., 2021). There was evidence that the voucher scheme has increased the use of eye examinations by the older adults and that it has reduce the financial barrier to some extent (Sum et al., 2022).

Community efforts in promoting the use of eye examination have also been observed at district level. Two district-based signature projects have been implemented in Southern and Kwai Tsing district respectively (Home Affairs Department, 2023). Both programmes have provided a one-off subsidized eye examination to a limited number of district-dwelling individuals. However, the design of the programme is likely to improve one-off behaviour rather than regular behaviour maintenance (e.g., undergoing preventive eye examination every one to two years or as recommended by an optometrist). Nonetheless the aim of these district-based signature project was not solely implemented to improve the uptake of preventive eye examination, but it focused on understanding the eye health status for the older adults in Hong Kong. Despite having no RCT evidence to support the effectiveness of the one-off subsidy on maintaining regular use of preventive eye examination, it is likely that in the absence of continued provision of financial incentive people's motivation to use the service would reduce. The financial burden will likely reappear and continue to prevent service user from demanding the service. New intervention strategies should be put forward for discussion to implement along with the existing financial incentive.

In Hong Kong, service providers offering preventive eye examinations are available across the 18 geographical districts in Hong Kong. Even with the elderly healthcare voucher scheme, a population-based survey found that 22% of older adults never used any eye examination before (Sum et al., 2022). This raises a question of alternative strategies that could be done other than just relying on the financial incentive to increase the regular use of eye examinations. Together with the literature and evidence from Hong Kong, it suggests that single-component intervention, especially mainly focused on financial incentives or solely providing health education have a limited impact on promoting regular use of preventive eye examinations. A more complex design of the intervention strategies, especially those that incorporate the input from service users, should be considered. However, with limited evidence from the literature and existing evidence in Hong Kong, there is a need to adopt a comprehensive and systematic

approach to propose these intervention strategies. A framework that is comprehensive enough to overcome the currently identified pitfalls in the literature is needed.

2.7 Theories to inform the design of behaviour change intervention

This section provides an overall discussion on the idea of theory-guided intervention development and the theories commonly used in intervention design. More specifically, the debate on the conceptualisation of being “theory-based” is also discussed. This information is necessary to evaluate the existing theories and guide the selection of appropriate theories to inform and guide the intervention development. This section ends with a comment that there is a need to consider a single yet comprehensive theory to guide the intervention development and a more systematic approach to intervention development.

2.7.1 What is theory?

Theory, more specifically health behaviour theories, focuses on why behaviour occurs. Multiple definitions of “theory” have been proposed by scholars (Kwasnicka et al., 2016; US Department of Health Human Services, 2018). They all shared common elements which is to *understand, explain and predict* health behaviour. According to Kwasnicka et al. (2016) theory has been defined as follow.

“A set of concepts and/or statements with specification of how phenomena relate to each other. Theory provides an organising description of a system that accounts for what is known and explains and predicts phenomena.”

Theory can be used to explain how behaviour can be changed which is a fundamental question that must be addressed in intervention development. This information is important to guide the intervention designer to understand how the intervention can be designed and refined, and how the intervention is intended to bring about changes.

2.7.2 Importance of a theory-based intervention development

The significance of a thorough and comprehensive intervention development stage as been demonstrated in the continuous mention in the intervention development framework guidance since its first publication in 2000 and subsequent updates (Campbell et al., 2000; Craig et al.,

2008; Kathryn Skivington et al., 2021). The guideline describes an iterative process of decision-making during intervention development and that having a well-thought-out intervention design increases the likelihood of successful intervention implementation (Campbell et al., 2000; Craig et al., 2008; Kathryn Skivington et al., 2021). Ineffectiveness intervention, which causes wasteful of resources, could be avoided by following a theory- and evidence-based approach to intervention.

There is a consensus among scholars that theory-based intervention development process has several benefits. First, theory explains the phenomenon which can be influenced by several constructs or concepts. These constructs would serve as a foundation for the intervention design and, more specifically a potential target for intervention (Michie & Abraham, 2004). As the definition of theory suggests, a theory involves constructs that would “explain” and/or “predict” the phenomenon, targeting or aiming to alter the construct would, theoretically, bring about behaviour change (Michie et al., 2008; Prestwich et al., 2015). Second, as theories are used, any selection of techniques to bring about changes can be more precisely measured and monitored, the findings would then reflect whether there is a need to refine the existing strategies (Michie et al., 2008). Thirdly, if the technique employed in an intervention are reported specifically enough, it would also allow researchers to investigate the relationship between the inclusion of behaviour change techniques and the effectiveness of intervention in changing behaviour (Michie et al., 2013; Prestwich et al., 2014). This will enrich the understanding of how would best include the techniques to achieve higher effectiveness (Bohlen et al., 2020).

It is worth highlighting that all the above-discussed points are based on the premise that theories are explicitly stated with sufficient details on the rationale for the chosen theory being reported. These are the key elements of achieving a “theory-based” approach, otherwise it would have only remained as “theory-inspired” (Michie & Abraham, 2004; Michie et al., 2018). Only if this assumption is fulfilled, the use of theory in intervention development would have both implications for theorists (how to improve, refine, or even reject a theory) and interventionists (reporting of intervention and how to improve the design to increase the effect on the behaviour) (Evans et al., 2022).

2.7.3 Existing theories/ theoretical framework to inform intervention development

A considerable number of theories have been developed to understand health behaviour. According to a scoping review, which investigated the use of health behaviour theories at individual levels, 82 theories were identified (Davis et al., 2015). These theories have been used to address a range of health behaviours. Of these 82 health behaviour theories, it was found that some theories are the dominant ones in terms of higher frequency of use. They also contributed to the extension or modification of future theories that were adopted for specific health behaviour scenarios. A previous systematic review also reported that some theories were used more frequently than others (Painter et al., 2008). The frequently used theories identified include (Davis et al., 2015; Painter et al., 2008): Transtheoretical Model (TTM), Theory of Planned Behaviour (TPB), Social Cognitive Theory (SCT), Health Belief Model (HBM), Information-Motivation-Behavioural-Skills Model (IMB), Self-determination theory, Health Action Process Approach (HAPA) and Social Learning Theory (SLT). There was no guidance on how to best select a theory used to inform intervention before scholar attempted to categorise the theoretical domain into framework, such framework (The Theoretical Domain Framework) will be discussed in later part of this chapter.

2.7.4 Issues surrounding the use of theory in behaviour change intervention

The commonly used health behaviour theories shared some commonalities in the concepts, yet different terminologies were adopted. In a discussion paper by Noar and Zimmerman (2005), the authors used five common theories as examples (HBM, TRA, TPB, SCT and TTM) to demonstrate how similar and differently these theories all address health behaviour. For similarities, these five health behaviour theories all cover “attitudinal beliefs”. Other concepts that are included to a different extent for each theory are: “self-efficacy”, “norm-related beliefs and activities”, “risk-related belief and emotional responses” and “intention, commitment, planning” (Table 1 of Noar and Zimmerman (2005)) provided a clear comparison with more detailed sub-categories under these five major groups). It was observed that none of these theories cover all these constructs. Moreover, these theories all limited to individual-level and neglected the factors that influence wider groups, such as the social and physical environment.

Although the guidelines for developing and evaluating complex intervention highlighted the need for theory-based development, it was out of the scope of these guidelines to provide practical guidance regarding how to design the intervention systematically and

comprehensively (Campbell et al., 2000; Craig et al., 2008). Consequently, it would have to rely on the judgement of the researcher or intervention designer to select a theory (or multiple theories) to inform intervention design.

With many theories available for consideration, the question now concerns the way to select the most appropriate theories, especially given the shared similarities in theories. The frequently used theories should not be seen as superior to the others. It is possible that other researchers were not aware of all the available theories, and therefore would trust the one that were published in earlier days, assuming the evidence would have been more established (Davis et al., 2015). Recognising the lack of information on the available theories, a book was later published with a summary of each of the 82 theories (S Michie et al., 2014).

Increasing the knowledge about the available theories, however, is unlikely to help researcher judge which theories would be most appropriate to inform and guide intervention development. With the overlap ideas and concepts among these theories, having a shared language facilitate effective communication on the methods and results of the intervention development. It increases the opportunity to effectively compare the effectiveness of each intervention and learn about what makes an intervention effective or not (Dombrowski et al., 2007).

In the early 2000s, the central of the discussion among behavioural science scholars was the conceptualisation of “theory-based” or “theoretical underpinning”. Many scholars have observed that previous studies published in the literature claimed to be “theory-based” but in fact the extent to which theory was involved was minimal or none. Painter et al. (2008) systematically reviewed research papers published between 2000 to 2005 which claimed that theory was used. The author considered that theory can be involved in intervention development in a *continuum*, consisting of four groups: starting from (1) having intervention “informed” by theory, then to (2) “apply’ theory and (3) “test” the theory, (4) before “building” new theory and/or “extend” the theory. The operationalised definition of each group is shown in Table 2.3. Using this coding theme, the research that aimed to build a theory would have all the characteristics of the lower rank of the theory involvement. This coding scheme has highlighted that for an intervention to be considered as theory-based one must not only state but also justify the selection of theory. The construct of the theory should be included in the intervention as comprehensively as possible. Selective inclusion of theory constructs would have resulted in a change in the level of theory involvement. The author analysed 193 records of empirical research by coding them into four groups accordingly. This review only focused

on coding the level of theory involvement and did not aim to evaluate whether the theory has been applied appropriately. Of the 52 intervention studies, the findings revealed that more than half of the intervention studies used theory to inform the intervention (65.6%), 15.6% of the studies applied theory in intervention, followed by 12.5% studies tested the theory and only 6.3% were used to constructed new theory. It was not sure at that time whether theory-based intervention would improve the effectiveness of an intervention. A more systematic way of investigating this question is needed.

Table 2.3 Painter et al (2008) conceptualisation of theory involvement in research

Criteria*	Coding definition*
Informed by theory	<ul style="list-style-type: none"> • If only measure one construct of the theory construct, then it would be informed) • No / limited, partial application • Did not explicitly described the theory, nor it measured the theory
Applied theory	<ul style="list-style-type: none"> • Specified the theoretical framework, and • Applied 1 or 0.5 constructs e.g. in HBM only cues to action and perceived threat were included
Testing theory	<ul style="list-style-type: none"> • Specified theoretical framework • More than half of the constructs were measured and explicitly tested • Or two or more theories explicitly tested or compared to one another
Building theory	<ul style="list-style-type: none"> • Developing new or revised/expanded theories using constructed specified measured and analysed.

*The information summarised was presented in Paint et al (2008).

To better understand how theory had been involved in intervention development, Michie and Prestwich (2010) developed the Theory Coding Scheme (TCS) which addresses six categories of a “good” theory-based intervention (Table 2.4). Theses six categories can be measured using TCS which includes 19 items. It is an objective way to assess how theory has been involved in the intervention. It can avoid having vague measurement of involvement of having one binary measurement (yes or no) for the inclusion of theory. In addition, it can also avoid stating vague statement related to theory involvement, i.e. without clear explanation and the descriptions on the use of theory. Unlike the continuum of theory-based categories proposed by Painter et al. (2008), the development of the TCS had undergone thirteen phases involving both the co-authors and other independent coders. The coding agreement was 0.70 for every single item on the scheme, except one sub-item ($\kappa = 0.64$, still considered a “high-level agreement” by the author). This makes the TCS a more reliable method to serve as a guidance to intervention developers or evaluation tools for systematic reviewers.

Table 2.4 Categories of good theory-based intervention proposed in Theory Coding Scheme

Criteria	Details*
(1) Mention of underpinning theory	<ul style="list-style-type: none"> Was theory stated or suggested? Mentioned any predictors of the targeted behaviour? Were the number of theories used to inform the intervention mentioned (single or multiple)?
(2) Targeting relevant theoretical construct	<ul style="list-style-type: none"> Explain how the theoretical constructs were targeted
(3) Using theory to select recipients or tailor intervention	<ul style="list-style-type: none"> Use theory as a justification for inclusion/ exclusion criteria Or use theory to justify the need for a tailored-based intervention
(4) Use appropriate outcome measurement (for the relevant construct)	<ul style="list-style-type: none"> Was all the mentioned construct(s) measured? How reliable and valid the measurement is?
(5) Is the theory tested?	<ul style="list-style-type: none"> Were there any pre- and post- intervention measurement? Was the measurement obtained under randomised controlled trial? Was there any mediating effect? Discuss the result in relation to the chosen theory/ theories – were the theory used appropriate?
(6) Refining theory	<ul style="list-style-type: none"> Discuss whether the result was constructive to evaluate the usefulness of the theory or whether the theory should be refined a result of this

Information was summarised from Michie and Prestwich (2010)

A meta-analysis, including 140 studies (with 190 intervention comparisons) obtained from two systematic reviews on physical activity and/or healthy eating, was performed to investigate whether theory-based interventions were more effective than non-theory based intervention (Prestwich et al., 2014). The answer to the questions were based on the results collected for the theoretical related constructs of the TCS (11 items). The findings support the previous findings that theory was not fully involved in the process of intervention development (Painter et al., 2008). It was found that only 107 out of the 190 intervention comparisons had explicitly stated being theory-based (56.3%), among of which only ten of them included all the constructs of the selected of the theory (9.3%). This review also found weak evidence to support the improvement in effectiveness of theory-based interventions as supported by a p-values of significant association ranging from 0.01 to 0.04 (Prestwich et al., 2014). Of the 11 theoretical construct-related items in TCS, only three items were found to have a significant association between theory use and intervention effectiveness. Two of the significant association was found in the theory of multiple theories and the third one was the use of theory to inform recipient selection. None of them were suggesting an improvement in effect of using theory-based intervention. More specifically, intervention that were based on multiple theories when

compared to having no or single theory were found to yield the same effect size ($g = 0.21$). This suggests that using multiple theories to inform intervention design did not result in any additive effect. Second, using theory to tailor techniques for the target group ($g = 0.21$) did not show a statistically significant improvement in effect when compared to an intervention that is not theory-based ($g = 0.33$). Although this review found no significant association between the absence and presence of theory in choosing the recipients, it was found that using theory to determine the target group for the intervention yielded the highest effect size ($g = 0.51$). Together, the result of this meta-analysis suggests the usefulness of having simple theory to design the intervention and the potential usefulness in using theory to select the target group.

Recent meta-analyses conducted on other health behaviours have further supported the research implications of theory-based intervention development. Studies have identified the research gap that warrants future investigation to better understand intervention effectiveness. It was found that there was a very limited amount of randomised controlled trials (Gorman et al., 2022), poor reporting of description or unclear description of theoretical underpinning (Evans et al., 2022; Gourlan et al., 2023) or no or limited mention of the theoretical underpinning in the intervention design (Evans et al., 2022; Sadeq et al., 2022). The mention of theory in intervention design has been varied among the researchers even since the discussion of the importance of theory-based intervention and the available guideline for intervention development. This is an alarming issue that should be avoided in future intervention studies. Without clear description, high quality evidence cannot be accumulated which impede the evaluation of intervention effectiveness in the future.

While the impact of theory-based intervention on ensuring effective intervention cannot be fully addressed by the existing evidence, there has been a consensus on the significance of having a theory-based development process improve the design and continue to test for a design that could have a greater effect on behaviour change (Campbell et al., 2000; Craig et al., 2008; Kathryn Skivington et al., 2021). This process requires a clear description of the decision-making.

The field of behaviour change research is advancing and scholars have been devoting time and effort to develop a system to benefit future researchers to be more certain about the link between theory, behaviour change technique and the mechanism that brings about changes (mechanism of action). Enriching knowledge of the link between theory-based techniques and mechanism of action would allow researchers to be more confident in reporting their design

and in turn contribute more evidence that would allow researchers to consider intervention and/or outcome measurement. Behaviour Change Wheel Framework is one of the types that could address these shortcomings.

2.8 An introduction to Behaviour Change Wheel

The Behaviour Change Wheel (BCW) was developed by Michie and her colleagues. The key paper was published in *Implementation Science*, entitled “*The behaviour change wheel: a new method for characterizing and designing behaviour change interventions*” (Michie et al., 2011). Since its publication, it has been cited more than a thousand times. Its applications have been evident in different research fields and have used to address different aspects within intervention development, such as from evidence synthesis to guiding intervention development processes (Atkins et al., 2020; Richardson et al., 2019). The field of behavioural science has been evolving, especially concerning the ways to characterise intervention more reliably resulting in putting forward a more established characteristic system.

The BCW framework can be used along with other associated framework such as the Capability-Motivation-Opportunity Behavioural Model (Michie et al., 2011), Theoretical Domain Framework (TDF) (Cane et al., 2012), and the Behaviour Change Techniques Taxonomy v1(BCTTv1) (Michie et al., 2013) .

2.8.1 Background of the BCW framework

The development of BCW was motivated by the debates on significance of having a theory- and evidence-based intervention development during the early 2000s. There has been a consensus among scholars that adopting a comprehensive approach to intervention development and having a detailed intervention description can advance the understanding of factors influencing behaviour change and therefore the selection of appropriate intervention types to address these issues (Campbell et al., 2000; Craig et al., 2008; Kathryn Skivington et al., 2021). Before the development of the BCW framework, there is no framework that links theories to intervention design (Michie et al., 2011).

The BCW was developed to provide a “*systematic approach to intervention development*” (Michie et al., 2014). By systematic, it means the decision on intervention design is not guided by intuitive thoughts, but a set of strategic questions to understand behaviour and identify a list of possible intervention designs before selecting the appropriate ones. By doing so, Michie et

al. (2011) argued that this process would have allowed the researchers to consider all the potential useful options before narrowing down the list of options. More specifically, the BCW framework has been designed to address the limitation of the existing frameworks of behaviour change which have been criticised to be lacking comprehensiveness and coherence in the use of terminology (Michie et al., 2011).

Michie et al. (2011) argued that to achieve a systematic approach to intervention design, the framework should begin by considering the behaviour as a starting point before linking the behaviour to intervention options. The idea of parsimonious (Epstein, 1984) provides a simple explanation of how an behaviour occur. Having a parsimonious framework help to include all the necessary components that can be applied in different behaviour change problems. Michie proposed that three layers within the BCW framework: the Capability-Opportunity-Motivation behaviour (COM-B) model, the intervention functions and policy categories . The level of the wheel indicates each level influence one another. Specific intervention options are selected to address the behaviour in terms of COM-B components while policy influence behaviour change by the means of the selected intervention options.

The COM-B model describes the three key behavioural components – capability, opportunity, and motivation. The development of this model was based on the understanding that behaviours can occur under the control of an individual or not (e.g. motivation to engage or not engage in a behaviour). The three key components were included after drawing upon the criminal law which described the three key components that constitute a volitional behaviour (Simms, 2002, p. 193). It is further supplemented by the Theory of Addiction which highlighted the role of automatic motivation in the behaviour change (West & Brown, 2013). This COM-B model set the core of the framework.

The BCW development was informed by findings gathered from three stages: systematic review, framework development and reliability testing. First, a systematic review was conducted to synthesis the existing frameworks and evaluated their usefulness in informing intervention development against three pre-defined criteria (comprehensiveness, coherence, and ability to link to an overarching model). The finding of the systematic review highlighted several limitations of the existing framework at the time which included being not comprehensive (not covering all the possible elements) and flexible enough to apply in the intervention (Michie et al., 2011). A clearer grouping of intervention and policy categories were required. Michie et al. (2011) also argued that policy is a channel to implement the intervention

to achieve behaviour change. Moreover, the use of terminology was not coherent with the findings, especially with multiple terms being used to describe intervention options.

Considering the result obtained from the systematic review of 19 existing frameworks, the BCW was developed to provide a clear and coherent description of intervention functions and policy categories. The reliability of this framework was supported by 79% - 85% inter-rater coding agreement tested respectively on two lifestyle behaviours produced by the UK government (Michie et al., 2011). This finding suggests that BCW is a reliable tool to categorise intervention options.

2.8.2 Components within BCW

There are three layers in the BCW framework (Figure 2.1). It addresses three main questions: (1) identify a behavioural problem, (2) how the issues identified in the behavioural problem can be addressed, and (3) implementation options. Following this logic allows the intervention designers to develop a good understanding of the behaviour that is simple yet comprehensive enough to cover the possible factors that increase the chance of influencing behaviour change.

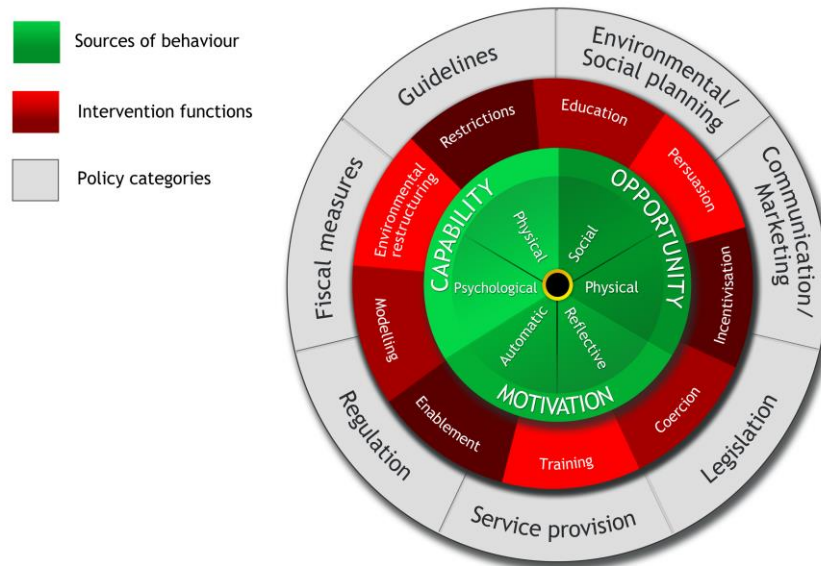


Figure 2.1 The Behaviour Change Wheel

From Michie et al (2011) "*The behaviour change wheel: a new method for characterising and designing behaviour change interventions*". 2011, By Michie, S., van Stralen, M. M., & West, R. (2011), 2011, Implementation Science, 6, 42.

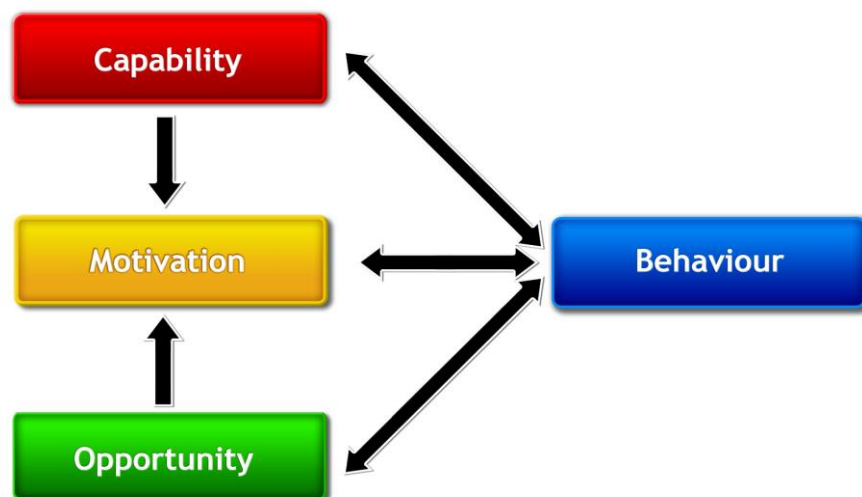


Figure 2.2 The Capability-Opportunity-Motivation Behaviour (COM-B) Model
From Michie et al (2011) *“The behaviour change wheel: a new method for characterising and designing behaviour change interventions”*. 2011, By Michie, S., van Stralen, M. M., & West, R. (2011), 2011, *Implementation Science*, 6, 42.
<https://doi.org/10.1186/1748-5908-6-42> Copyright © 2011, Michie et al; licensee BioMed Central Ltd. (<http://creativecommons.org/licenses/by/2.0>)

Capability-Opportunity-Motivation (COM-B) behavioural model describes the three behavioural drivers. Figure 2.2 was the very first illustration published along with the key paper in 2011. A decade later, more scholars discuss the direction of COM-B components influencing one another (West & Michie, 2023). Theoretical Domain Framework (TDF) can be used along with the COM-B model to supplement the COM-B analysis. Together COM-B and TDF provide the information needed to identify intervention options and policy categories which the linkages are listed in BCW.

2.8.3 Understanding the behavioural drivers in terms of COM-B components

2.8.3.1 Capability

Capability refers to two types of capability: physical and psychological. **Physical capability** describes the physical ability of an individual to engage in a behaviour. For example, if the target behaviour were to improve eye examination utilisation behaviour, a person with a

disability would not have sufficient physical capability to access the service (Chan & Yap, 2016). **Psychological capability**, on the other hand, describes the psychological ability which includes whether there is sufficient knowledge and cognitive skills to process certain information that enable an individual to perform a behaviour. For example, whether an individual knows the recommended interval for a regular eye examination for the older adults (get their eyes checked every one to two years); whether they know what assessments are included in the eye examination; or whether they have the correct knowledge on where to get their eyes checked. A more advanced psychological capability can be whether they have health literacy to understand the health-related information to make a decision that is best for them.

2.8.3.2 Opportunity

Opportunity are the factors that exists within the context that enable one to perform a behaviour – physical environment and social environment. **Physical opportunity** includes resources or cues that you can be placed in the environment, and time to access a healthcare service. For example, whether there is a location that can provide comprehensive eye examinations to the older adults (service availability). To increase the opportunity, the location should be accessible and affordable for the older adult to increase their likelihood to use the service. An older adult would refuse to go for a service that has high indirect costs in terms of transportation fees and time to access, two common factors cited within the literature (Holmes et al., 2018; Neyhouser et al., 2018). As for **social opportunity**, it refers to the opportunity that can be found in the interpersonal context, such as social and cultural norms or cues that are socially interpreted. In the case of eye examination, one may have more an older adults might be more willing to go for an eye examination if they are encouraged by their trusted lay referral network, e.g. peers or family members. Similarly, the older adults may be more likely to attend a scheduled eye examination appointment if they ask their family members to remind them of the appointment.

2.8.3.3 Motivation

Motivation is a key component that determines whether an individual would carry out a behaviour. An individual with higher (or having sufficient) motivation the more likely an individual is going to perform the behaviour. There are two types of motivation: reflective motivation and automatic motivation.

Reflective motivation refers to the motivation that results from evaluation or consideration of certain issues – its reflective nature can be shown in the way people believe the behaviour would result in certain behaviour. This type of motivation is a product of more advanced cognitive processes, e.g. evaluation or making plans to take action. The decision made is a product of conscious thinking. It can include a belief an individual holds after they have considered all the advantages or disadvantages of performing a certain behaviour. This can involve what they think could be good after getting their eyes checked, or what the potential consequences they have to face after getting their eyes checked. Having an intention to take action is a type of reflective motivation. These are the beliefs towards a particular behaviour, and such beliefs may or may not be valid in terms of appropriateness. For example, one may believe that getting their eye examined every year can harm their vision or cause them to lose their eyesight. This is an example of false beliefs that could influence one's reflective motivation and reduce the likelihood of some accepting the idea of regular eye examination.

Automatic motivation is more intrinsic, “intuitive” thoughts and feelings. A common form of automatic motivation includes emotions and desire. For example, one could feel reassured after getting their eye checked, but some may be worried about getting their eye checked and to face with potential bad news. A more typical automatic motivation is fear of screening for cancer (Smits et al., 2018).

2.8.4 Theoretical Domain Framework

As mentioned in previous session multiple theories have been developed to explain various health behaviours; some shared similarities with one another (Noar & Zimmerman, 2005), while some constructs were covered by other theories. The Theoretical Domain Framework (TDF) was developed to serve as a comprehensive framework to understand the theoretical determinants of a behaviour (Atkins et al., 2017). This framework was developed through a series steps of theory simplification exercise, evaluation, validation and pilot testing to group theories with similar constructs into domains (Cane et al., 2012; Michie et al., 2005). The findings resulted in the development of the original framework of 12 domains (Michie et al., 2005) which was later refined and validated into a final TDF consisting of 14 domains (Cane et al., 2012). Linking TDF constructs to COM-B model is straight forward as evident in the 100% mapping consistency validated by three behavioural science experts (Cane et al., 2012). Using TDF to supplement the COM-B analysis can help intervention designers to understand what specific domains the intervention was designed to address (Cane et al., 2012). Together,

the application of TDF and COM-B model were used to analyse the factors influencing behaviour, with COM-B model working as a key to link determinants to the guide of selecting appropriate intervention options to bring about behaviour change.

Table 2.5 Theoretical Domain Framework and COM-B components mapping

COM-B component		TDF Domain
Capability	Psychological	Knowledge
		Skills
		Memory, Attention and Decision Processes
		Behavioural Regulation
	Physical	Skills
Opportunity	Social	Social Influences
	Physical	Environmental Context and Resources
Motivation	Reflective	Social/Professional Role & Identity
		Beliefs about Capabilities
		Optimism
		Beliefs about Consequences
		Intentions
		Goals
	Automatic	Social/Professional Role & Identity
		Optimism
		Reinforcement
		Emotion

The mapping of TDF domains to COM-B components was validated by three behaviour change experts, with 100% coding agreement (Cane et al., 2012).

2.8.5 Identify intervention options

The second layer of the BCW concerns selecting intervention functions. Intervention functions describe how intervention can be designed to bring about behaviour change by tackling specific COM-B components. An intervention type can have multiple functions (Michie et al., 2011). For example, a health education intervention could involve a certain level of information provision and may also involve persuading the target group to change a behaviour through the information they included in the intervention design. By separating education and persuasion as separate intervention functions (in BCW), researchers can consider more possible options to design the intervention to bring about behavioural changes. To avoid confusion in the issues to be discussed in the later part of this thesis, the term “intervention types” will be used when addressing an explicitly stated type of intervention by the researcher/authors.

The intervention function is the means that can address the deficit behavioural drivers identified in the COM-B model, the intervention functions are placed in the second layer within the BCW framework. The linkages between the COM-B and nine intervention functions have been identified through expert consensus and validated (Michie et al., 2011).

- **Education** – Interventions that have an “education” function would aim to educate the target population, for example providing information on the issues the target group were found to be lacking. If it was found that the older adult was not sure about the assessment, they will be undergone during a regular eye examination, the intervention may aim to maximise their psychological capability by providing them with relevant information. Intervention with education function can help to provide relevant and accurate information that could maximise psychological capability as well as reflective motivation.
- **Persuasion** – Persuasion is more than just educating (providing information) someone. When an intervention has a “persuasion” function, the techniques involved would aim to create psychological feelings that may motivate someone to perform a behaviour or stop someone from doing so. For example, a typical example would be the use of images on cigarette packages to portray the damage smoking had on the lungs; by doing this it may induce negative emotion (e.g. worry) for smokers to reduce their motivation to smoke. Persuasion is usually used to target at the issues that one may value the most, it could help to alter someone’s beliefs and therefore target at the motivation (both automatic and reflective motivation).
- **Incentivisation** – Incentivisation is typically used to target at automatic motivation and reflective motivation. Intervention with “incentivisation” would involve creating expectations of positive rewards for the target group. A typical example is the provision of financial incentives, such as cash or vouchers. Other than monetary-based incentives, social incentives are also another type. For example, apprising someone who has successfully lost weight and maintained a healthy diet can result in a positive emotion (e.g. satisfaction) that is reinforced by the behaviour. They might be more willing to maintain the behaviour as they are looking forward to the compliment again.

- **Coercion** - This is the opposite of the incentivisation function. Coercion focuses on punishment or cost after doing or not doing certain behaviour. This function also is useful for targeting at the motivation component (both automatic and reflective). The magnitude of coercion or the expectation of punishment or cost can vary.
- **Training** – Intervention with a training function focuses on providing the target group with the skills that need to maximise their psychological and physical capability, physical opportunity, and automatic motivation. For example, in the context of increasing physical activity, an intervention may involve training the participants with the skills to engage in appropriate physical exercises or train an individual how to slow down their thought process while processing certain information, or it could be training the patient how to regulate their behaviour to reduce their automatic motivation (e.g. desire to engage in a health-risking behaviour).
- **Restriction** – As the name suggests, intervention with restriction would involve means to restrict someone from performing certain behaviours. It usually involves setting rules for people to comply with. Restriction is used especially when there is a competing behaviour that would reduce the chance of performing a targeted behaviour. Typical example of intervention.
- **Environmental restructuring** – Intervention with an “environmental restructuring” involves making changes to their environment or context (physical or social) to increase their opportunity to perform a behaviour. For example, by increasing physical activity, one may have increased social opportunities if there are an exercise groups available to them. Alternatively, in the case of maintaining a healthy diet, strategies to target social influence would be not hanging out with the social group which are likely to cause an individual to consume more junk food.
- **Modelling** – Intervention with a “modelling” function involves showing an example to people to know how certain behaviour is done. By providing an example, people can copy or increase their willingness to copy someone’s behaviour. The person or scene used for modelling purposes would be someone or something that the target group values most. For example, an intervention may involve using social influence to

encourage the uptake of preventive services, such as inviting reputed artist to film a video which includes, he or she received a seasonal vaccination. The term “modelling” or “model” has no relation to mathematics.

- **Enablement** – Interventions with an “enablement” function involves strategies that goes beyond increasing capability or motivation. The idea of “enable” means it affords chances to maximise both capability and/or opportunity that increases the likelihood of behaviour change. Some strategies might not be possible to execute for various reasons – these factors may be a barrier to increasing capability and/or opportunity. For example, if someone is extremely obese, where there is impossible to engage in a regular exercise routine to increase the physical activity level, other strategies that enable one to increase physical activity may consider surgical intervention before training the individual how to exercise that would have the best influence on weight loss. Similarly, if someone facing financial difficulties and cannot afford to get an eye examination, strategies to reduce this significant barrier before considering other strategies to increase capability and opportunity are needed.

2.8.5.1 Policy categories

After considering the types of intervention functions, it comes to the identification of policy categories. Seven policy categories can be considered to implement specific intervention functions (Table 2.6). The example and explanation of these policy categories are general in the key paper. There is more elaboration on the ideas of these categories in other guidance written for policymakers. The following content is a summary of these seven categories after reviewing a mixture of academic and grey literature. All the material reviewed was prepared by the relevant researcher who contributed to the development of the BCW framework (Public Health England, 2019, 2020; West & Gould, 2022).

Table 2.6 Linkage between intervention functions and policy categories

Policy categories	Intervention functions								
	Education	Persuasion	Incentivisation	Coercion	Training	Restriction	Environmental restructuring	Modelling	Enablement
Communication/ marketing	x	x	x	x				x	
Guidelines	x	x	x	x	x	x	x		x
Fiscal measures			x	x	x		x		x
Regulation	x	x	x	x	x	x	x		x
Legislation	x	x	x	x	x	x	x		x
Environment / Social planning							x		x
Service provision	x	x	x	x	x			x	x

- **Communication/ marketing** – This refers to the means that uses communicational channels to disseminate the information which can cover physical information copy such as printed leaflets or advocating the importance of eye health using mass media.
- **Guidelines** – Documents with evidence-based guidelines being put together by authorities that include guidance and recommendations that allow individuals to follow. This also includes any changes to the service delivery. This could be guidelines on the physical health activities recommendation.
- **Fiscal measure** – This category makes use of financial factors to implement the intervention strategies. This usually either incentivises or disincentivises the target group to perform a behaviour. In Hong Kong, a typical fiscal measure that had been put in effect was to reduce the use of plastic bags by introducing the plastic bag charging scheme (Legislative Council, 2022).

- **Regulation** – This category makes use of social elements to create rules that could influence the behaviour. This is an important element that ensures the strategy implemented through guidelines and legislation is properly.
- **Legislation** – This involves amending the law to restrict certain behaviours by setting societal standards. This implementation option can be considered when the issues targeted are fundamental to the individual or target group, such as safety, or mental wellbeing, just to name a few.
- **Environmental or social planning** – This involves strategic planning in the environment that could provide the opportunity to perform a behaviour or inhibit a behaviour. For environmental planning, it could be achieved through urban planning or housing planning. For social planning, it could be increasing the collaboration within the community through the help of authorities.
- **Service provision** – As the name suggested, this refers to how the service is provided to the target group. The provision should increase the opportunity for the individual engaging in the service. For example, having affordable and accessible eye examination services.

2.8.6 Identify behaviour change techniques

After the intervention functions were identified and the appropriate ones were selected, the techniques that will be used to implement those functions will be considered. A Behaviour Change Technique Taxonomy (BCTTv1) was developed to characterize the strategies to implement the intervention functions identified in the BCW framework (Michie et al., 2013). There is a total of 93 behaviour change techniques that can be grouped into sixteen groups (Table 2.7). The rationale for developing such taxonomy was based on the aim to allow replication of studies which can facilitate meaningful evidence accumulation and so that those techniques that are associated with successful intervention implementation can be identified and reported with a share language (Michie et al., 2013; Prestwich et al., 2014). Having a structured taxonomy also facilitate evidence synthesis, such as systematic reviews (Atkins et al., 2020; Lawrenson, Graham-Rowe, Lorencatto, Burr, et al., 2018; Michie et al., 2013). It also facilitates intervention development through a more structured reporting of intervention

content that designed to implement specific intervention functions (Michie et al., 2013). Having this taxonomy have provided a list of potential useful behaviour change techniques for the researcher to consider.

Table 2.7 Number of behaviour change techniques in the Behaviour Change Technique Taxonomy (v1) by behaviour change technique groups

Group	BCT groups	n
1	Goals and planning	9
2	Feedback and monitoring	7
3	Social support	3
4	Shaping knowledge	4
5	Natural consequences	6
6	Comparison of behaviour	3
7	Associations	8
8	Repetition and substitution	7
9	Comparison of outcomes	3
10	Reward and threat	11
11	Regulation	4
12	Antecedents	6
13	Identify	5
14	Scheduled consequences	10
15	Self-belief	4
16	Covert learning	3

2.8.7 Debates on the use of BCW in intervention development

While the development of the BCW was intended to improve the intervention development, scholars have been debating on the usefulness and significance in advancing the field of behavioural science.

The advantages of BCW and BCTTv1 are designed to provide a systematic and strategic approach to select the intervention function and reporting the intervention component under a systematised taxonomy. Together these two tools produce a clear and standardised way of reporting intervention that are expected to have positive impact on future evaluation, implementation, and replication – key components for meaningful evidence accumulation. The usefulness of COM-B model and the BCW in guiding intervention design has been demonstrated through numerous application across various behaviours of the older adults, such as increasing physical activity (Meredith et al., 2023), digital technology utilisation behaviour (Kebede et al., 2022), oral health provision (Göstemeyer et al., 2019) and exercise adherence

(Hughes et al., 2019). While these frameworks are developed to address the shortcomings of the identified limitation of the existing variability in theory and provided a systematic way to deal with evidence accumulation, this approach has been criticised and had led to some meaningful and enlightening debate among scholars.

An opinion paper by Ogden (2016a) “*Celebrating variability and a call to limit systematisation: the example of the Behaviour Change Technique and the Behaviour Change Wheel*” was published in *Health Psychology Review* and has received attention from the behavioural science researchers who debated on the usefulness of the Behaviour Change wheel and the BCTTv1 and their contribution to intervention development, or even more, its contribution to the field of health psychology (Abraham, 2016; Albarracin & Glasman, 2016; Johnston, 2016; Ogden, 2016b; Peters & Kok, 2016; Teixeira, 2016). The main argument raised by Ogden (2016a) concerned that the development of BCTTv1 and BCW, which addressed the call for better reporting of intervention description, seem to put risk of lowering the potential for innovation as the variability was eliminated with the use of integrated theoretical framework and systematization approach to designing and reporting intervention description.

To reduce theory variability, a parsimony model like the COM-B model, an integrated model, was included in BCW. To reduce variability in reporting intervention content, the BCTTv1 was developed including 93 BCTs. Ogden (2016a) criticized the use of BCW and BCTTv1 as a “*descriptive*” and “*prescriptive*” approach (p.248). Adopting such approach to understanding behaviour and solving real-life problem are criticised to be at risk of training behaviour change researcher or healthcare professional to be a “*puzzle solver*” not “*problem solver*” (Ogden, 2016a, p. 247). While the scholar recognising the potential benefit of a systematised approach to coding behaviour change techniques, there is also concern on losing “flexibility” in its application. This concern is usually regarding the risk of reducing complex phenomenon into a simple theory which is often through theory integration. This also risk of losing creativity in the design of intervention and the understanding of complex health behaviour. It was argued that if all the research are produced under a systematised approach – all researchers will be thinking inside the box and not outside the box; innovation is unlikely to be achieved (Ogden, 2016a). Innovation is important for science advancement in term of understanding health behaviour, predicting health behaviour and put forward effective intervention. Ogden (2016a) believed systemised approach that BCW and BCTTv1 offered are not the way forward. Several commentators have commented on this notion where mixed opinion were shared, central to the

debates surrounds the idea of necessity for systematisation, neglecting the existence of variability and the impact of these features on limiting the potential for innovation in the profession (Ogden, 2016b).

Regarding the use of systemisation methods to address the existence of theory variability, the concern of systemisation on understanding complex behaviour are not indifferent among most of the commentators. They were aware of the variability but the way they understood this issue varied. Most of the commentators argued that variability is important and that having variability help explain different behaviours and to solve real health-related problem as well as moving the field forward through the proposal of innovative methods. But the criticism of systemization proposed by Ogden (2016a) has led to a discussion on whether one should choose a theory that can explain all the variability in the behaviour or take a more general approach using a single theory (e.g. the BCW framework). Peters and Kok (2016) doubted that it was impossible to consider all types of variability and that it would be impractical to have a “theory of everything”. To construct a “Theory of everything”, theories would need to be integrated. However, there is no objective criteria that guide the inclusion and exclusion of constructs in the final model. More importantly, Peters and Kok (2016) highlighted when the original theories are developed, they all holder slightly different hypothesis between constructs and therefore the prediction of the relationship between constructs would be different – the differences couldn't be easily incorporated in theory integration. So arguably, the constructs relationship could be very similar but theoretically different therefore it is not practicable to integrate multiple theories just to address all individual variability.

Having a taxonomy facilitates evidence synthesis, which can be used to obtain information of what makes an intervention effective or ineffective (Michie et al., 2013). While there are advantages of using such a taxonomy, the usefulness of the synthesis depends on the included data. Johnston (2016) agreed with Ogden (2016a) that variability is an important element take into account but disagree on the notion where systemisation would harm science advance. Johnson argued that evidence is the "foundation" to innovation. Without knowing of what have been done and whether they worked or not, one could not be confident that the methods or model they proposed are valid. However, the usefulness of deconstructing intervention components in addressing how intervention design was questioned. The concern arose because poor reporting of intervention description was common in previous research studies (Prestwich et al., 2014). Teixeira (2016) doubted “*the value of looking post hoc at published interventions*

– *most of which have been poorly designed and/or reported*”. Despite this doubt, Teixeira (2016) believed that behaviour change research field are still growing and that the effort for systemization, and theory integration is just a "starting point". Echoing the statement highlighted by Michie et al. (2014) which reminded that the framework (COM-B model) is not a "substitute" for any theories that can provide more detailed explanation to health behaviour. While the limitation of using behaviour change framework to guide intervention development is recognised by the scholars, some scholars believed that more research are needed and it is *“too far early for a major paradigm shift”* (Teixeira, 2016).

Further to the concern about adopting descriptive and prescriptive approach to reporting intervention, Albarracin and Glasman (2016) shared their thought on an innovative way of refining the reporting taxonomy that incorporate the patient variability. They proposed that instead of fully rejecting the systemisation, it calls for a refinement in the taxonomy that takes into account of more variables other than behaviour change technique to explain the variance, such as the characteristics of the population, setting and facilitators, and the target behaviour. These are new approach proposed that warrant future detailed research support evidence.

The value of theory in practice and research are other concerns which have been highlighted by the commentators. Teixeira (2016) viewed systemization as only one of the aspects in behaviour change research. What is more importantly is that health professional to learn about the theories and what are the best theories and or behaviour change technique to bring about changes and under what scenario. But further to this, health professional should equip with a mindset that is open-minded that is being flexible with all the information available to them. As health behaviour change is still a relatively new field, Teixeira (2016) believed that the current evidence base is too narrow to make an informed decision on the selection of theory for a range of specific health behaviour. Peters and Kok (2016) believe that it is equally important to train health psychology practitioners so that they can critically evaluate theories, behaviour change methods and including the parameters that are critical for effective behaviour change. However, this also arise the concern about translation work form profession into practice. Not all professional working in the practice is trained in health psychology who would have the knowledge that allow them to make judgement to become to a conclusion of which theory to select. Therefore, the use of systemization as the way the BCW and BCTTv1 were developed have advantages for translational work, of which Teixeira (2016) believed that the Behaviour Change Wheel was *"among the very best tool to guide the design of real word*

intervention, especially by those less familiar with the area". But for expert researcher, the question remained to understand which and how theory can be used to fully explain and predict behaviour.

There are still gaps that needed to address before researchers can conclude how to best utilize theory to explain health behaviour and therefore using the result to inform intervention. The conclusion for this literature is to ensure that the application of BCW is appropriate after considering the use of intervention, the potential audience of the intervention and what are the final objective of the research project.

2.8.8 The application of the BCW framework in preventive health services

Scoping of the literature found that the application of BCW and the associated frameworks in preventive eye care (regular uptake of preventive eye examination in the older adult population) research is limited. The application of BCW and the associated framework was evident in field of primary care, such as applying the TDF to improve service delivery such as understanding the prescribing behaviour of optometrists (Spillane et al., 2021) and using the BCW framework to understand the factors influencing primary eye care delivery by the optometrists such as quality improvement and barriers and facilitator to service delivery (Duncan et al., 2018; Toomey et al., 2021). None have been applied to focus on the service user. On the other hand, the BCW and the associated frameworks (COM-B and TDF) have also been applied to different level of eye care such as cataract service for children (Sethu et al., 2021), medical adherence for glaucoma care (Bott et al., 2024), experience of having age-related macular degeneration (Dillon et al., 2021), diabetic retinopathy screening (Ford et al., 2021; Graham-Rowe et al., 2018; Gyawali et al., 2022; Lake et al., 2017; Lawrenson, Graham-Rowe, Lorencatto, Rice, et al., 2018; Riordan et al., 2020; Umaefulam et al., 2023).

No study was found to use BCW to analyse the older adults' behaviour to engage in preventive eye examination; nor there are studies that use BCW to inform the development of intervention strategies. Together, this review provides a summary on the application and the issues that may encounter during the application of BCW framework and the other associated framework (e.g. TDF, BCTTv1).

Researchers who applied BCW and/or other BCW associated frameworks valued the systematic approach to intervention development and the impact of a systematic intervention development by providing a more options for consideration during development, refinement of

the intervention (Spillane et al., 2021; Toomey et al., 2021; Umaefulam et al., 2023). Such standardised methods to intervention development were also seen necessary for evidence accumulation, especially in the field where previous studies had demonstrated limited information on technique to increase attendance behaviour, or the effect of intervention were mixed and could not be explained clearly (Riordan et al., 2020).

While COM-B model posits at the core model within the BCW, TDF affords more detailed explanation on the factors that influences the three key behavioural components. TDF was commonly used to provide an analysis of the behaviour while COM-B were mainly used as a linkage to identify possible intervention functions as stated in the BCW. Other than the BCW associated framework, one study reported using TDF along with other framework to inform the intervention development. In Riordan et al. (2020), TDF and BCTTv1 were used to form the basis of the intervention, along with another organisational level framework – Consolidated Framework for Implementation Research (CFIR) – to provide more evidence to inform the select of BCTs. Previous study investigated the potential of using multiple frameworks together (Birken et al., 2017).

Previous studies have showed that BCW, COM-B, TDF and BCTTv1 slightly differently depends on the type of research, namely qualitative, quantitative, mixed methods, or in evidence synthesis such as systematic review. Previous studies also demonstrated how the use of data collection methods can further exploit the benefit of BCW associated framework(s) in understanding behaviour to build a foundation for intervention development.

2.8.8.1 Primary empirical studies

TDF have been commonly used in primary qualitative research in data collection and data analysis. The framework was used to analyse the factors that hindered or enabled an individual to carry out the target behaviour. Data was collected through conducting semi-structured interviews (e.g. in person or telephone interview) and/or focus groups. Among these studies, TDF has been used to inform the data collection stage such as interview guide (Gyawali et al., 2022; Lake et al., 2017; Spillane et al., 2021), or served as a underlying framework to support the use of another implementation framework (Duncan et al., 2018). Majority of the researcher adopted a deductive analysis approach to identify the relevant TDF domains followed by an inductive analysis to identify themes and sub-themes (Lake et al., 2017; Riordan et al., 2020; Umaefulam et al., 2023). In contrast, only one study adopted an inductive analysis of thematic

analysis first, followed a deductive analysis informed by the TDF. Spillane et al. (2021) explored the factors that influence the behaviour of the optometrists who delivered eye care services in Australia. In this study, the interview data was analysed inductively using thematic analysis, which was then followed by mapping the themes to the TDF domain, followed by COM-B component to shortlist potential useful intervention functions accordingly.

Limitations observed in the reporting of data analysis process in previous qualitative studies using BCW associated framework to understand the determinants. There was a limited discussion on researcher reflexivity (Duncan et al., 2018; Gyawali et al., 2022; Lake et al., 2017; Spillane et al., 2021). This is an important element in qualitative study, as highlighted in recommended qualitative study reporting guideline (Tong et al., 2007), it enabled researchers to reflect on the role of researcher in the qualitative and how it may have an impact on data analysis and therefore data interpretation. One study explicitly reported the research reflexivity (Ford et al., 2021). Several issues were more clearly stated, such as the ways they ensured participants were aware that providing negative views on the service access was acceptable and how researcher tried to build rapport by using terminology “we” to represent the healthcare professionals. It was also well understood that the research teams were multi-disciplinary which could ensure that there are experts who were capable to apply behavioural science framework to analyse the data. Although this review focused on the application of framework, after all it was the data that support the data analysis and interpretation. Therefore, it is important that researcher remained reflexive throughout the process to ensure the data obtained are reliable and valid and discuss any potential influence that may have on the results.

While TDF provides a framework to understand the existing importance factors, the importance of determinants identified using TDF can be studied through coding frequencies (Atkins et al., 2017). For instance, Lake et al. (2017) compared between young adults (18 – 39 years) and older adult (40 years or above) for the factors influencing DR screening behaviour. In this study it found that, several criteria were used to determine the importance of factors – which could lead to biased results as the qualitative study focuses on in-depth understanding and heavily rely on the data of how the interviewee provided and how the interviewer collected and whether there would be any bias in collecting the data. Similar approach to determine importance of an identified TDF domain is also evidence in evidence synthesis, which will be discussed in the next section.

2.8.8.2 Evidence synthesis

Beside applying the framework in primary studies, TDF and COM-B model have been used to synthesis evidence which the findings were then mapped in BCW to identify the intervention function and behaviour change techniques to be considered in the intervention design.

Involving BCW and its associated framework in systematic review has several benefits. First, it allows researchers to organise all the factors and synthesized under a structured framework to facilitate understanding of the behavioural influences. With support of included studies can help provide an evidence base to identify more relevant strategies that may not be included in a single primary study. The systematic review has provided the evidence base that facilitate the selection of BCT. With the evidence generated in systematic review, it facilitates the selection of BCT in an intervention development stage.

To facilitate decision-making on the selection of target theoretical determinants, reviewers attempted to determine the importance of the identified domains by considering several criteria such as the coding frequency of each domain as well as based on the discussion from the authors of the included studies in the systematic review. Despite this approach can understand the importance of domains, it depends on data of the original data whether to coding truly reflect the level of importance. For qualitative study, there is a chance that participants did not share the details or elaborate equally on certain concepts which can lead to lower or higher number of the coded domains later in the data analysis.

The findings from a systematic review limits the understanding of any missed opportunities in intervention design target as it does not reflect the identified determinants would have influence the behaviour (Graham-Rowe et al., 2018). Mapping back to the COM-B may provide an explanation that one's motivation require sufficient capability and opportunity to perform he behaviour. If context and the specific focus of the target group (e.g. cultural sensitivity) is what the research is concerning, then reaching a consensus through systematic approach such as nominal group technique would be ideal (Umaefulam et al., 2023). Conducting a qualitative study, in generally, will gain deeper understanding of the factors and provide explanation to target behaviour more comprehensively. Together with the support of the findings from systematic review, it would form a more solid evidence base to facilitate the next stage of intervention development.

2.8.8.3 Informing intervention development process

Intervention development require supporting evidence to justify the design. The evidence from systematic review can inform intervention development. Similarly, the findings from qualitative studies have been used to identify intervention functions guided by the BCW. Within this stage, the design of an intervention needs to be considered and finalised which often require selecting appropriate intervention functions and the implementing techniques (characterise the technique using BCTTv1).

While the BCW affords a systematic approach to intervention development, this approach usually results in a long list of BCT that required further narrow down by considering various factors. Reaching the final decision could be challenging at times for various reasons. (S. Michie et al., 2014) suggested five key factors to guide the decision-making which are Affordability, Pracricability, Effectiveness (and/or cost-effectiveness), Aceptability, Side-effect/ Safety and Equity, which is so-called the APEASE criteria. It can be used to evaluate the appropriateness of selecting the BCT and intervention function. For primary study that use BCW to inform selection of intervention functions and BCTs, researchers have explicitly reported challenges encountered while using APEASE criteria.

In Riordan et al. (2020) study, an intervention that aim to improve DR screening uptake was developed with different stakeholders. Multiple rounds of discussion were carried out to ensure the selected BCTs were feasible and acceptable for future implementation. At the beginning of the development stage, stakeholders would equip different knowledge level about the strategies that works as well as the opinions which they believed are feasible and acceptable. It was reported that considering the APEASE criteria to include could be tricky as some stakeholders have no knowledge about the effectiveness of the technique to bring about behaviour change. The process of judgement regarding effectiveness was only possible after the researcher conducted rapid evidence to obtain the evidence needed to facilitate the discussion between stakeholders. Together with existing systematic review evidence, which include the most effective BCT to target at the TDF factors (Lawrenson, Graham-Rowe, Lorencatto, Burr, et al., 2018), the authors were able to directly use the findings obtained from TDF analysis of select the most appropriate BCTTv1. This highlights that when using the BCW, despite being a relative user-friendly tool, when it comes to decision-making of the intervention design, the involvement of other experts from the relevant field should be included to allow more evidence and opinion to accumulate so that the intervention design can decide on all the available

evidence to justify the inclusion or exclusion of specific intervention functions and/or BCT in the intervention design.

Another way to select behaviour change techniques which previous studies have adopted is through the use of Theory and Techniques Tool (Johnston et al., 2021). This interactive online tool was developed after the publication of BCW and BCTTv1. This tool aims to provide a clearer data base for researcher or intervention development to select the most appropriate BCTs to target at the theoretical influence of the target behaviour identified in TDF.

Most studies stopped at BCT identification using BCTTv1, only one study further explore how to operationalise the selected techniques. This involve asking the target group what they think the BCT can be presented (Umaefulam et al., 2023). A typical example given in the article was the providing information about health consequences. They asked the participant who, and how should the information be given. The operationalisation, therefore, have provide more context to the BCT. This is an important element in intervention development. While the BCT Taxonomy provides the system to classify the techniques, the uniqueness of the BCT lay within eh description of the technique itself.

In conclusion, while theory-based approach affords systemization and clearer description as well as steps to approach the intervention development, evidence-based are important especially when making decision on the inclusion or exclusion criteria of the intervention function as well as techniques. While there is no evidence (or weak evidence base), stakeholder involvement holds an important input. This, together suggest that an intervention development process is dynamic and there are multiple aspects that must be considered while designing and that a detailed description of the intervention later would help to detangle another unanswered research question in the future. Depending on the research objective/ aim, inductive and deductive approach would provide a comprehensive understanding of the reason for the behaviour and that the theoretical underpinning of the behaviour can be understood better.

From the involvement of TDF in data analysis within a qualitative study, it can be understood that TDF is considered as a basis to understand the behaviour. One author commented that “TDF can further unpack what may influence the behaviour”, and therefore can identify the function more accurately (Spillane et al., 2021). The COM-B model, the core layer of BCW, is treated as a step to link the factors (identified TDF domains) to candidate intervention functions. No study was found that solely used COM-B model to understand behaviour in the eye care

service research field. Similar application approach has been found in article of evidence synthesis. While primary studies focus on the exploration of factors that influence a target behaviour, findings obtained and documented in secondary articles, such as systematic review has afforded more insight into the BCW application. Similar application approach was found in oral health research. Buchanan et al. (2021) identified nine studies that utilise either TDF or COM-B, or both, to inform intervention development. The review also found that TDF was mainly used while COM-B was not commonly used.

Currently, there is no study that attempt to use BCW framework to inform the development of intervention to improve the use of preventive eye services, despite the usefulness of BCW in guiding intervention development. With previous studies demonstrating successful BCW application to inform intervention development, this justifies the feasibility of applying BCW and its associated frameworks (COM-B model and TDF) to put forward intervention strategies to improve the uptake of preventive eye examination services by the older adults.

2.9 Using Discrete Choice Experiment to elicit preference for intervention strategies to improve preventive health service uptake

This section discusses a systematic approach to elicit user preference as a source of stakeholder engagement to inform the intervention design. The following section starts by highlighting the importance of stakeholder engagement in intervention design. This is followed by an introduction to the Discrete Choice Experiment (DCE), providing justification for its usefulness to elicit user preference. This section ends with a review on the application of DCE on preventive eye examination, supplemented by evidence from preventive general health check.

2.9.1 Before intervention implementation: the value of stakeholder engagement in intervention development stage

Along the intervention development and evaluation pathway, opinion and evaluation of the programme can be collected in the pilot stage (Kathryn Skivington et al., 2021), which is a retrospective way of understanding what can be done to further improve the intervention after intervention implementation. However, collecting information prospectively before the pilot have several implications. Aligning expectations of the users is thought to reduce the likelihood of implementing intervention that are ineffective (Ostermann et al., 2017), and therefore avoiding wasteful of resources. It also provides information to evaluate the intervention after implementation. Factors contributed to the intervention strategy effectiveness in bringing about change can be attributed to various context-specific factors one of which is the participation in the intervention being implemented (Powell et al., 2017). After all, it is up to the target users whether they would take up any intervention programme being offered to them – the choice of the target group plays an important role in their engagement of the intervention programme. In other words, their preference of the intervention being implemented should be investigated.

There are different ways to learn about the view and opinions of the service user for a healthcare intervention (Ryan et al., 2001). Qualitative methods include those that conducted with a limited number of people such as interview, focus groups, Delphi methods or methods that included more people can be public meetings or nominal group technique (Ryan et al., 2001). Quantitative methods include rating scales, ranking, Likert scale, or choice-based questions (Ryan et al., 2001). Each of these groups has its own strength and limitation in addressing

specific research questions, with qualitative approach has limited generalisability and has little quantifiable information to inform policy decision-making while quantitative information can allow manipulating the variables and the impact on the outcome (Powell et al., 2017; Ryan et al., 2001).

User preference for an intervention can be elicited using revealed preference or stated preference (Ryan et al., 2008). Revealed preference are choices made by an individual that can be observed from their actual behaviour (what they chose), while stated preference are the choices stated by the decision-maker under a hypothetical scenario (what they will choose under a specific scenario). Studying different preference type has its strength and limitations. One of the strengths of studying stated preference is that preference can be elicited based on hypothetical choices where the interested factors can be stated in advance – this is unlikely to happen in real life if revealed preference were chosen (Ryan et al., 2008). A systematic approach to elicit the user preference is required (E. Lancsar & J. Louviere, 2008; Powell et al., 2017).

The following sections discuss the theoretical basis, the value of DCE and its validity to mimic real life scenario. This is followed by the discussion on the practical steps involved in DCE study. The chapter then ends with a discussion on the application of DCE to inform intervention design.

2.9.2 What is DCE?

DCE is a preference-elicitation technique used to understand individual stated preference by asking the respondents to complete a series of hypothetical choice sets consisting of two or more alternatives each, collected in the form of survey. It is an attributed-based approach, with each choice set including a combination of attributes levels for individual to make trade-off. The choice they made reveals their stated preferences (Lancaster, 1966; Ryan et al., 2008; Ryan & Gerard, 2003).

2.9.3 Theoretical underpinning of DCE

Drawing from the classic consumer theory which assumes that individuals are rational decision-makers with a utility maximisation mindset. Under the scenarios of budget constraints, being a rational decision-maker would mean individuals are motivated to choose the one that has the highest utility. The utility can be the satisfaction or usefulness perceived for a

programme; the value being conceptualised would depend on the decision-making context (Mühlbacher & Johnson, 2016). Extended to this is the new approach proposed by Lancaster (1966) which postulates that a good can be described by multiple attributes with which shared by other similar goods (substitutes). The utility of a good is “determined by the intrinsic properties” – the attributes are mutually exclusive to each other. DCE assumes that individual place values on each of the included attributes and that they will choose the option with the highest utility after making trade-off between the levels. This also means that the changes of attribute levels may influence the utility of the option and may result in change in choices. The preference of a rational decision-maker should be complete, transitive, reflexive and stable. With these assumption, the findings obtained from DCE study can be analysed under the random utility framework (McFadden, 1974). Random utility theory assumes that while certain behaviour is deterministic, there is a part that researcher cannot be observed (Hanemann, 1984) and the other components that are random.

2.9.4 Validity of DCE to mimic real life scenario

Given DCE is conducted based on hypothetical scenarios, whether such methodology can produce valid result to mimic real life scenario has become a topic of debate (de Bekker-Grob et al., 2012; Mentzakis et al., 2011; Quaife et al., 2018; Rakotonarivo et al., 2016; Ryan & Gerard, 2003). To ensure that the results obtained from DCE can reflect the real-life scenario as realistic as possible and to address the research question of interest (Rakotonarivo et al., 2016), a systematic approach to designing the DCE study should be followed. As the field of DCE research progress rapidly, more empirical studies have been published that investigated the impact of different designs on the results.

Several factors can influence the validity of the DCE findings, such as the people who were completing the survey, their understanding of the questionnaire and the included attributes, other relates to the design of the DCE, or other contextual factors in the real-life setting and the decision-making scenario (Huls & de Bekker-Grob, 2022; Milte et al., 2014; Quaife et al., 2018; Veldwijk et al., 2023).

Existing studies have attempted to compare revealed preference (data collected from real-life) and stated preference (collected using DCE survey) (Huls & de Bekker-Grob, 2022; Lambooi et al., 2015; Mohammadi et al., 2017) to understand the validity of DCE findings. Limited research has been conducted related to external validity of the DCE study given the difficulties

obtaining revealed preference data from real-life scenario (Quaife et al., 2018). The external validity of the DCE findings were also examined by calculating the agreement predicted uptake (calculated prediction) and observed uptake (based on the choice sets completed by the respondents). A study was conducted to test how the questionnaire design and prediction model might have an impact on the validity of the results for two healthcare service, i.e. influenza vaccination and colorectal screening, among the older adult population (aged 55 to 75 for colorectal cancer screening and 60 years or above for influenza vaccination) (de Bekker-Grob et al., 2019). Three extended models were compared to the basic logit model - multinomial logit model. The extended models have different specific focuses and address the factors that may influence the validity of the findings, such as preference heterogeneity and scale heterogeneity. Under specific use of models that take into account of preference heterogeneity, some of the findings were not consistent across different models. While this study only tested on three extended models of multinomial model, it demonstrated the influence of prediction model would have on understanding the preference of the target group (de Bekker-Grob et al., 2019). The selection of model to analyse the DCE depends on the research questions and therefore this factor should be considered to ensure the result obtained can address the specific research question in mind. There are also different ways to collect information regarding reliability and validity of the DCE findings which will be discussed in the subsequent sections. In another study on vaccination behaviour, it found the DCE could accurately predict 80% of the behaviour in real-life scenario (Lambooij et al., 2015). There are other factors that influence the accuracy of prediction, one study found that DCE are more accurate in predicting positive behaviour (getting the vaccination) than negative behaviour (not getting the vaccination) (Lambooij et al., 2015).

Overall, based on existing evidence, DCE is a useful tool to elicit preference which has validity to understand behaviour in the real-life scenarios (de Bekker-Grob et al., 2019; Huls & de Bekker-Grob, 2022; Lambooij et al., 2015; Mohammadi et al., 2017). Conducting a DCE also obtained information that may supplement the real-life evidence and provide the information needed to interpret and explain the findings obtained from real-life scenarios. However, it should be noted that there are factors that can influence the findings in real-life scenario given the nature of the questionnaire completion differs the one from real-life scenario, there are other factors that would need to be investigated when available real-life evidence has been obtained.

2.9.5 Designing a DCE study

DCE study is a mixed-method design which comprises of both qualitative and quantitative elements. The design process consists of multiple steps and decision made at each step are inter-related with one another (Mühlbacher & Johnson, 2016). Several guidelines have been published to help researchers design a good DCE study. A 10-item checklist was published by the ISPOR task force to encourage researchers to be more systematically reporting the practical step taken to design a DCE study. The checklist focuses on presenting items that required “methodological consideration” (Bridges et al., 2011, p. 404). Another checklist included 14 criteria with each including different evaluation questions to ensure research quality (Emily Lancsar & Jordan Louviere, 2008, p. 666). Guideline regarding sample size estimation is also available (de Bekker-Grob et al., 2015). All these guidelines emphasis on transparent reporting of the decision-making that undertaken to reach the final DCE design.

2.9.6 Identifying and selecting attributes and levels

First, it is important that the research question of interest can be addressed by the DCE. A research question should be well-defined, followed by a clear description of the decision-making context. Therefore, before the next step of identifying the attributes, researcher must obtain information of how individual make decision. By understanding the decision-making process, not only the important factors influencing the decision can be identified, but researchers can also understand if there would be other factors could influence the choice of decision. These are important elements that could be considered in the model specification in the later part. For example, whether other factors would influence their choices of getting an eye examination or not.

With DCE being an attribute-based approach to elicit preference, the design includes a selected a fixed number of decision-related attributes. Attributes included in the DCE should be relevant to the decision-maker, be “plausible” and allow respondents to make trade-off (Ryan et al., 2008; Ryan & Gerard, 2003). Attributes can be described in different format: qualitative, quantitative and mixture of both qualitative and quantitative.

At the beginning of attribute selection stage, it is common to generate an extensive list of candidate attributes. All the decision regarding attribute and attribute levels identification and selection should be evidence-based and multiple approaches can be considered. Evidence can be drawn from secondary evidence such as systematic reviews and primary evidence such as

qualitative methods namely interviews or focus groups (Coast et al., 2012), consultation with experts and/or stakeholders (Föhn et al., 2023), use of think-aloud techniques to qualitatively investigate the decision-making process (Obadha et al., 2019), or quantitatively such as ranking and rating exercise. Each of these methods have their benefits and limitation in attribute selection.

The finding from systematic review help researchers consider a list of relevant attributes that have been applied previously. In the case of improving cancer screening uptake several attribute are relevant to the decision-making have been identified such as outcome factors such as mortality reduction and test sensitivity, cost related factor (out-of-pocket payment), and other service-related factors such as procedures and screening frequency (Brain et al., 2022; Brinkmann et al., 2022). It should be aware that referring to secondary evidence may end up with an extensive list of attributes that is not relevant to the study context. When contextual factors are different or assumed to be different, alternative method should be sought to facilitate the identification of context-specific attributes and levels. This is important as DCE should be based on scenarios that are as realistic as possible or are feasible for implementation to ensure validity of the result findings.

An alternative method to supplement the findings from systematic review is the use of qualitative evidence (such as interviews and focus groups). With DCE application becoming increasing applied in low-income regions, the context and the issues faced by specific population would have been different to those in higher income regions (Mangham et al., 2009). It would be risky to be including attributes that are commonly applied in other regions without evaluating its appropriateness in low-income context. Similarly, depends on the research objective and the target group the selected attributes and level could also differ in the number of attributes selected, or the way to interpret the attribute levels – all of which benefit from qualitative study evidence. For instant, cost-related attribute levels would be defined differently between different locations (Stamuli et al., 2023; Stamuli et al., 2022).

The important role of qualitative study in attribute identification and selection have been appreciated among scholars (Coast et al., 2012; Coast & Horrocks, 2007; Kløjgaard et al., 2012; Vass et al., 2017), with its ability to identify relevant attribute within a specific context and the ability to refine wording that can be easily understood by laymen population. Coast et al. (2012) published a discussion paper detailing the strengths and challenges of using qualitative methods to develop attributes. When there is little sufficient relevant literature, and that the specificity

of topic being studied, qualitative study continues to be constructive to address these issues in attribute development stage. There are times when primary evidence, especially qualitative study, would provide more relevant and appropriate attribute and levels identified for certain studies. It also allows researchers to understand the wordings selected to describe the attribute that can be easily understood by the target group (Coast et al., 2012; Coast & Horrocks, 2007; Kløjgaard et al., 2012; Vass et al., 2017). It could also refine the description of levels to avoid confusion between respondents (Obadha et al., 2019). With the increased in evidence and knowledge accumulation, the role of qualitative study in attribute identification may not be as dominant (Clark et al., 2014). Despite this, there is a general agreement that qualitative studies continue to serve an important role in attribute development to identify relevant attributes and levels for the target group (Coast et al., 2012; Coast & Horrocks, 2007). It should be aware that while there are a number of strengths in using qualitative study, conducting one can be time-consuming, with the time spending on data collection, data entry (preparing transcript) and data analysis. Apart from qualitative study, several methods can be consider to generate and/or refine the list of attributes such as expert opinion or using rating and ranking, or through pilot testing (Coast & Horrocks, 2007; Helter & Boehler, 2016), think aloud technique which asked the respondents to verbalise their thought process while completing the task (Veldwijk et al., 2016).

The main consideration within the stage of attribute and levels selection is carefully selecting the evidence supportive of the inclusion or exclusion of attributes and levels. Using multiple sources are encouraged. The selection of attributes and levels goes through a systematic approach from collection, reduction, removal and refinement of attribute lists (Helter & Boehler, 2016). Throughout this stage, pilot testing holds an important role to further explore the issues that could influence the final list of attributes, including cognitive burden, understanding of respondents as well as statistical efficiency (Helter & Boehler, 2016). Selecting appropriate list of attributes, clearly and relevantly describe them to the respondents is related to reliability and validity, which are discussed in later section.

2.9.7 Experimental design and constructing the DCE tasks

2.9.7.1 Full factorial design and Fractional factorial design

DCE involves presenting respondent with a series of choice sets. The choice sets are based on the combination of different attribute levels; more complex the design, the more choice

combinations will be generated (Emily Lancsar & Jordan Louviere, 2008). The total combination can be calculated the L^A , where L = the number of levels and A = the number of attributes with L number of levels (Hensher et al., 2005). Using all the possible combination to generate the design are called a full factorial design (Ryan et al., 2008). This is the first step of constructing an experimental design. Ideally, the orthogonal property of the full factorial design allows researchers to investigate both main effect and opportunity to explore all interaction effects (Emily Lancsar & Jordan Louviere, 2008; Rose & Bliemer, 2009). However, depends on the complexity of the design (the number of attribute and levels assigned to each attribute), a DCE with a full factorial design may be impractical to complete all the question. Take an example shown in Table 2.8, it demonstrates the impact of design on the total combination results. One may be able to complete Example A but not Example B as it is impractical to ask an individual to complete all 512 combinations. The common range of number of choice sets being implemented were 9 – 16, with 4 – 5 attributes included (Soekhai et al., 2019).

Table 2.8 Comparison of total number of combinations under two different DCE design

Example	Number of attributes	Number of attributes at different level			Denoted as	Total number of combinations
		2-level	3-level	4-level		
A	4	3	0	1	$2^3 \times 4^1$	32
B	6	3	0	3	$2^3 \times 4^3$	512

Alternatively, a fractional factorial design (FrFD), which includes a subset of the full design, can be used. This is a way to effectively elicit preference without having to complete all the combination. Using a FrFD require fewer sample size than a full profile. Throughout the history of DCE application, FrFD continue to be common design adopted to construct an experimental design (Clark et al., 2014; de Bekker-Grob et al., 2012; Ryan & Gerard, 2003; Soekhai et al., 2019). According to systematic review on DCE in health-care, the proportion of studies that adopted FrFD has always been reported above 80% (Clark et al., 2014; de Bekker-Grob et al., 2012; Ryan & Gerard, 2003; Soekhai et al., 2019). The latest statistics revealed that of 301 studies included in the systematic review, 269 studies (89%) used FrFD experimental design (Soekhai et al., 2019).

2.9.7.2 Selecting a fractional factorial design: orthogonal design or efficient design?

If the decision was made that a full factorial design was not a feasible option and that a FrFD design was decided to be followed, other issues need to be determined to ensure that the subset being chosen is the most appropriate one. These issues concern the statistical efficiency that a subset holds to reveal information regarding the preference of the target group. Randomly selecting a subset is a possible option but not the most ideal one as the selected subset may not fulfil the properties of a good design. A good design has four properties (Huber & Zwerina, 1996; Ryan et al., 2008):

- **Orthogonality** – It refers to an absence of correlation between attributes. This can be checked using matrix.
- **Level balance** – When the design is balanced in level, the number of times each level appear are the same.
- **Minimal overlap** – The levels within each choice set should not be overlapped, or have minimal overlap, in order to generate more information about the trade-off between attribute levels.
- **Utility balance** – This is a property that is more relevant to efficient design (Huber & Zwerina, 1996). If a design is balanced in utility, the alternatives within a choice should be equally attractive for the respondents.

Two methods can be used to systematically obtain a FrFD, namely orthogonal design and efficient design. Each of these designs have its own assumptions to fulfil, strengths and limitations in analysing preference data.

Orthogonal design is considered a standard approach to design a DCE choice set when there is no prior parameters about the preference (Ryan et al., 2008). An advantage of adopting an orthogonal design is that the relationship of the attributes on choice can be easily interpreted. The orthogonal design that permits the investigation of main effect is called the orthogonal main effect plan (OMEPE). An ideal orthogonal design requires to fulfil all the properties of orthogonality, level balance and minimal overlap. However, in some cases, the design cannot meet all the properties, particularly on the level of balance when there is attribute with 3 levels. Orthogonal design, therefore, is a suitable approach to estimate preference weighting for a simple design. For orthogonal design, it is possible that the researchers later found the number of tests create cognitive burden for the older adult which could reduce the validity and

reliability of the results. It is possible to further reduce the number of tasks for completion. Researchers can further reduce the number of required by blocking the design (Jaynes et al., 2016) but is at the expense of larger sample size (Hensher et al., 2005). There are also debates on the difficulties to have perfect orthogonality, as it is “a statistical property of the design and not a behavioural property imposed upon the experiment” (Rose & Bliemer, 2009, p. 591).

Efficient design are designed to produce more statistically efficient design to understand users' preference by eliciting more information using smaller sample size (Rose & Bliemer, 2009). Despite efficient design are increasing used (Soekhai et al., 2019), such design requires having a prior assumption on the parameters (Ryan et al., 2008) to calculate the most efficient design that can maximise the information collected. These assumptions can be either obtained from previous studies of similar researcher objective or through conducting a study using orthogonal design to obtain a parameter (Ryan et al., 2008).

2.9.7.3 Methods to generate FrFD design

There are different ways to generate a DCE design such as manually using catalogue or generating with the use of computer programme. Over the years, software programme has been the main options for generating DCE design (Clark et al., 2014; de Bekker-Grob et al., 2012; Ryan & Gerard, 2003; Soekhai et al., 2019). Examples of software programme include, Ngene, SPSS, SAS, STAT and R. Software programme has an advantage for generating efficient design, while catalogue are sufficient for a simpler design. Catalogue permits any design up to five attribute levels and the total choice sets required will not exceed 32 choice sets (Hahn et al., 1966). Regardless of which method is used to generate the choice sets, researchers are recommended to always check the property to ensure the design is aligned with the good design practice that are able to answer the researcher question (Mühlbacher & Johnson, 2016).

Apart from considering the properties that ensure statistical efficiency, response efficiency should also be considered. The decision on balancing between statistical efficiency and response efficiency may change how the choice sets are presented.

2.9.7.4 Choice question format design

At this stage, a series of decision had to be made to construct a questionnaire that can capture the preference data as realistic as possible.

First, the label of the alternatives needs to be determined. When presenting the choice sets to the respondents they would have to choose an alternative, which the alternatives can be either labelled (with specific labels) or unlabelled (using general terms, e.g. Package A and Package B). There is evidence that labelled alternative would have an impact on investigating trade-off (de Bekker-Grob et al., 2010). The labelled alternative would grab the attention of the respondents to the label and could reduce the likelihood of following a compensatory decision-making process by considering all the attributes before choosing an alternative with the greater utility (attractiveness) to them (de Bekker-Grob et al., 2010; Doherty et al., 2013). For example, some people may have associated negative feeling with invasive techniques in cancer screening and would consider the alternatives that are labelled with the non-invasive technique (Peters & Siersema, 2020). Adopting a labelled alternatives would therefore increase the behavioural realism of the model. In contrast, if trade-off between attribute levels is the key objective and that there are no significance factors that might significantly influence the choice that need to be considered, then unlabelled alternatives, such as Package A and Package B, will be more appropriate.

DCE is designed to understand preference based on hypothetical scenarios. To ensure the finding are useful to reflect the realistic decision making, it is important that the questionnaire format can mimic the decision-making context as realistic as possible to increase behavioural realism. The choice set can either adopt a forced or unforced design (Ryan et al., 2008). A forced design means that an individual is required to choose one of basic alternative options. For instance, an individual is asked to choose between Screening option A or Screening option B only. On the other hand, an unforced design implies that the respondent is not required to choose between the two forced alternatives but are given the opportunity to choose a third options which can be opt-out, status quo or neither option.

The decision to adopt an unforced design depends on the decision-context and the research objective (Veldwijk et al., 2014). For example, if the research question is seeking to answer whether the target group will choose the newly developed treatment over the current available treatment and that the target group are those patients who have received the original treatment before, then including a status-quo alternative would be relevant. In another scenario, where a DCE is designed to understand whether the two new screening options would encourage the target group to undergo regular screening, and that there are no existing screening options yet, then having an opt-out option will be relevant. The information regarding non-uptake rate can

be obtained and used to justify whether it is worth investing in a new screening option. The decision of unforced or forced design would have great impact to the subsequent data analysis regarding predicting uptake rate, policy welfare analysis which are based on the utility score to provide more interpretable statistics (e.g. predicted uptake rate of a newly-develop programme). Adopting a forced choice design while status-quo and non-uptake rate is relevant can result in overestimating the preference weighting.

Three terminologies can be used in the questionnaire to define an unforced alternative: “opt-out”, “neither” or “status quo”. The use of terminology to describe an unforced options needs careful consideration. Determann et al. (2019) conducted a study to compare different scenarios of including opt-out alternatives under the context of having status quo or no status quo, including 1) investigate the impact of including an opt-out option when there is no status quo in reality, 2) investigate including a status-quo question and an opt-out question when there is a status quo in real life. The findings revealed that using inappropriate unforced alternative would influence the parameter which can cause imprecise calculation of estimate (Determann et al., 2019).

The inclusion of an unforced options had led to scholars to consider its impact on the result and subsequent interpretation. Firstly, adopting an unforced choice design raises issues of potential serial selection of the unforced alternatives (von Haefen et al., 2005). A study conducted by Veldwijk et al. (2014) found that when an opt-out option was available, there were a large proportion of the respondents switched to opt-out rather than choosing the forced alternative – their choice behaviour changed. When a status-quo unforced alternative was included, “status-quo effect” was observed where the respondents tended to choose to maintain their current status (Meyerhoff & Liebe, 2009). Furthermore, scholars have also discussed when status-quo was available in real-life setting, researchers were recommended to be “hesitant to use the neither option” (Determann et al., 2019). To further understand the reason behind the decision of unforced alternative, additional questions should be followed to supplement the interpretation of opt-out or status-quo alternatives.

2.9.7.5 Mode of questionnaire administration

The survey can be administered by interviewers or can be completed by the respondents themselves. The survey can be presented to them in-person, or telephone, electronically such

as emails or web-based survey (Kanninen, 2007). There are different ways to administer an DCE questionnaire and each approach has its strengths and limitations.

For interviewer-administrated survey, the advantages focus on affording more opportunities for timely clarification of the concepts and having more control to the ways the questionnaire are being completed. However, as interviewer are the one who are responsible for the explanation, there are potential interview bias, especially when there are multiple interviewers involved in the data collection. Another issues that need to be acknowledge is that there could be a social desirability bias, a common bias that are commonly observed in questionnaire-based study where the respondents try to guess the “best” answer that the interviewer are expecting. Interviewer-administered survey also implies that the interviewer would require to travel to administer the survey, there are indirect cost to it, let alone the training time and resources required. The overall benefit of interviewer-administrated survey is the better control in the way respondents completed the survey and that it is likely to have higher response rate.

Apart from interviewer-administered mode, self-administered survey can also be considered , these can be completed in the form of paper-based survey, email administered, web-survey (Soekhai et al., 2019). Multiple systematic reviews have been conducted since 1990 to monitor DCE application. These reviews revealed a change in survey administration mode since 1990 and found that self-completed survey has been commonly administered since 1990 (Clark et al., 2014; de Bekker-Grob et al., 2012; Ryan & Gerard, 2003; Soekhai et al., 2019). More specifically, there was a shift from paper-based self-administered survey to online-based self-administered survey from 2013 onwards. The latest statistics showed that between 2013 to 2017, 57% of the health-related DCE survey were administered online and self-completed by the respondents (Soekhai et al., 2019). Self-administered survey has several advantages over the interviewer-administered survey. From researcher perspective, it is less costly to administer, with greater reach of different population, with minimal concern of interview bias. For respondents, it may be easier to complete the questionnaire within their own convenient time. Yet, on the downside, there is little control over the way respondents complete the questionnaire, the research quality may not be easily controlled. Even when instructions are given, it cannot be guaranteed they would complete the questionnaire as instructed. Besides this, if self-administered survey was paper based, there could be extra cost to prepare the documents. However, with the help of online survey programme, researcher can set up a logistic to restrict

the way respondents interact with the survey, and to minimise the bias that arise from poor research quality.

Determann et al. (2017) conducted a DCE study with two versions of DCE survey, consisted of 17 questions which were identical only the logistics were slightly different. The online version was designed to answer all questions in a non-scrollable format and automatic recording of completion time. On the other hand, the paper-based survey was more flexible, without forced questions and required the respondents to self-record response completion time. Respondents from both groups were all comparable in terms of age, sex, and educational level. This study found that, people completed the paper-based reported longer completion time. There was no missing data in the online-based survey, while there were some missing data in the paper-based but the missing data was only recorded from seven respondents (Determann et al., 2017). Both online-based and paper-based self-administered survey all recorded some level of information seeking during the completion time, it is therefore cannot be determined how these questions are reflecting the preference of the target group or not. There is also evidence that the mode of administer may have an impact on cognitive burden. The study asked the respondents to rate whether they thought the number of choice sets were “too small”, “just right” or “too high”. While the rating on “too mall” received similar results between two modes, the rating on “just right” and “too high” were different, suggestive of potential impact on cognitive burden for the respondents. There were more people form the paper-based group found 17 questions “just right” (79.8%) than the online-based group (69.4%). Similarly, more online-based group respondents rated the number of choice sets “too high” (24.0%), than the paper-based group (13.0%). This suggests that conducting the questionnaire online may cause burdensome to some respondents and that researcher should be carefully considered the target group before selecting the most appropriate mode of administration.

2.9.8 Reliability and validity

Reliability and validity are important issues to consider in the design of the DCE study, especially when DCE is completed using hypothetical scenarios. Previous systematic reviews from various fields were conducted to understand how reliability and validity of DCE had been addressed in previous studies, such as from environmental goods (Rakotonarivo et al., 2016), primary healthcare professionals in healthcare (Merlo et al., 2020). While there are different types of reliability and validity, previous DCE study did not address them all equally, with more focusing on internal validity, more specially theoretical validity and assumption of non-

satiation by using dominant choice sets (de Bekker-Grob et al., 2012; Lancsar & Louviere, 2006; Soekhai et al., 2019).

As DCE requires respondents to answer a series of choice sets, cognitive burden has been in central of the discussion in DCE as it would impact the reliability and validity of the questions. Under the influence of cognitive burden, respondents would adopt various ways to reduce such burden, such as simplifying the decision making process (Johnson et al., 2019; Veldwijk et al., 2023), which may have an impact on data quality. Some of the heuristics adopted by the respondents would hamper the reliability and validity of the results, e.g. violating the DCE theoretical assumption of a rational decision-maker.

There are different ways to test these assumptions to ensure the data collected are reliable and valid, though the debates on how to best be incorporated these tests are still unclear and debatable. More often, it can be observed from existing DCE studies that additional questions with specially designed content were incorporated in the DCE questionnaire, i.e. other than the formal DCE questions, one or more questions would be added. However, there are still more research needed to be done to understand how to best address the issues accompany simplified heuristics (Johnson, 2023). Beside including additional questions to check the assumptions, the design of the DCE could be modified to reduce areas that may contribute to cognitive burden of the respondents, such as reducing the number of attributes, or for orthogonal design blocking the design is also one way forward (Johnson et al., 2013).

Furthermore, misunderstanding on having different conceptualisation on the attributes and level would lead to biased and invalid results. Systematic reviews have been conducted to understand the methods to ensure an appropriate use of methods to explore meaning and concepts of the attributes – and how these results can inform the development/ refinement of attribute lists (Pearce et al., 2021). It was found that understanding of the respondent can influence their ability to complete the questionnaire as intended. Researchers could monitor this issue throughout the DCE study, including piloting of questionnaire and during DCE questions completion (Pearce et al., 2021). This review also revealed that researchers seem to hold different conceptualisations on the term “understanding” within a DCE study and that there is no guideline how to best address the understanding of the respondents (Pearce et al., 2021). It was recommended that the selection of focus should consider the research objective (Pearce et al., 2021). Some common ways to check the understanding of the respondents in

DCE application within the health setting include: debriefing questions, pretesting/ piloting questionnaire and testing the respondents' rationality (Pearce et al., 2021; Pearce et al., 2020).

2.9.9 Sample size estimation

A systematic review by de Bekker-Grob et al. (2015) reviewed 69 DCE studies applied the healthcare fields in the year 2012 found that various sample size estimation had been previously applied, which can be summarised under three approach: parametric calculation, rule-of-thumb and based on previous evidence on review or empirical studies. It was also found that a large amount literature in the 2021 had limited or no reporting information on sample size estimation (de Bekker-Grob et al., 2015). Among those who had reported the samples size estimation approach, the most common way to calculate minimal sample size was based on rule-of-thumb proposed by Orme (1998) and (Johnson & Orme, 2003). Following this rule-of thumb, the minimum sample size of respondents (n) can be calculated as follows: $n \geq 500c / ta$, where c is the largest level of the attributes, t is the total number of required choice sets and a is the number of alternatives.

While there are guideline to calculate the minimal sample size, the decision on the final sample size should also consider whether other constraints would be placed on sample recruitment (Emily Lancsar & Jordan Louviere, 2008). The sample size used in DCE can range from as little as less than 100 respondents, or over 1000 respondents (de Bekker-Grob et al., 2015; Orme, 2010), with a typical range between 100 and 300 reported in systematic review (de Bekker-Grob et al., 2015; Kleij et al., 2017). Depends on the research objective, the recommended sample size varied. Based on Orme (2010)'s recommendation, to obtain robust results, it is suggested to have a sample size of 300; and for subgroup analysis, each subgroup should have 200 or more respondents.

2.9.10 Data analysis

2.9.10.1 Data management

After the data has been collected, the data will be entered into a data management programme to create a dataset for subsequent data analysis. It is common to enter the data as wide format where one row represents answer from one respondent. However, for statistical programme to analyse stated preference data, the dataset must be transformed into long format, where each row equals an observation. For example, for a questionnaire that adopts a forced design

including 16 choice sets. Each respondent will contribute a total of 32 row of observations. All the attributes and level needs to be coded and the response needs to be indicated in a separate column. There are two ways of code categorical variables of attributes, namely dummy coding and effect coding (Daly et al., 2016; Hauber et al., 2016). The different types of coding chosen have a different interpretation on the parameter weighting. Dummy coding codes the occurrence of an attribute as 1 and non-occurrence as 0. Effect coding includes coding the categorical variables wither either 0, 1, or -1 to represent each attribute level. While advantages of dummy coding are the ease of interpretation, effect coding are better to adopt when interaction effect would be investigated (Hauber et al., 2016).

2.9.10.2 Model estimation

Conditional logit model (CLM), some refers to multinomial model (MNL) are a basic model to analysis DCE data (Hauber et al., 2016). CLM depends on the several assumptions that are in line with the economics theories and are aligned with the random utility theory (McFadden, 1974). DCE can therefore analysed using CLM. Conditional logit can estimate the “probability of choice among two or more alternatives to the characteristic of the attribute levels those alternatives” (Hauber et al., 2016, p. 304). α is the alternative specific constant, β is the weighting or relative importance of the included attributes levels (e.g. Att1, Att2, Att3, Att4).

$$Y = \alpha + \beta_1 Att1 + \beta_2 Att2 + \beta_3 Att3 + \beta_4 Att4 \dots + \varepsilon$$

However, CLM does not account for preference heterogeneity, and it assumes an absence of identical error, independence of irrelevant alternative (IIA). Although CLM is a relatively restrictive model, it is sufficient to estimate the overall preference where preference heterogeneity was not accounted (Hauber et al., 2016).

Other models can be considered when there is a need to relax theoretical assumption that are tied to CLM. These models are considered an extension to the conditional logit model, the common ones include mixed logit model, latent class analysis, probit model (Hauber et al., 2016). The selection of model estimation depends on several issues such as the estimated effect (main effect with or without interaction), evidence of preference heterogeneity, violation of IIA assumptions (Hauber et al., 2016).

2.9.11 Application of DCE on eliciting preference for intervention to improve preventive health service uptake

To start designing a DCE, researcher would need to know what attributes have been used in previous studies or identify new ones from existing literature. Several systematic reviews have been conducted to understand DCE application in different healthcare services, which mainly focused on preference for cancer screening (Brain et al., 2022; Hall et al., 2022; Mansfield et al., 2016; Wang et al., 2021; Wortley et al., 2014). No review was conducted preventive eye examination service. The studies that were closely related to preventive eye examination were DR screening (Yeo et al., 2012), and arguably the ones from other secondary eye care services such as cataract surgery service and glaucoma service could provide useful information to understand how attributes were developed and selected (Chua et al., 2022; Grauman et al., 2021; Larsen et al., 2020). Apart from the application on eye care service, evidence generated from primary healthcare such as general health check (Kleij et al., 2017) can be used to facilitate decision making on the DCE design. With the different services being reviewed in the literature, the focus was placed on the type of attributes included and the ways these attributes were identified and selected, and how these studies have used DCE to inform the intervention design.

Previous systematic reviews have attempted to classify the attributes into groups (Hall et al., 2022; Mansfield et al., 2016). Mansfield et al. (2016) conducted a systematic review on 22 studies to understand how stated preference were used to elicit preference for three types of cancer screening (breast, colorectal and cervical cancer screening) between 1990 to 2013. This review found that attributes included in DCE mainly focused on two key aspects, which is the screening test itself (screening test attributes) and how the service was delivered (service-delivery attributes). These two groups of attributes have been found to either included in a DCE survey alone, or in a mixture of both. The review found that screening test-related attributes were always found to be significantly influencing the decision to take up cancer screening while healthcare delivery may not always be a significant factor. Example of nonsignificant attributes were length of the appointment, waiting time for the appointment, the time of getting an appointment and the quality of the healthcare professional.

A similar yet more detailed system of classifying attributes to Mansfield et al. (2016) was employed in Hall et al. (2022) systematic review. The review by Hall et al. (2022) included 49 studies which focused to elicit preference of asymptomatic population for taking up cancer screening. The attributes have been grouped under four attribute categories, namely outcome

attribute, test-specific attributes, service-delivery attributes, and monetary attributes. Similar to Mansfield et al. (2016), this review found that attributes included in DCE were more on screening test attributes and service delivery attribute, suggesting that while a range of attributes could be considered these two groups of attributes are most relevant to the decision-making for the service users regarding cancer screening. However, Hall et al. (2022) found that apart from cost, individual valued a test that can correctly identify cancer, and information on mortality reduction. This also echoed with Mansfield et al. (2016) suggested two classifications of attributes. Together these reviews provided supportive evidence of these attributes being relevant and important to the service users. Despite these systematic reviews varied in age range and the types of cancer screening which made it difficult to compare effect of attribute on choice, these reviews highlighted the key group of attributes that are useful to facilitates subsequent comparison with other preventive healthcare services.

DCE application in primary health care was also evident in the literature. Kleij et al. (2017) conducted a systematic review on the DCE used to elicit preference for primary healthcare specifically focusing on medical care. This review grouped the attributes into three groups which was informed by an existing model on the quality of healthcare (Donabedian, 2005) which included *structure* (material/personal resources and organisational structure such as the type of healthcare provider, cost), *process* (any activities included during healthcare delivery, such as the screening diagnosis or the interpersonal interaction with an healthcare professional) and *outcome* (the consequences of healthcare delivery such as improvement in health status). While the groupings have provided useful information on the common attributes being included, the include studies were focusing on medical care which diverged from the focus of the current research project which focuses on preventive services.

Several empirical studies have been published on preference for general health check with various aspects being investigated. The studies have elicited preference for attributes related to GP consultation, results communication and the introduction of pharmacists to deliver health check. Larsen et al. (2020) examined the high-risk individuals of noncommunicable disease for their preference for preventive health check with the included emphasised on GP consultation through a web-based DCE questionnaire. The selection of attributes was inspired by the 5A model for behaviour change counselling (Glasgow et al., 2006) with modification to align with the preventive health care scenario relevant to Danish referral pathway. Eventually this led to an inclusion of five attributes, namely “assess”, “advise”, “agree”, “assist”, and “arrange”. This

DCE was designed to elicit preference under a hypothetical scenario where the respondents had already made an appointment. This may explain why cost-related attribute (a common attribute related to service utilisation in previous reviews) was not included.

Grauman et al. (2021) conducted a web-based DCE questionnaire to explicit preference of six attributes (written results, notification methods, consultation time, waiting time, lifestyle recommendation and cost). This DCE was conducted with a motivation to provide information for policy makers to implement a better health check program, as health communication found to be overlooked and mentioned as barrier for patients to access service in Sweden. The decision-making context hypothesised under a scenario where the respondent was being invited to a general health check and that no serious illness were found. The results obtained was used to calculate the predicted uptake between six different scenarios, including the ones of least preferred attributes and most preferred attribute. To further inform the policy maker, the realistic scenario relevant to the current implementation of health check was also calculated and compared to other scenarios. The calculation of predicted uptake rate can demonstrate how the changes in attribute would have an impact on uptake rate. For example, having to pay € 120 for a health check would result in a reduction of 25% when compared to the realistic scenario. This study further demonstrated the benefit of having quantifiable information to test how the programme should be formulated to reach a certain uptake rate. It should be noted that this web-based questionnaire reported a response rate of 29.9%, with a target age between 40 to 70. It suggests that web-based questionnaire may not be the best approach to collect data among the older age group.

Apart from enhancing communication to improve uptake of preventive service, the possibility of engaging other healthcare professional other than doctor in delivering preventive service was also investigated. A face-to-face DCE was conducted to examine whether public would accept health check provided at community pharmacy and how they would like to have the service provided (Chua et al., 2022). Six attributes were included which covered: the day of accessing the healthcare services, the way the service could be accessed, the type of provider, the duration of a health check, the availability of follow up to monitor and discuss progress and the cost required for a health check. These included attributes are similar to those of Grauman et al. (2021).

From the general literature, it can be understood that relevant attributes to preventive service can cover various aspects such as preventive service components, healthcare delivery including

the interaction with service provider that reflect the service quality, and the factors related to arranging next appointment (Chua et al., 2022; Grauman et al., 2021; Larsen et al., 2020). These attributes are different from those of cancer screening and medical care available at primary healthcare level which had a focus on the screening service to detect the illness and the potential outcome on health status (Hall et al., 2022; Kleij et al., 2017; Mansfield et al., 2016). More general preventive health service placed more emphasis on the communication aspects on health information and the appointment arrangement, together these attributes allowing patient to be informed about their health situation and guiding them to a healthier life. Another important issue to consider is the mode of administration, especially the use of web-based questionnaire on older adult population, which seems have resulted in a lower response rate compared to face-to-face administration. Review from cancer screening systematic review also support the use of face-to-face administration generally have higher response rate than mail and online survey data collection mode (Wortley et al., 2014).

Furthermore, previous studies had demonstrated different ways to systematically identify and select appropriate and relevant attributes that are suitable for the research/ decision-making context. The approach commonly involved started with systematic review, conducting qualitative studies and consulting expert and stakeholders. Other than this, two studies from general health check demonstrated the use existing theories or model to select relevant attributes. Existing theories used are related to healthcare quality and healthcare delivery. These studies demonstrated the usefulness of theories to set the scope for selecting attribute and were found feasible in doing so. However, there are opportunities to expand the theories to focus on health behaviour and explore how it could be useful to identify and select attributes to be included in DCE (Mansfield et al., 2016).

2.9.12 Significance and value of using DCE to elicit preference to inform intervention design

Selecting and tailoring the strategies for the target group should be guided by systematic approach, with clear description of reporting how stakeholder can be involved. In recent years, the usefulness of DCEs has been recognised for its ability to get stakeholder involved in the decision-stage especially how it would be useful to be conducted with scant evidence of RCTs on intervention effectiveness study on its impact on improving service uptake (Powell et al., 2017).

Researchers appreciated the usefulness of DCE in guiding intervention designer or healthcare policy maker to better understand the decision-making process of the target group with an aim to deliver or consider user/patient preference in future programme design and implementation. Incorporating preference into the intervention design has several research and policy implications. There is evidence suggesting that preference-based intervention is more likely to increase treatment completion (Lindhiem et al., 2014). It is commonly believed that strategies that are preference-based are more aligned to their expectation and therefore increase their chance to accept and engage in intervention to improve their uptake of regular eye examination and benefit from regular visual health monitoring. Given the above, to ensure the intervention design is attractive enough to improve engagement in service utilisation, it will be valuable to collect data that reveal the preference of the target group. It would be advantageous to use preference to inform the intervention development prior to intervention implementation to ascertain the design and proceed with further refinement if necessary.

Terris-Prestholt et al. (2019) may be the first researcher to explicitly highlight and demonstrate the benefit of DCE in the intervention development stage and linked this to the intervention development guideline K. Skivington et al. (2021). Terris-Prestholt et al. (2019) described the development process of an intervention to increase voluntary medical male circumcision service uptake and demonstrate how DCE had been successfully implemented and informed the intervention design by identifying components that could be prioritised. This study highlighted the role of qualitative studies in understanding potential influencing factors of health behaviour while DCE provided quantitative information and supplemented the qualitative evidence to further pinpoint *how* intervention should be designed. Six attributes were included in this DCE: “time of service”, “service separation”, “HIV testing”, “gender of service provider”, “female partner counselling” and “incentive”.

To discuss how the results of DCE could inform intervention design, two attributes were extracted for discussion here. Terris-Prestholt et al. (2019) provided a detailed discussion for other attributes. Take an example of the attribute “time of service”, two levels were included “normal working hours and days” and “extended hours and weekend services”. These attributes were included with supportive qualitative evidence indicating that time accessing the service being a barrier for the target group, the author would have thought that having options to access the service in the weekend might be valued by the male patients and improve service uptake. Yet the DCE indicated this factor did not significantly influence the decision to engage in the

service. With this DCE results, this has led to a decision of not including out-of-hours services but make this service “upon request”. Another example concerned a situation when it was impossible to directly implement the preferred options. Other than directing influencing the design with the preferred attributes levels identified in the DCE, the intervention design could be modified the intervention components given known its importance contributing to the decision-making. A good example this study demonstrated was the highly valued male providers offering the service as reflected in the DCE results that the target group prefers to have all males and dislike having all females. The author commented that due to manpower constraint increasing the number of male healthcare professional delivering the service was not possible. However, the DCE has highlighted that how important it is the gender of healthcare provider influence decision-making. An alternative way was adopted to incorporate this in the intervention which was to “emphasis staff professionalism” and mentioning this in the campaign. This intervention had been evaluated and the results found that the intervention result in significant increase service uptake though it was on one of the two tested regions. This is study has also captured the attention of researchers working to improve the framework for development and evaluation of complex intervention development with a focus on generating evidence for economic evaluation. This study has been listed as Case Study 26 in intervention development guideline by K. Skivington et al. (2021).

2.10 Chapter Summary

This chapter includes the literature reviews that are relevant to the current PhD project which aim to bring forward strategies that are theory- and evidence-based to improve the uptake of eye examination by the Hong Kong older adults. Below are the key messages.

1. Utilisation of eye examination service by the older adults is suboptimal and this is a global and local issues that require addressing.
2. A list of factors has been found to influence preventive eye examination uptake by the older adults, while the major groups of factors are common, the reasons leading to such barriers can be context specific. Qualitative study can capture the reasons that explain the differences among the studies, supplementing the findings captured in quantitative studies. There are limited studies that can explain the reasons for not using preventive eye examination by the older adults in Hong Kong.

3. Using behaviour change framework help understand the nature of the behaviour drivers. More specifically, applying behaviour change wheel and other associated frameworks (COM-B and BCCTv1) facilitate selection of theoretically useful intervention options that can be tested in subsequent studies.
4. DCE is commonly used to elicit preference in healthcare and its usefulness to incorporating stakeholder involvement to inform intervention design has been evident. No DCE study has been conducted to elicit the preference for intervention to improve uptake of preventive eye examination.

The findings from these literature reviews have directed several research gaps provided the rationale to conduct the current PhD project. The next chapter restates and discusses these research gaps followed the objectives of this project.

Chapter 3 Aims and Objectives

3.1 Overview

Suboptimal eye examination utilisation has been reported in Hong Kong (Sum et al., 2022). To improve the uptake of regular eye examination by the older adults, evidence-based uptake enhancement strategies need to be put forward. Chapter 2 discussed and summarised the up-to-date literature that form the basis of this thesis. Three key knowledge gaps pertinent to the uptake of eye examinations were identified. Addressing these gaps form the basis of the objectives of this study.

To propose an uptake enhancement strategy, the reason “why” older adults are not using the preventive eye examination services, and “how” they could be encouraged the utilisation rate, should be addressed. However, factors related to suboptimal use of regular eye examination have been mainly investigated in non-Hong Kong regions. In Hong Kong, one survey study investigated the eye examination utilisation under the context of a financial incentive voucher scheme and found other non-financial factors persisted (Sum et al., 2022). While barriers to increase service uptake were similar to those identified in previous literature, the evidence were obtained quantitatively. Quantitative findings provided the direction of what type of strategy could be considered, yet the information was inadequate to inform the design of an intervention.

On the other hand, qualitative study enabled researchers to get an in-depth understanding of a phenomenon of interest and therefore the findings would be able to answer both “why” and “how” questions related improving preventive eye examination utilisation. Yet, the existing qualitative research was again conducted in non-Hong Kong regions (Arinze et al., 2015; Biddyr & Jones, 2015; Neyhouser et al., 2018; Shickle et al., 2018), the generalisability of the findings was doubted. As for Hong Kong, one focus group study was conducted, with preventive eye examination not being the key focus of the discussion which provided limited information to explain why older adults were not using preventive eye examination (Liao et al., 2021). No qualitative study explicitly focused on preventive eye examination to understand the reasons that may have contributed to low use of preventive eye examination. There is a knowledge gap in understanding the context-specific explanation for the reasons for not using preventive eye examination by the Hong Kong older adults. The impact of this knowledge gap

continues to limit understanding on how an intervention could be designed to improve the eye examination utilisation.

Hong Kong operates a dual-track healthcare system. Service users in most situation is required to pay out of-pocket for a regular eye examination by Part I Optometrists. The influence of healthcare voucher scheme (a type of financial incentive) on encouraging the eye examination uptake has found to be somewhat useful, but other barriers persisted (Sum et al., 2022). In addition, it is known that the voucher scheme was not as useful as it intended to be in encouraging use of preventive services (Liao et al., 2021; Yam et al., 2019).

The proposal of uptake enhancement strategy was further hindered by the limited RCT evidence of effective intervention. Among the limited RCT evidence, previous health educational interventions were not effective to improve preventive eye examination and only one study has found supportive evidence for mobile service in improving eye examination utilisation rate. Yet, the service provision context was not aligned with the Hong Kong context. No available evidence could be confidently drawn to support the proposal of intervention for the Hong Kong older adults.

Together with the evidence from general literature and considering the local context in Hong Kong, it has led to the question of what could be done, in addition to the provision of financial subsidy and increasing knowledge and awareness of eye health, to improve the uptake of preventive eye examination by Hong Kong older adults.

3.2 Aims and objectives

The overarching goal of this research is to improve the visual wellbeing of older adults. The aim of this study is to support this goal by improving the uptake of preventive eye care in the form of the regular preventive eye examination.

Before this study, it was unclear what strategies could be considered as there has been a limited understanding on the reasons for not using eye examination regularly in Hong Kong. To ensure the proposed intervention strategies would not be limited to educational and financial types, the Behaviour Change Wheel was used as an overarching framework to allow a holistic approach to intervention development. Applying this framework to design strategies to improve regular eye examination can have several benefits. First, it has the ability to link behavioural drivers to intervention design, in which the linkage is supported by theory and evidence. It also

helps guide researchers or intervention designers to think of a wider range of possible intervention options and selecting the ones that are most appropriate under the context of implementation. The BCW framework has not been applied to intervention development for improving preventive eye examination uptake of the older adults before. Considering the evidence regarding the reasons for suboptimal eye examination was yet to be established in this project, a qualitative study would be conducted to provide sufficient information to form the basis for the intervention development. Furthermore, synthesising existing evidence to inform intervention development is needed. In addition, the engagement of the stakeholder would also include to ensure the proposed intervention were preferred by others to maximise the potential of implementing useful intervention strategies in the future.

Below are the four objectives of this project.

3.2.1 Objective 1

To identify the factors influencing the decision-making process of older adults to use regular eye examination in Hong Kong.

3.2.2 Objective 2

To develop theory- and evidence-based intervention strategies to promote regular eye examination using the Behaviour Change Wheel framework.

3.2.3 Objective 3

To elicit the older adults' preference for the developed strategies to promote regular eye examination uptake in Hong Kong.

3.2.4 Objective 4

To estimate the potential uptake rate of preventive eye examination programme that consisted of the preferred attribute levels.

Chapter 4 Barriers in older adults' decision-making process to use routine eye examinations in Hong Kong*

**This chapter has contributed to a peer-reviewed publication (Lau et al., 2024). This chapter has been edited to be included in this thesis.*

*Lau, W. Y., Liao, Q., Lian, J., & Yap, M. (2024). Barriers in older adults' decision-making process to use routine eye examinations in Hong Kong. Clinical & experimental optometry, 107(4), 442–448.
<https://doi.org/10.1080/08164622.2023.2237971>*

4.1 Chapter overview

The literature review chapter discusses the existing literature on factors influencing eye care seeking behaviour which were mainly investigated among regions outside of Hong Kong. There is limited evidence available to explain why older adults are not engaging in preventive eye examinations regularly in the Hong Kong older adult population. This knowledge gap can be addressed by conducting a qualitative study to provide a context-specific explanation for this phenomenon of interest. Especially, the details afforded by qualitative evidence serve as a foundation to design intervention content to tailor towards a specific influencing factor.

The part of the research also serves as the first step of the BCW which guides the researcher to understand the behaviour in terms of capability, opportunity and motivation – the information required to identify what intervention functions can be selected to bring about behaviour change.

This qualitative study focused on exploring the factors that influence the decision-making process of the older adults in Hong Kong and exploring the reason for not using such services. This research study will provide valuable information to enrich the understanding of older adults for not using preventive eye examination – providing a foundation to build intervention to address the factors found to influence preventive eye examination utilisation.

4.2 Background

An important facet of primary eye care is the preventive eye examination which includes an assessment of refractive status, visual function, and ocular health. Health authorities recommend an eye examination every one to two years, for individuals aged 65 years or above (Centers for Disease Control and Prevention, 2020; Health Direct, n.d.; National Health Services, 2023; Optometrists and Opticians Board, 2018a). In Hong Kong, Part I optometrists are the service providers responsible for preventive eye examination with preventive eye examination provided mainly in the private sector (Department of Health of The Government of the Hong Kong Special Administrative Region, 2017). Hong Kong citizens aged 65 years or above are eligible for the elderly healthcare voucher, providing each eligible person with an annual amount of HKD 2000 to be spent on a range of private healthcare services. Comprehensive eye examination provided by a Part I Optometrist is also included under the scheme (Health Care Voucher, 2021a; Health Care Voucher, 2021b). Although the voucher amount can be accumulated to HKD 8000, the maximum amount allowed to be spent on optometric services is capped at HKD 2000 every two years. This financial incentive improved the uptake of eye examination somewhat (Sum et al., 2022). However, it is also known that older adults often spent the voucher on curative episodic services (Yam et al., 2011; Yam et al., 2019). It suggests that providing financial incentives alone may not be effective to improve the uptake of preventive eye examinations (preventive service).

No study focused on how older adults decide to use preventive eye examinations. It was unclear why older adults were not using preventive eye examinations in Hong Kong. Therefore, this qualitative study explores in greater depth how older adults decide to use the preventive eye examinations in Hong Kong. The research question was: what factors influence the decision-making process of older adults in using the preventive eye examinations? The aim was to construct a theory to explain the preventive eye examination utilisation in the Hong Kong older adult population. Addressing this research gap allows us to propose evidenced-based strategies to improve service uptake.

4.3 Methods

This study was approved by the Hong Kong Polytechnic Institutional Review Board (ref no: HSEARS20210422005-01). The report of the method section follows the Consolidate Criteria for Reporting Qualitative Research (COREQ) checklist (Tong et al., 2007).

4.3.1 Research team and reflexivity

The research team consisted of researchers in public health services, qualitative research, optometry and health psychology. All the interviews were conducted by the PhD research student (WYL) who is female and has an academic background in health psychology.

WYL was trained to conduct qualitative research by an experienced qualitative researcher (QL). The discussion of coding results was done with a research team with experts in psychology, behavioural sciences, health services research and vision care (QL, JL and MY).

The participants were purposively recruited from an existing data pool from a previous research project in which WYL has previously been involved. Of the 25 respondents, only two of them whom the interviewer has met before. Only one recognised the interviewer. The study objective for this study was not concealed from the respondents. The researcher encouraged respondents to share their opinions and thoughts about using preventive eye examinations.

4.3.2 Design

To gain an in-depth understanding of the decision-making process of the using preventive eye examination, a theory was constructed using the grounded theory approach to explain why older adults were not using preventive eye examination (Glaser, 2017).

4.3.3 Centre recruitment and subject recruitment

To streamline the recruitment process, the respondents were recruited from an existing cohort established from a previous study. Elderly centres were recruited using convenient sampling. The participating centres were from six geographic districts in Hong Kong, including (not in any particular order) Yuen Long, North, Central and Western, Southern, Sha Tin, and Sham Shui Po. Invitation letters were sent to centres and sought for their willingness to participate. For centre that have agreed to take part, the PhD student provided a name list for the centre staff to assist individual subject recruitment. No direct contact was made between the potential subjects and the PhD research student during the recruitment period. For subjects who agreed to take part, a one-hour timeslot was scheduled.

Eligible criteria for this interview study were those who had participated in the previous research project conducted with the research team. This cohort shared the following characteristics:

- Participants aged 65 years or above
- who were community-dwelling individuals; and
- had not used routine eye examination in the past 24 months

Purposive sampling was used to recruit the subjects. To maximise the heterogeneity of the subject characteristics to enable exposure to diverse experiences and perspectives, with reference to previous healthcare utilisation framework (Andersen & Newman, 2005), several indicators were used to purposively identify the participants. These include sex, age, educational level, previous eye conditions and the number of common chronic illnesses. The previous research study has collected relevant information on these variables which would allow purposive sampling to happen.

Subsequent subject recruitment was guided by information obtained from former interviews until all information gaps were saturated (Glaser, 2017). For example, enquiry raised from people with no chronic illness may perceive little financial burden to use preventive eye examination, with this question in mind, the next interview would aim to recruit respondents with more diagnosed chronic illnesses to explore whether the barrier would be similar or different. By doing so, the reasons for not using preventive eye examination would be captured more comprehensively and contributed to the construction of theory to explain reasons for not using preventive eye examination by older adults.

Data collection was terminated when data saturation was reached. Data saturation occurs when there is no new additional information identified during the data analysis stage (Glaser, 2017), e.g. no new themes were identified.

4.3.4 Interview guide: piloting and amendment

For this semi-structured interview an interview guide was developed to explore the decision-making process for using preventive eye examinations. All the questions were designed to be open-ended to encourage the respondents to share their thoughts without restricting their scope. The original guide included questions related to eye examination utilisation only. However, the observations from pilot interviews revealed that respondents were not familiar with preventive eye examination which resulted in difficulties in discussing this service with the team. During the first few interviews, the facilitator has brought up other preventive services, such as vaccination and general health checks. It was found that discussion about these services had helped participants to start thinking about preventive services, more specifically about

preventive eye examination in subsequent discussion. Therefore, the interview guide was revised by adding a warm-up question regarding previous usage of preventive services. (refer to Supplementary Material B Section B for the question). In subsequent interviews, it was observed that participants were more talkative and appeared more willing to share their thoughts about preventive eye examinations. The revised interview guide was then used to guide the subsequent interviews (Appendix B1). Questions in the interview guide involve open-ended question to allow respondents to express their thoughts freely about the topic.

4.3.5 Data collection

All interviews were conducted in the community elderly centre at the six locations stated above. Only the interviewer (the PhD research student) and the participant were present at the time of the interview. All interviews were completed in a room free of interruption.

The interviews were conducted between May 2021 and September 2021 by the PhD research student. The language medium was Cantonese. The interview time ranged from 26 minutes and 61 minutes, with an average duration of 41 minutes. After obtaining informed consent to take part and being audio-recorded by the respondents, the interviewer followed the interview guide to initiate the conversation while keeping an open mind to go into other topics as necessary. Demographic and health-related information was collected after each interview. All the interviews were audio-recorded using an audio recorder. Filed notes were written during the interview and collated afterwards by the PhD research student. All respondents, who completed the interview, received a shopping voucher as a token of appreciation.

4.3.6 Data analysis

Participant demographic characteristics were summarised descriptively. Interview data were transcribed verbatim by the PhD research student and a student assistant (who transcribed 20% of the interviews). All transcripts were checked and finalised by the PhD research student. The participants were not invited back to comment on the transcript as older adults would have found it too cognitively demanding to read the transcript.

The process of data analysis follows the grounded theory approach where opening coding and axial coding were identified accordingly. Through constant comparison techniques, by comparing the coding produced between different interview data, a selective coding was produced which was organised in key concepts and key themes (Glaser, 2017). The recording

of each interview was relistened by WYL several times before formal analysis was done. More specifically, during the familiarization stage, extra notes were added to the existing field notes, and memoing ideas during coding facilitated identifying meaningful themes and contributed to the development of theory to explain the phenomenon of interest.

For this research project, the PhD research student was the primary researcher who was responsible data analysis. Under limited manpower and available researchers who knew how to perform qualitative interview analysis, an alternative approach was adopted to ensure data quality, unlike the conventional way of having at least two researchers engaged in data analysis. First, the PhD research student and an experienced qualitative researcher (QL) independently analyse one interview data. This was done to check the process of coding was correctly performed by the PhD researcher student and that the coding was identified appropriately. After that, the two researchers discussed the preliminary theme constructed from one interview. The preliminary results constructed from the first few interviews were discussed with the research team, this was done to check whether the theme was constructed. Then after the data analysis was completed, the results were presented to the research team. The research team also involved a researcher who was not involved in the data analysis process and invited for comments about the coding. This was done to ensure the theme construct was appropriate to reflect the real-life scenario regarding the service provision situation for a preventive eye examination. Discussing the identified themes with the research team involving relevant researchers, ensured the identified themes were appropriate to explain the phenomenon of interest. To ensure the quality of the findings, the PhD research student independently reanalysed the interview transcript again in three months. No discrepancies in the identified themes were observed.

NVivo 12 was used to manage the data analysis process. No automatic coding function in NVivo was used; all data coding and analysis were done manually by the PhD research student. Illustrative quotations were translated from Cantonese to English by the PhD research student. The data started to saturate after 20 interviews were conducted. Five additional interviews were conducted to confirm this.

An example of coding of an excerpt is shown in Table 4.1.

Table 4.1 Example of coding an excerpt

Excerpt	Codes	Initial Concepts
<i>Interviewer: "Although you have never had an eye examination before, have you ever considered one?"</i>		
<i>Interviewee: "But...first of all, I don't know how to get it checked. I think it's good to receive an eye check as an elder, but I can see clearly and I believe I don't have cataract. People said that you will see black stuff if you have cataract in your vision. I see very clearly; do you understand what I mean? Everything is so clear..."</i>	<p>Perceived benefit to have CEE but don't know where to get it checked</p> <p>Perceived current vision was fine, believed to have no cataract No black stuff means vision is alright.</p> <p>Comparing other's visual status and perceived herself to have good vision ("can see clearly")</p>	<p>No access to service-related information</p> <p>Misunderstanding of needs Symptom-driven need appraisal</p> <p>Social comparison of visual status to determine needs</p>

4.4 Results

Table 4.2 shows the summary of the demographic characteristics of the 25 participants (Supplementary material C includes individual demographic characteristics). The self-reported health status and self-rated fitness of eyesight of each participant is shown in Table 4.3 and Table 4.4 respectively. Most notable for visual status (Table 4.3), the majority of the participants have glasses for presbyopia (80%) and nearly half (48%) have ever been diagnosed with cataract previously.

Table 4.2 Summary of demographic characteristics of participants (N = 25)

Participant demographic characteristics	n	%
Age group		
65 – 69	5	20
70 – 74	12	48
75 – 79	5	20
80 – 84	1	4
85 +	2	8
Sex		
Male	5	20
Female	20	80
Highest education attainment		

Primary or below	9	36
Lower secondary	5	20
Upper secondary	7	28
Post-secondary (non-degree)	0	0
Post-secondary (degree)	3	12
Refuse to answer	1	4
Marital status		
Never married	1	4
Married	11	44
Widowed	9	36
Divorced	3	12
Others	1	4
Personal income (in Hong Kong dollars)		
<2,000	1	4
2,000 – 4,999	8	32
5,000-9,999	5	20
10,000-14,999	2	8
15,000-19,999	1	4
20,000	2	8
No income	6	24
Income source		
Family/ relative financial support	8	32
Comprehensive Social Security Assistance Scheme	3	12
Old age allowance	8	32
Saving	5	20
Pension	0	0
Salary	0	0
Disability allowance	0	0
Others	1	4
Current living arrangement		
Living alone	8	32
Living with spouse	8	32
Living with spouse and child(ren)	3	12
Living with child(ren) only	4	16
Others	2	8

Table 4.3 Summary of the self-reported health status (N = 25)

Self-reported health status	<i>n</i>	%
History of chronic illness(s)		
hypertension	13	52
type 2 diabetes	2	8
high cholesterol	10	40
Refractive error		
Myopia	9	36

Hyperopia	2	8
Astigmatism	15	60
Presbyopia	20	80
History of eye disease(s)		
Age-related macular degeneration	0	0
Cataract	12	48
Diabetic retinopathy	0	0
Glaucoma	0	0
Others	7	28

Multiple answers were allowed. The percentage may not add up to 100%.

Table 4.4 Self-rated fitness of eyesight

Self-rated fitness of eyesight	n	%
Very poor	0	0
Poor	3	12
Fair	9	36
Good	12	48
Excellent	1	4

4.4.1 Core theme: prioritising and including routine eye examinations in existing health service utilisation

During the discussion, respondents shared that they had “no intention” to use preventive eye examination. This thought was intuitive. However, through in-depth discussion and follow-up questions, it was revealed that several factors were found to influence their decision to use such a service or not. Their intention is not fixed but modifiable. The core theme derived suggests older adults did not consider using preventive eye examination as they encountered difficulty in prioritising and including primary eye care into existing healthcare utilisation (Figure 4.1). Low perceived needs, low perceived self-efficacy of service utilisation, and unfulfilled service expectations, all contributed to low motivation to use the routine eye examination. Previous healthcare utilisation was found to have influenced these key decision components to some extent. The illustrative quotations can be found in Appendix B2.

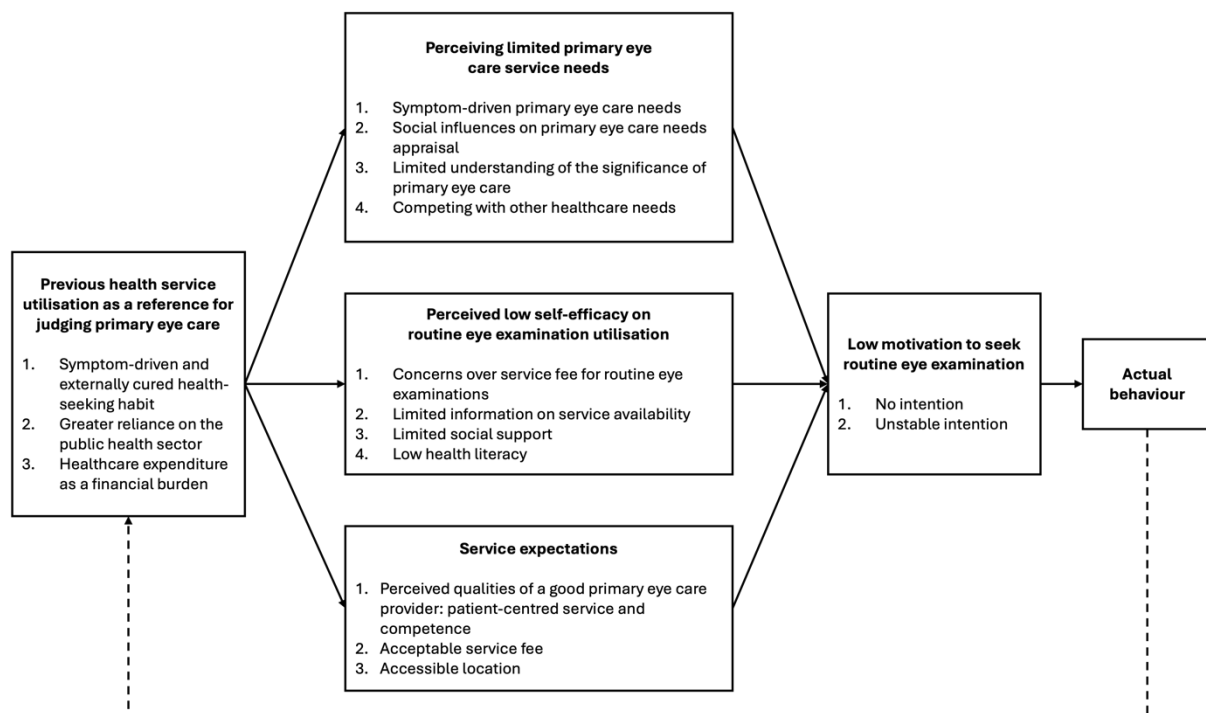


Figure 4.1 Prioritising and including routine eye examinations in existing health service utilisation

4.4.2 Perceiving limited primary eye care service needs

Respondents shared that they would only use healthcare services when they were ill (symptom-driven mindset), which was what they have been doing to address other physical healthcare needs. Their health seeking behaviour were externally motivated by the recommendations provided by an authority figure which they encounter either during health check-up (medical doctors) or broadcast in daily lives (government recommendation).

Recognising the need for preventive eye examinations is an important driver of behavioural intention. Like the existing health seeking habit as reflected in previous healthcare utilisation, the eye care needs appraisal was symptom-driven and socially cued. The reduced perceived need was also influenced by limited knowledge of the significance of the routine eye examinations.

Participants' need appraisal was based on the impact of symptom severity on daily activities. Unless they perceived the symptoms may progress into blindness, the intention to seek eye care services remained low. Participants used a present-time perspective in need assessment, giving more weight to symptoms right now and less consideration of how it may affect visual health in the future. Naturally, they seek strategies to cope with blurry vision, e.g., wearing reading

glasses, or utilising magnifying functions in mobile devices; these coping strategies all help the participants see clearer while engaging in daily activities. Using lubricating eyedrops to alleviate the dryness of the eye was also mentioned. As the health-seeking behaviour was symptom-driven, the alleviation of symptoms or inconvenience reduced the perceived need for an eye examination.

Social influences on need appraisal were also frequently mentioned – with most believing vision deterioration is part of normal ageing process. The role of vision in performing daily activities (such as grocery shopping) was considered less critical in relation to the tasks performed when they were still working. This rationale seemed to make poorer vision status more acceptable despite not being optimal. Participants usually adopt a downward social comparison where they compared themselves to others who have poorer visual health, causing them to think more optimistically about their visual health and hence lower perceived needs. Those who attend regular check-up at the public hospital shared that the absence of primary eye care advice from public doctors was interpreted by the participants as “no need to use eye examination”.

Only a few participants could elaborate on the significance of the routine eye examination (e.g., early detection of common eye disorders). Others believed the routine eye examination only includes spectacle prescription, perceiving the service as simple and not comprehensive. Together with the perception that vision deteriorates gradually, the participants were less likely to prioritise primary eye care over other general healthcare needs.

4.4.3 Perceived low self-efficacy on routine eye examination utilisation

Despite some perceiving the need for regular eye examinations, the behavioural intention was diminished by the lack of confidence in accessing the service. The low self-efficacy was influenced by financial concerns, lack of information on service availability, limited social support and low health literacy.

Older adults shared that they already had other curative healthcare needs which required treatment from their existing healthcare needs. Some financial concerns came from the recurring use of services. Interestingly, it was found that the participants used a curative service, e.g., dental curative services, as the reference service to judge their ability to pay for an eye examination. Yet, these curative services have a higher service fee than an eye examination. The extent of financial concerns is presumably genuine, albeit based on misperceptions. The

financial concerns may not be as pressing for those who have more savings or have children to assist them financially. Despite the participants' eligibility for the healthcare voucher, most of the funds would be spent on other primary healthcare services; the financial concern remains.

Most participants were uncertain about where to get an eye examination. The participants' trustworthy information channels (e.g., the governmental website or community elderly centres) seldom disseminate information on service availability. There was a lack of action-planning cues in health educational talk hindering participants from making a judgement on their access ability (e.g., accessibility and affordability). This shows the importance of providing information about service availability along with improving knowledge in promoting service access.

Healthcare professionals, especially those working in the public sector, were a key factor that the participants heavily relied on for navigating the healthcare system. Having low health literacy meant they had little chance of acquiring useful information during a conversation with the healthcare professional, which also affected their perceived needs and altered their intention to use the service. The encounter with an optometrist with mutual information exchange was described as a "learning process" by one participant, which could increase self-efficacy in future service access as the eye health knowledge accumulated.

The participants also relied on their lay referral network for obtaining service information (e.g., friends or family members). For those with limited social support, community facilities have great potential to compensate for the disadvantages by being a key information source. The importance of social companionship in reducing the sense of insecurity and inconvenience caused by blurry vision after pupil dilation was also shared.

4.4.4 Service expectations

Apart from individual-level judgement, service-level judgement was also identified. Service expectations for eye examination were based on the participants' views of what they thought a "good healthcare provider" should be, with a tendency to use public health services to judge the service quality. Several attributes of the healthcare service (cost, doctor-patient relationship) experienced in public services were considered preferable. Participants in the lower socioeconomic bracket showed a greater reliance on public services despite long waiting times. Participants with poorer health would require more medical treatment services and therefore would have a greater financial burden to bear. It seems that the frequent encounter with

healthcare practitioners at the public services may have built a trusting relationship between service providers and the older adults. Participants shared that they “trust their doctors’ advice”. All these factors have some impact on the decision on whether or not to use the routine eye examination service.

The expectation includes not only the eye care service provider's calibre but also their price and location, all of which are related to the question of whether the service is valuable enough to warrant paying for and devoting time to access. The intention to use an eye examination could be further strengthened if a service was recommended by others who they trust. If ambiguous information was shared (e.g., mixed health recommendations or personal experience), then behavioural intention would reduce.

Although the participants were not certain about the service fee, when being asked how much he/she would pay for an eye examination, the acceptable service fee could range from HKD100 to HKD1000, varying by the participants’ socioeconomic status. The typical fee range for an eye examination is HKD 300 - 400. A comparison to other well-known and commonly used healthcare services, such as the price of a private doctor visit, was typically used to determine what was considered an "appropriate" price for an eye examination. This implies that the costs of prior service use were used as a baseline to assess the worth of funds spent on eye examination.

As for location, it was found that participants usually cited places that they were already familiar with, such as “near the hospital” or “near the elderly health centre”. The participants also shared the downside of their past health service experience in terms of transportation and the time required to travel and the long waiting time, and that reducing these barriers would improve the intention to use the routine eye examination.

Participants perceived higher intention to use the routine eye examination when the services are patient-centred, reducing the impression that an optometrist only cared about “selling the product” (e.g., expensive designer brand spectacles). In addition, they also believed that having appointment reminder would also improve service uptake.

4.5 Discussion

This chapter provides an explanation regarding the reasons for not using preventive eye examination for older adults in Hong Kong. More specifically, this study explored the potential

factors that contributed to a decision-making process that resulted in low intention to use the routine eye examination for Hong Kong older adults. It was found that participants were not familiar with the preventive eye examination compared to other healthcare services. This study captured the eye examination utilisation decision-making process of the participants, which was guided by their existing health-seeking habits reflected from their previous health service utilisation. The participants displayed a symptom-driven and socially cued needs appraisal process by adhering to their previous health behaviour routines. Due to low self-efficacy perceptions, unmet service expectations, and low perceived primary eye care needs, participants were less motivated to use the routine eye examination.

The low intention to use the routine eye examination can be explained by the difficulties in prioritising and including primary eye care needs into existing health service utilisation. Previous service utilisation serves as an anchor for judging needs and shaping service expectations. For example, comparing an eye examination to other existing preventive health programmes like vaccination and cancer screening programmes, which are fully subsidised and with sufficient information on service availability. This may explain why an eye examination is prioritised lower than other preventive health services (Liao et al., 2021; Mohd Rosnu et al., 2022). As the eye examination is not a prioritised service, despite having the health care voucher scheme, the limited voucher amount has been used to settle the service fees of other private services used by the participants, meaning it has little impact on encouraging eye examination use. A similar situation also occurs in primary oral care (Chan et al., 2021), suggesting the possibility of translating current findings to understanding access barriers of other primary healthcare services.

This study found that self-efficacy is influenced by health literacy, and by the participants' ability to overcome financial and physical barriers to access the service. Such ability to overcome barriers is not only affected by predisposing factors but the eventual decision to use the routine eye examination, to some extent, is shaped by the healthcare environment (Andersen & Newman, 2005). It is, therefore, not surprising to learn that some participants shared homogenous opinions and service expectations regarding eye examination utilisation in Hong Kong.

This study highlights the importance of social influences in changing needs appraisal and enhancing information dissemination, with missed opportunities identified at the community level to promote the routine eye examination, which were also found in studies conducted in

low- and middle-income regions (Lee et al., 2023; Yasmin & Schmidt, 2022). The lack of sufficient information dissemination through preferred information channels means that older adults are less likely to access the service actively. The participants believed improving information dissemination along with providing action-planning cues would improve their motivation to use the routine eye examination. Encouraging collaboration amongst pivotal stakeholders would be ideal. However, the practicability of suggestions must be considered, e.g., those involving public doctors are likely not to be feasible. This study found that involving community elderly centres would be a more workable option to facilitate service alignment to service expectations and more effective health education dissemination. The current findings reflect the importance of the practitioner-patient relationship in encouraging eye examination utilisation. Collaborating with elderly centres has several expected benefits, such as increasing health information dissemination and ease of service access. This may include inviting the optometrists to the community centres and delivering health educational talks with eye health-related information most relevant to older adults, along with service availability information. The immediate provision of action-planning cues after a health educational talk seems to help older adults make better health decisions. In doing so, this may better include primary eye care service into existing healthcare habits. A community-engagement intervention could be considered in future intervention design.

This study also identified barriers that were not mentioned in previous studies such as coping strategies reduce perceived needs, competing for healthcare needs and the influences of previous healthcare utilisation experience in decision-making, suggesting that some barriers to eye examination utilisation are context-based. For example, the coping strategies identified in this study, e.g., wearing reading glasses, were found to reduce participants' perceived need to use eye examination. This was not the case in studies conducted in other region (Shickle & Griffin, 2014). It was out of the scope of this study to investigate this factor. However, this difference suggests that it is important to consider the potential contextual differences when designing an intervention (Samuels et al., 2023).

4.5.1 Limitations

The sampling techniques which focused on community elderly centres may neglect other groups within the older adult population, such as those with physical disabilities (Chan & Yap, 2016). The findings obtained may not fully explain the utilisation behaviour of these groups, though similar barriers were found such as financial and knowledge barriers. Also, despite

efforts in recruiting participants with different demographic backgrounds, there were more female participants, and most participants were from the 70 -74 age group. Previous studies involving community elderly centres reported similar situation (Yu et al., 2022; Yu et al., 2020).

Another limitation is that this study only focused on the group that has not had a routine eye examination in the past 24 months. This may have neglected other factors that contribute to understanding eye examination utilisation as a whole, such as behavioural maintenance. Future research could undertake a longitudinal qualitative study to explore the decision-making process comprehensively (Tuthill et al., 2020). It would be helpful to also collect information related to the visual status before and after getting an eye examination and see if these factors influence behaviour maintenance.

4.5.2 Implications

Even though this study was conducted in Hong Kong, the findings provide a framework for the consideration of factors influencing the preventive eye examination uptake in other regions with a similar healthcare system to Hong Kong, or a healthcare service with similar function to an eye examination (Chan et al., 2021). The findings suggest a multi-disciplinary approach to promote regular eye examinations by targeting the three identified key factors (i.e., needs appraisal, perceived self-efficacy, and service expectations). There are two aspects that future intervention may target: 1) how to better integrate primary eye care into other existing and more familiar health services for older adults (Goodman et al., 2023); 2) how to exploit the benefit of the social environment for more effective information dissemination. These are useful information to support the development of intervention strategies to improve the uptake of preventive eye examination in the subsequent stage of this research project.

4.6 Chapter summary

Prior to this study, limited evidence was available to provide an explanation to why older adults have low motivation to use preventive eye examination. This study illustrated the components in the decision-making process that are relevant to the older adults. More importantly, the identified factors are modifiable, suggesting the possibility of altering the current behaviour with behaviour change intervention to encourage older adults to engage in preventive eye examination.

Chapter 5 The effectiveness of interventions to improve general health check uptake by the older adult population: a systematic review and meta-analysis

** The protocol of this systematic review has been uploaded as pre-print (Lau et al., 2021).*

- Lau, W. Y., Lian, J., & Yap, M. (2021). *What Are the Effective Behaviour Change Techniques Used to Improve General Health Check Attendance: A Systematic Review Protocol*. Retrieved 1 September 2021 from <https://doi.org/10.21203/rs.3.rs-509946/v1>

As of December 2024, the manuscript has been submitted for peer-review and were under revision.

5.1 Chapter overview

The literature review chapter (Chapter 2) revealed that previous studies have investigated a limited number of intervention strategies to improve the uptake of preventive eye examinations among older adults. Most evidence focused on providing health education to service users, which was consistently found to be ineffective when compared with a control group without educational elements. Further supported by the qualitative study of this thesis (Chapter 4) where factors identified were modifiable, it provided the rationale to develop intervention strategies to address the issue of suboptimal uptake of preventive eye examination, especially focusing on exploring strategies beyond health education provision.

According to the UK Medical Research Council guidance on intervention development, synthesising evidence of existing intervention can guide the researcher to decide if a new intervention should be developed or if the existing intervention should be adapted or modified to be implemented (Kathryn Skivington et al., 2021). However, considering there were limited intervention strategies available from the field of preventive eye examination, the evidence used to support intervention design should be supplemented by a preventive service that shares parallel functions with preventive eye examination.

This chapter reports the results from a systematic review of the effectiveness of interventions to improve general health check uptake by the older adult population. The systematic review search literature records published until June 2023 in four electronic databases. Before reporting the methods and results, the similarities between general health checks and preventive eye examinations are discussed to provide a rationale to ground the evidence based on general health checks. The findings reported in this chapter were used to inform the development of the intervention, especially its role in providing supporting evidence to justify the selection of BCTs in the proposed intervention.

5.2 General health check and Preventive comprehensive eye examination

Among the published literature, educational interventions were not effective in improving eye examination utilisation (Dan et al., 2015; Owsley et al., 2013); and one study reported amending the message tailoring to an individual or target at a group does not show a significant difference (Katibeh et al., 2020). These findings suggest that focusing merely on health educational components has limited effect on improving preventive eye examination utilisation behaviour of older adults. To further supplement the evidence used to inform the design later on, it is necessary to scope for evidence from a healthcare service that shares parallel functions.

A general health check was deemed to be an appropriate preventive service to serve as a proxy to preventive eye examination. Preventive eye examination describes the nature of an eye examination which includes a range of examination components to obtain an overall assessment of the visual well-being of an individual (American Optometric Association, n.d.). More importantly, what makes a preventive eye examination special is the inclusion of dilated eye examination which allows a detailed examination of the eye structure, an important step to identify early signs of age-related eye diseases (American Optometric Association, n.d.; National Academies of Sciences & Medicine, 2016). A list of examination components included in a preventive eye examination includes the following items (American Optometric Association, 2015; National Academies of Sciences & Medicine, 2016). A detailed eye examination is included though based on individual specific circumstances an optometrist may advise an individual not to dilate the eye to evaluate the fundus.

- Case history taking

- Vision acuity and refraction assessment
- Binocular vision assessment
- Intra-ocular pressure measurement
- Colour vision assessment
- Internal and external ocular health assessment
- Fundus examination
- Explanation of results and professional advice on follow-up options

On the other hand, general health checks are another type of preventive service that targets the overall health of the older adults, especially cardiovascular diseases. This service includes different examination components to obtain an overall physical health status of an individual. Undergoing general health check regularly are also recommended and the results from a general health check can also help to identify risk factors that may require further monitoring. As part of a general health check, it is also common to have included some forms of eye examination or vision screening.

Given the similarity of the preventive role in maintaining the health and well-being of an individual, a general health check was used as a proxy for comprehensive eye examination.

5.3 Background on general health check services

General health checks, as one of the preventive services, provide an overall physical examination of multiple risk factors of diseases and therefore allow timely modification of risky behaviour related to chronic illnesses and early disease detection (National Health Service, 2019b; Si et al., 2018).

Access to health check programme vary in different jurisdictions. Some require patients to pay out-of-pocket, while other patients could be benefited under national health insurance or fully subsidized by the government. A well-known universal health check programme, which has been widely researched, is NHS healthcare programme in the UK. It has been launched since April 2009, offering general health check services to individuals aged 40 to 75 years old with no pre-existing cardiovascular conditions. The latest statistics on the overall uptake rate for this health check programme is 52% (Riyaz et al., 2020). This programme has been estimated to contribute to improving health outcomes , such as reducing premature death and compressing

morbidity (Mytton et al., 2018). Further supported by the real-world evidence of the same programme, it has found that those engaged in general health checks had lower BMI, systolic blood pressure and proportion of smoking than the controls without receiving a health check (Alageel & Gulliford, 2019).

Despite the health benefit and cost-saving potential (Starfield et al., 2005), the uptake of general health checks remained relatively low, ranging from 43% to 48.2% among older people reported in different parts of the world (Brunner-Ziegler et al., 2013; Centre for Health Protection, 2017; Martin et al., 2018; NHS Digital, 2019). Clearly, there is room to accommodate additional strategies to improve the use of general health checks.

Previous systematic reviews have identified interventions that have been implemented at behavioural and organizational levels to improve health check uptake. However, the overall effectiveness of the interventions targeting older people is still not well known. A systematic review by Cheong et al. (2017) reported that using physician reminders, provision of financial incentives to patients (e.g. vouchers or free-of-charge service) and the involvement of dedicated personnel in delivering the service was effective in improving the uptake rate of risk factor screening for cardiovascular diseases in meta-analysis. However, diverse screening types with some solely focused on the screening for one single risk factor such as blood pressure were involved in the analysis. The review included trials involving interventions developed for different age ranges (e.g. 18 years or above versus 40 – 75 years), without stratifying the analysis for older people. Considering people of different ages may have different healthcare-seeking behaviour (Deeks et al., 2009), the effectiveness of these interventions on older people could not be determined and remains unknown.

Another systematic review focused on the factors and interventions influencing the uptake of the UK general health check program (Bunten et al., 2020), including two randomized controlled trials (RCTs), six cross-sectional studies and one cohort study. Given only two RCTs, the meta-analysis was not performed to provide quantitative evidence on the effectiveness of the interventions to improve the uptake. Instead, a narrative synthesis was used to descriptively summarize the findings from each study (Bunten et al., 2020).

Information about how an intervention works is important for external generalization of the findings when there is a plan to replicate the intervention in other healthcare settings. A realist review can answer a research question concerning why an intervention works or not, by

providing an explanatory account of the mechanism (who and how the intervention is designed) and the context in which the intervention was implemented to improve general health check uptake (Rycroft-Malone et al., 2012). A realist review of 12 studies published in 2013 synthesized the behavioural components in the interventions used to improve cardiovascular risk factors screening. This review identified three intervention components that could be used to improve uptake, including feedback, providing knowledge and increasing health-related dialogue (Holland et al., 2013). However, a more systematic way of categorizing these techniques is needed to facilitate future replication and generalizing to other healthcare settings. Since the publication of this review, a taxonomy was developed by Michie et al. (2013) – BCTTv1. This taxonomy has been used to characterize the intervention components, and findings have been used to enhance the understanding of the effectiveness and external generalization of the intervention (French et al., 2014).

This systematic review sought to answer two questions: “What is the overall effectiveness of interventions used to improve general health check uptake of older adults?” and “What are the behaviour change techniques used in these effective interventions?”.

This systematic review addresses part of the Objective 2 of this thesis, by providing the evidence to inform the development of theory and evidenced-based strategies to improve preventive eye examination uptake of older adults. Guided by the BCW framework and the need to evaluate the intervention design referring to the APEASE criteria, which one was concerning effectiveness, this systematic review specifically focused on first identifying the intervention types that were previously investigated. This was followed identifying the intervention components and associated intervention functions. The overall effectiveness of these intervention was also estimated providing evidence to select strategies to improve preventive eye examination uptake.

5.4 Methods

The reporting of the method section followed the PRISMA 2020 reporting guideline (Page, McKenzie, et al., 2021; Page, Moher, et al., 2021) (Appendix A1) This review protocol was registered on PROSPERO (ref: CRD42021221041) and uploaded as a pre-print elsewhere (Lau et al., 2021).

5.4.1 Eligibility Criteria

5.4.1.1 Inclusion criteria

This review only included studies that focused on the general health check service utilisation, which was defined as “a service that aims to look at the general risk factors of different diseases using several screening tests to assess the general health, but not health services that aim to detect a disease using a specific diagnostic test’ (Krogsbøll et al., 2019).

This review only interested in interventions that targeted the population inclusive of individuals aged 50 years or above and the outcome measurement must be the actual completion of general health checks. Although the current project focused on older adults aged 65 years or above, this review set the age criteria to including 50 years of age because this was usually the time when preventive services are being introduced to older adults. Setting such age criteria would reduce the chance of excluding potentially useful articles.

5.4.1.2 Exclusion criteria

In order to select general health check service that serve parallel function as preventive eye examinations, disease-specific health checks, such as those focused on cancer-screening were excluded. Studies that focused only on intention-related outcomes (e.g. intention or willingness to get a general health check) were excluded.

As this review aimed to identify RCTs that are associated with effective intervention, the study types of protocol, systematic review, conference paper and qualitative empirical studies were excluded.

5.4.2 Information sources

We searched four electronic databases that are relevant to social science, psychology, and healthcare (PubMed, PsychINFO, EMBASE and Web of Science).

A literature search was conducted on 19 August 2020 followed by two search updates which were conducted on 4 May 2021 and 1 June 2023, respectively.

5.4.3 Search strategy

A final decision on the search strategy was reached after modifying the search in light of the research team’s feedback and help from a university librarian.

Three main concepts were considered in the search strategy development: “general health”, “intervention” and “uptake”. Together with the alternative search terms, these key terms were combined into a search strategy and executed in four databases, respectively. No language or date limit was imposed on the search strategy. A full search strategy for each database can be found in Appendix A2. Below is a search strategy executed in PubMed.

```
((("general" AND "health check") OR "health check?" OR "health check" OR  
"preventive health check?" OR "medical checkup?" OR "medical check?" OR  
"comprehensive health check?") AND ("uptake" OR attend* OR participat* OR  
utili?ation OR adher* OR appointment?)) AND ("intervention" OR "strategy" OR  
"strategies" OR "method?" OR "technique?")
```

5.4.4 Study Selection

The PhD research student, who was the primary reviewers, executed the search strategy into the databases and imported the retrieved records into EndNote where duplicates were eliminated. Then the dataset was exported in Excel where the screening of title and attracts were performed. A coding scheme was established to record the reason for study exclusion (Appendix A3). Following the coding scheme listed order, two reviewers (the PhD research student and one research assistant) worked independently and performed the initial screening of titles and abstracts. Those records that passed the initial eligibility assessment were screened at full-text level to confirm the eligibility. For any inaccessible records, the PhD research student sought assistance from the university library service to retrieve records from the publisher. Irretrievable records were excluded.

Search records were updated again in May 2021 and June 2023. The record subtraction method in EndNote suggested by Bramer and Bain (2017) was adopted to identify any additional records that were not include in the previous search.

5.4.5 Data collection

The characteristics of the included studies were extracted by the first reviewer, and the accuracy of the result was checked by the second reviewer.

To identify the intervention component and the associated intervention, the BCTTv1 and the BCW were used. BCTTv1 is used characterize the intervention component with 93 BCTs could

be considered (a detailed discussion can be found elsewhere (Michie et al., 2013)). The intervention functions served by these BCTs were identified by mapping the BCT to the intervention functions of the BCW.

To identify the BCT incorporated in the intervention, two reviewers first received online-training to use the BCT taxonomy (BCT Taxonomy v1 Online Training, 2020). This online course focuses on instructing taxonomy users to identify relevant BCT based on a series of coding principles. More specifically, users would need to follow the definition of the BCTs to identify the intervention content (S. Michie et al., 2014; Michie et al., 2013). The BCT identification stage was independently done by two coders (the PhD research student and a research assistant). Each reviewer familiarised the intervention descriptions presented in the manuscript and supplementary materials (if there was any) through repeated reading. Then BCTs were identified according to the five coding principles (BCT Taxonomy v1 Online Training, 2020): 1) BCT would only be coded if it focused on the behaviour and the target group; 2) identify if there were different behaviour change types for the BCT (whether the BCT was targeted to the behaviour or the outcome); 3) looking for technical terms that are relevant to BCTTv1; 4) looking for action verbs used in intervention descriptions; 5) following the definition of each BCTs to code the presence of a BCT. Discrepancies were defined as a BCT being coded by one reviewer and not the other. Discrepancies were resolved by first referring to the coding principles and each reviewer would provide detailed explanation for coding or not coding a specific BCT. Both reviewers would consider all justifications to come to an agreement whether to accept the coded results.

Only the first reviewer identified the intervention functions in BCW. The mapping of intervention functions was based on the most frequently and least frequently used BCTs, as listed in S. Michie et al. (2014) guide.

5.4.6 Data items

The relevant study characteristics were extracted, that is population, intervention comparators and outcome, and details on the study design.

To avoid confusion on the use of terminology the intervention type referred to in the table describes the type of intervention strategy described by the authors (e.g. invitation letter, telephone invitation, questionnaire), while intervention functions are the terms specifically

referring to those included in the BCW which describes how the intervention can do to bring about behaviour change (e.g. education, persuasion, enablement).

5.4.7 Study risk of bias assessment

The Risk of Bias Tool by the Cochrane Review was used to assess the quality of the included RCTs (Higgins et al., 2011; Higgins et al., 2020). This tool assesses the bias arising from randomization, methodological deviation, outcome measurement, missing data, and selective reporting. Two reviewers assessed the study quality independently and provided each domain with a rating of either “low risk”, “high risk” or “unclear risk” accordingly. All judgements were supported by illustrative quotations. The judgments made by two reviewers were compared. The discrepancy was resolved between these two reviewers through discussion. The risk of bias illustrations was generated in RevMan5.

Publication bias would be investigated using funnel plot if there were sufficient studies (more than 10 studies) to do so (Sterne et al., 2011).

5.4.8 Synthesis of results

The plan for synthesizing the findings included performing a meta-analysis to estimate the overall effectiveness of the interventions. The study and intervention characteristics were narratively synthesized. The identified BCTs in terms of BCTTv1 were collated and presented in a table for better comparison.

5.4.8.1 Summary measures

A pairwise meta-analysis was conducted. If a RCT contained multiple trial arms, the intervention arms (of any intervention type) would be collapsed into a single intervention group to avoid unit-of-analysis error whereby the intervention groups have been compared more than one time (Borenstein et al., 2021; Rücker et al., 2017). A random-effect model (inverse-variance weighting) was considered to estimate the overall effect of the interventions if heterogeneity was observed across studies. Otherwise, a fixed-effect model would be used. The result for heterogeneity was reported with Q statistics and degree of freedom (*df*), along with the p-value and the 95% confidence intervals. I^2 statistics were also provided to illustrate the proportion of the true effect explained by the between-study variance rather than by chance (sampling error) (Deeks et al., 2020). If it was not possible to further investigate the factors

that may have contributed to the extent of heterogeneity, a descriptive discussion would be provided. The pooled summary effect was estimated in Excel and validated using RevMan 5. The forest plot was produced by RevMan5.

5.4.8.2 Subgroup analysis

If there were sufficient data that allow exploration of different intervention type, a subgroup analysis would be followed.

5.4.8.3 Sensitivity analysis

If there were evidence with a high risk of bias, sensitivity analysis would be performed to explore the influence of poor quality RCTs on the findings.

5.5 Results

5.5.1 Study Selection

The literature search was first performed in August 2020, and later two search updates were performed in May 2021 and June 2023 (Figure 5.1). The selection procedure and results are reported separately for all three literature searches below.

The initial literature search yielded 2268 records. After removing duplicate and performed preliminary screening of title and abstract, a total of 97 records were eligible for full-text screening. Seven RCTs were eligible for inclusion. However, two of them were records of the same study which were published in different formats; one as a detailed report (McDermott et al., 2016) and the other as an empirical research paper (McDermott et al., 2018). The report paper was included as it would provide more information to facilitate the understanding of the intervention design (McDermott et al., 2016). Six trials were included from the initial search (Gidlow et al., 2019; Gold et al., 2019; McDermott et al., 2016; Sallis et al., 2016b; Sallis, Gold, et al., 2019a; Sallis, Sherlock, et al., 2019).

The first updated search (May 2021) yielded a total of 2443 records. After removing duplicates in EndNote, 233 records with the publication year of 2020 onwards were extracted and the title and abstract were screened. Nine studies were screened at full-text level. Of the nine, one record was eligible for inclusion (Sallis et al., 2021) but was eventually excluded. This record was a

duplicate of a journal article that was already included in the initial search, which was an advance access article published in 2019 (Sallis, Gold, et al., 2019a).

The second search update in June 2023, which screened the records with a publication year of 2021 onwards. After screening 450 record with a publication year of 2021 onwards, 12 records were screened at full-text level. Eventually, the second search update found two relevant RCTs (Gold et al., 2021; Shimoda et al., 2022).

At the end, eight RCTs were included in this review (Gidlow et al., 2019; Gold et al., 2019; Gold et al., 2021; McDermott et al., 2016; Sallis et al., 2016b; Sallis, Gold, et al., 2019a; Sallis, Sherlock, et al., 2019; Shimoda et al., 2022).

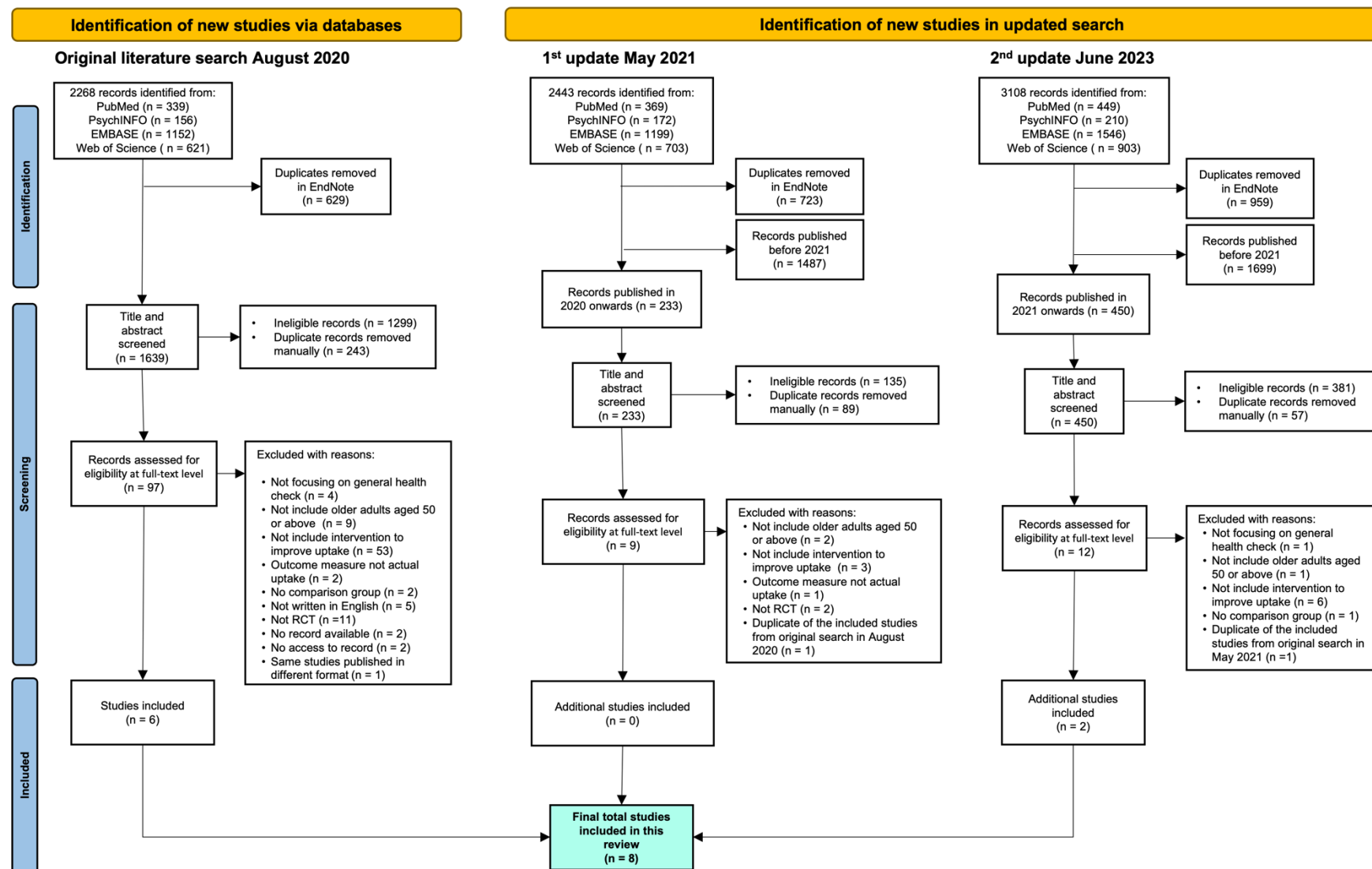


Figure 5.1 PRISMA flowchart

5.5.2 Study characteristics

Table 5.1 shows the characteristics of the included RCTs. Of the eight included RCTs, three were two-armed RCTs (Gold et al., 2021; Sallis et al., 2016a; Shimoda et al., 2022), four were three-armed RCTs (Gidlow et al., 2019; Gold et al., 2019; McDermott et al., 2016; Sallis, Gold, et al., 2019b), and one was a mixed-factorial RCT (Sallis, Sherlock, et al., 2019).

A total of 78,353 participants were included. These participants were either from the UK or Japan. The participants from the UK NHS health check programme were recruited from a range of general practices around the UK, who were aged 40 to 74 years, with no previously identified cardiovascular condition were eligible participants. For the participants of the Japanese study, the eligible people of the Specific Health check-up programme were included. Although this programme targets those aged 40 to 74 years, the included participants in the trial were those of 40 – 64 years, who have not conducted a health check by December 2016 and who are also a dependent of an insured person. The authors highlighted the decision was motivated to target groups that had lower participation rate who were dependents of the insurer (Shimoda et al., 2022).

The service provision of the two general health check programmes varied in payment amount, with the NHS Health Check being fully subsidized by the government for eligible individual (National Health Service, 2019a), and general health checks in Japan included in this review requires co-payment (Shimoda et al., 2022).

Of the eight RCTs, seven considered full completion of a health check as the primary outcome (Gidlow et al., 2019; Gold et al., 2019; McDermott et al., 2016; Sallis, Gold, et al., 2019b; Sallis, Sherlock, et al., 2019; Shimoda et al., 2022), and one trial defined the primary outcome as the completion of both the NHS health check and blood test, which included completion of a blood test before or after the health check (Sallis et al., 2016a). The primary outcome was recorded at various time intervals, ranging from one month after the receipt of the invitation letter (Shimoda et al., 2022) to within the trial period which can last for 15 months (Sallis, Sherlock, et al., 2019).

Table 5.1 Study characteristics of included studies

Author/ Year	Country	RCT design	Control group (n)	Intervention group(s) (n)	Theory used ^a	Outcome measurement	Uptake rate(s), %
Gidlow et al. (2019)	UK	Three-arm	<ul style="list-style-type: none"> Standard letter (n = 1454) 	<ul style="list-style-type: none"> Telephone invitation (n = 1167) Risk-personal personalised letter (n = 1993) 	Not mentioned	NHSHC attendance within the 12-month trial	<ol style="list-style-type: none"> Standard letter (control), 30.9% Telephone invitation, 47.6% Risk-personalised letter, 31.3%
Gold et al. (2019)	UK	Double-blinded RCT, Three-arm	<ul style="list-style-type: none"> Standard letter (n = 3677) 	<ul style="list-style-type: none"> Loss-framed leaflet (n = 3664) Gain-framed leaflet (n = 3697) 	Prospect theory	NHSHC attendance by November 2018 (around five months)	<ol style="list-style-type: none"> Standard letter (control), 17.6% Loss-framed leaflet, 17.4% Gain-framed leaflet, 18.2%
Gold et al. (2021) (Gold et al., 2021)	UK	Pseudo-RCT, Two-arm	<ul style="list-style-type: none"> No prompt to clinical staff (n = 3778) 	<ul style="list-style-type: none"> Point-of-care computerised prompt (n = 3786) 	Not mentioned	NHSHC attendance six weeks after the intervention implementation (by 28 August 2015)	<ol style="list-style-type: none"> No prompt (control), 7.4% Point-of-care computerised prompt, 12.0%
McDermott et al. (2016)	UK	Three-arm	<ul style="list-style-type: none"> Standard invitation letter (n = 4095) 	<ul style="list-style-type: none"> QBE questionnaire (n = 3988) QBE questionnaire + financial incentive (n = 3969) 	Theory of planned behaviour	NHSHC attendance within 6 months of receipt of invitation letter	<ol style="list-style-type: none"> Standard invitation (control), 14.4% QBE questionnaire, 15.8% QBE questionnaire + financial incentive, 15.8%
Sallis et al. (2016)	UK	Pragmatic-quasi RCT, Two-arm	<ul style="list-style-type: none"> Standard invitation letter (n = 1755) 	<ul style="list-style-type: none"> Enhanced invitation letter (n = 1756) 	Not explicitly mentioned, but focused on a range of behavioural insights	NHSHC attendance during the trial period (specific time frame was not mentioned, subjects were people who were eligible for an NHS health check in 2023 - 2024)	<ol style="list-style-type: none"> Standard invitation (control), 29.3% Enhanced invitation letter, 33.5%
Sallis, Gold et al. (2019) (Sallis, Gold, et al., 2019a)	UK	Three-arm	<ul style="list-style-type: none"> Standard invitation letter (n = 2123) 	<ul style="list-style-type: none"> Sunk-cost letter (n = 2105) Counter-argument letter (n = 2085) 	Protection motivation theory; Health belief model; Sunk cost effect; Loss aversion	NHSHC attendance by 12 weeks (after 31 January 2015)	<ol style="list-style-type: none"> Standard invitation letter (control), 34.2% Sunk-cost letter, 38.5% Counter-argument letter, 39.7%

Sallis, Sherlock, et al. (2019) ^b	UK	Double-blinded mixed-factorial RCT	<p>The control arm was without pre-notification SMS, control invitation letter, without reminder SMS.</p> <ul style="list-style-type: none"> NoPre_CO_NoRem (n = 814) 	<p>The mixed factorial design resulted in 15 intervention conditions. The combination described followed the pattern: with or without prenotification sent via SMS + the type of letter + with or without reminder sent via SMS.</p> <ol style="list-style-type: none"> NoPre_OE_NoRem (n = 724) NoPre_TL_NoRem (n = 747) NoPre_SN_NoRem (n = 800) NoPre_CO_Rem (n = 885) NoPre_OE_Rem (n = 692) NoPre_TL_Rem (n = 754) NoPre_SN_Rem (n = 723) Pre_CO_NoRem (n = 783) Pre_OE_NoRem (n = 765) Pre_TL_NoRem (n = 761) Pre_SN_NoRem (n = 754) Pre_CO_Rem (n = 803) Pre_OE_Rem (n = 727) Pre_TL_Rem (n = 734) Pre_SN_Rem (n = 778) 	Not mentioned	NHSHC attendance (results were based on attendance recorded between 5 December 2014 and 2 March 2015)	<ol style="list-style-type: none"> NoPre_CO_NoRem (control), 18.2% Intervention uptakes ranged from 19.9% to 30.0% NoPre_OE_NoRem, 23.1% NoPre_TL_NoRem, 21.2% NoPre_SN_NoRem, 19.9% NoPre_CO_Rem, 23.7% NoPre_OE_Rem, 28.0% NoPre_TL_Rem, 26.9% NoPre_SN_Rem, 24.3% Pre_CO_NoRem, 21.5% Pre_OE_NoRem, 26.7% Pre_TL_NoRem, 25.9% Pre_SN_NoRem, 23.7% Pre_CO_Rem, 23.9% Pre_OE_Rem, 24.6% Pre_TL_Rem, 30.0% Pre_SN_Rem, 24.4%
Shimoda et al. (2022)	Japan	Two-arm	<ul style="list-style-type: none"> Template postal reminder (include a website link listing all available clinics) (n = 10543) 	<ul style="list-style-type: none"> Tailored postal reminder (with the information of the nearest clinics tailored for each participant) (n = 10474) 	Not mentioned	Attendance of the health check service provided by an insurance association within one month of the receipt of a postal reminder	<ol style="list-style-type: none"> Template postal reminder (control), 2.1% Tailored Postal reminder, 3.2%

RCT = randomised controlled trial; UK = United Kingdom; NHSHC = National Health Service Health Check; QBE = question-behaviour-effect; SMS = short message service.

^a The theory used in the intervention was identified from the discussion of the rationale for developing the intervention in the introduction or methods section of the published article.

^b An example of the intervention arm reported in Sallis et al. [38] using without pre-notification, with Open-ended and with reminder is denoted as NoPre_OE_Rem. The abbreviations used to refer to the intervention components were as follows. Pre = pre-notification; NoPre = no pre-notification; CO = control letter; OE = open-ended letter; TL = time-limited letter; SN = social norms letter; Rem = reminder; NoRem = no reminder

5.5.3 Intervention characteristics

Nine intervention types were identified, including postal invitation letter (Gidlow et al., 2019; Sallis et al., 2016a; Sallis, Gold, et al., 2019b; Sallis, Sherlock, et al., 2019); telephone invitation (Gidlow et al., 2019); question-behaviour-effect questionnaire (McDermott et al., 2016); financial incentive (McDermott et al., 2016); leaflet (Gold et al., 2019); pre-notification (Sallis, Sherlock, et al., 2019) reminder SMS (Sallis, Sherlock, et al., 2019), point-of-care automated prompts to clinical staff (Gold et al., 2021) and postal reminder letter (Shimoda et al., 2022). Intervention development of the identified interventions was theory- and evidence-based. Several theories have been explicitly stated that guided the intervention development process such as the Theory of Planned Behaviour (McDermott et al., 2016), Protection motivation theory and Health belief model (Sallis, Gold, et al., 2019b), Prospect Theory (Gold et al., 2019), and other economic concepts such as sunk-cost fallacy and loss aversion (Sallis, Gold, et al., 2019b).

The chosen locations for implementing the intervention were mainly based on the available invitation system/ information technology system facilitating intervention implementation (Gidlow et al., 2019; Gold et al., 2019; Sallis et al., 2016a; Sallis, Gold, et al., 2019b; Sallis, Sherlock, et al., 2019), or the location/ specific group of people that were found to have a low uptake rate (McDermott et al., 2016; Shimoda et al., 2022). Shimoda et al. (2022). included dependents of the health insurers. studied the region in London which had a lower than national average uptake rate (McDermott et al., 2016; Shimoda et al., 2022).

For the UK trials, the control arms involved the standard invitation methods by sending out the invitation letter (NHS national template). For the factorial trials, the control arm was the absence of prenotification and SMS reminder, and with a control letter (national letter template) (Sallis, Sherlock, et al., 2019). The results from Sallis, Sherlock, et al. (2019) have been used to inform the change of content in the national template. The effectiveness of the revised invitation letter was supported by the Sallis, Sherlock, et al. (2019) findings published, using data collected between 2013 and 2014. The revised invitation letter was used in two of the included RCTs as the control arm (Sallis et al., 2016a; Sallis, Gold, et al., 2019b).

For Shimoda et al. (2022), which was conducted in Japan, the control arm was a standard postal reminder which included a list of available clinics for the participants to choose from. The

intervention arm included information on the closest available service location determined by the address of the recipient.

The criteria for classifying as a non-attender differed among the trials. The reminders to attend the health check were sent to participants in some studies before they were classified as non-attenders, but the time could vary between eight (Sallis, Gold, et al., 2019b) and twelve weeks (McDermott et al., 2016) after the first invitation letter was sent out. In other intervention types, such as the telephone invitation, the general practices staff could make up to three phone calls before considering the case as non-attender (Gidlow et al., 2019).

5.5.4 Identification of behaviour change techniques and intervention functions

Fifteen BCTs were identified across the seven intervention types, accounting for 16.1% (15/93) of the available BCTs from the BCTTv1 (Table 5.2). No BCTs were identified in two intervention types: pre-notification and reminders given the limited description of the intervention. A full list of the identified BCTs in each study and illustrative quotations are stated in the Appendix A4.

These 15 BCTs have been used to target increasing knowledge, social support, and motivation to use general health checks. The 15 BCTs can be mapped to seven different intervention functions in terms of the BCW, namely, education, persuasion, coercion, incentivization, training, environmental restructuring, and enablement (Appendix A5).

Table 5.2 Summary of BCTs identified in the included studies

Study (Year)	Intervention(s)	Behaviour Change Technique(s) ^a														
		1.4	3.1	4.1	5.1	5.3	5.5	6.2	6.3	7.1	9.1	9.3	10.1	13.2	13.3	15.1
Gidlow et al. (2019)	Telephone invitation		x		x					x						
	Risk-personalized letters				x											
Gold et al. (2019)	Loss-framed leaflet				x	x		x	x			x		x		x
	Gain-framed leaflet				x	x		x	x					x		
Gold et al. (2021)	Point-of-care computerised prompt to clinical staff		x													
McDermott et al. (2016)	QBE questionnaire						x								x	
	QBE questionnaire + financial incentive						x						x		x	
Sallis et al. (2016)	Enhanced invitation letter ^b	x								x						
Sallis, Gold et al. (2019) (Sallis, Gold, et al., 2019a)	Sunk-cost letter			x						x						
	Counterargument letter			x	x						x			x		
Sallis, Sherlock et al. (2019)	Open-ended letter ^b	x		x						x						
	Time-limited letter ^b	x		x						x						
	Social-norm letter ^b			x				x								
	Pre-notification SMS ^c															
	Reminder SMS			x												
Shimoda et al. (2022)	Tailored postal reminder	x														

SMS = short message service.

^a In the Behaviour Change Technique Taxonomy (version 1), each behaviour change technique has been assigned a number. This table reports the corresponding number to the behaviour change technique. The full name for each identified BCT is provided as follows. 1.4 = Action planning; 3.1 = Social support (unspecified); 4.1 = Instruction on how to perform the behaviour; 5.1 = Information about health consequences; 5.3 = Information about social and environmental consequences; 5.5 = Anticipated regret; 6.2 = Social comparison; 6.3 = Information about others' approval; 7.1 = Prompts/ cues; 9.1 = Credible sources; 9.3 = Comparative imagining of future outcomes; 10.1 = Material reward (behaviour); 13.2 = Framing/ reframing; 13.3 = Incompatible belief; 15.1 = Verbal persuasion about capability

^b The BCTs used in the intervention have already been characterised by the authors themselves.

^c There was insufficient information to code the intervention content for this intervention.

5.5.5 Risk of bias

The risk of bias evaluation with illustrative quotations can be found in the Appendix A6. The risk of bias graph and risk of bias summary are shown in Figure 5.2 and Figure 5.3, respectively. All studies demonstrated good randomization except two RCTs. One RCT did not clearly report how randomization was achieved (only stated “individual patient randomisation”) and therefore was rated as “unclear risk” for random sequence generation (Gidlow et al., 2019). The other RCT was rated with a potential high risk of selection bias as random sequence were generated by surnames of the patients which was not a true randomisation (Sallis et al., 2016b).

Almost all the studies demonstrated good allocation concealment. Only one RCTs could not conceal the allocation from the researchers (Gold et al., 2021). This was due to IT restriction regarding how the letters were sent out to the patients. To overcome the restrictions, the researchers were involved in “*devising an allocation sequence*”, so the researcher would have been aware of the allocation arrangement (Gold et al., 2021).

Four RCTs were rated with a potential high risk of bias in blinding of participants and personnel component. Reasons for that included intervention characteristics was obvious that it was impossible to blind the participants (McDermott et al., 2016) and the personnel who delivered the intervention (Gidlow et al., 2019; Gold et al., 2021; Shimoda et al., 2022).

For blinding of outcome assessor, only one RCT did not describe how the outcome measurement was handled. In Sallis et al. (2016b), there was no information provided on how the outcome were extracted. It was unsure if any potential bias would be introduced from the data extraction stage.

Five RCTs reported incomplete outcome data for various reasons.

- Gold et al. (2021) reported randomisation was not performed correctly for 225 participants and these participants were excluded after the randomisation stage.
- Two RCTs reported excluding participants after errors in delivering the interventions were found. Sallis, Sherlock, et al. (2019) reported participants were identified with invalid mobile phone numbers after randomisation and therefore the participant were excluded as the intervention could not be delivered. Gold et al. (2019) reported that errors were made in delivering the control/ intervention materials, which had led to the exclusion of data from the analysis stage.

- Two RCTs reported that data were lost, or potentially lost due factors observed from the personnel side. Gidlow et al. (2019) reported that 1415 patients were excluded from the analysis as the general practice did not follow the protocol fully. Gold et al. (2021) reported that two out of 15 participated practices reported zero health check attendance. The potential reasons were suspected but were not explored further.
- Sallis, Gold, et al. (2019a) reported that ethnicity was missing in the data collected. Considering there was a systematic difference on the main outcome, with more non-attendees did not have this variable recorded than the attendee, this information was not included in the analysis.

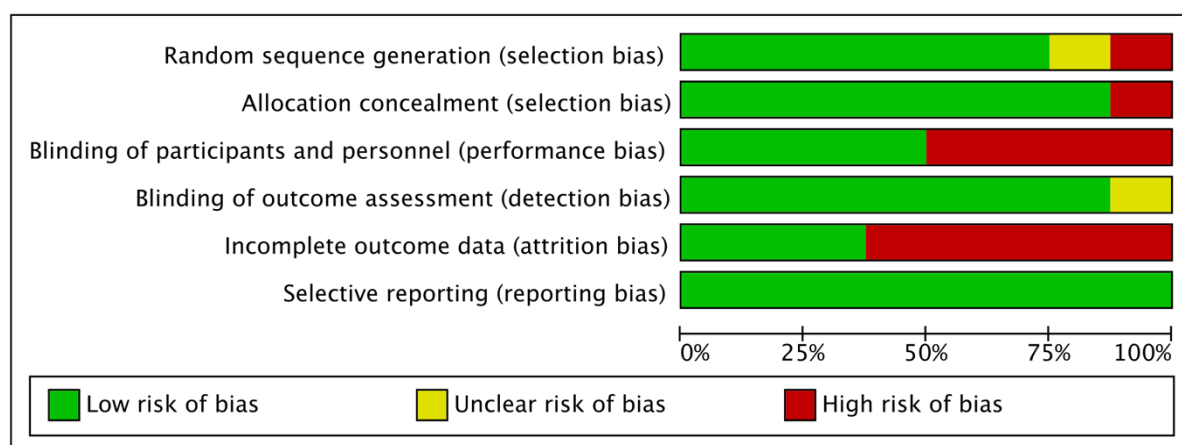


Figure 5.2 Risk of bias graph

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)
Gidlow et al 2019	?	+	-	+	-	+
Gold et al 2019	+	+	+	+	-	+
Gold et al 2021	+	-	-	+	-	+
McDermott et al 2016	+	+	-	+	+	+
Sallis, Gold, et al 2019	+	+	+	+	-	+
Sallis, Sherlock, et al 2019	+	+	+	+	-	+
Sallis et al 2016	-	+	+	?	+	+
Shimoda et al 2022	+	+	-	+	+	+

Figure 5.3 Risk of bias summary

5.5.6 Synthesis of results

The intervention arms reported by individual studies that were significantly more effective than the control arm to improve general health check uptake include risk-personalized letters (Gidlow et al., 2019), telephone calls (Gidlow et al., 2019), behavioural-insight enhanced invitation letters (Sallis et al., 2016a; Sallis, Gold, et al., 2019b; Sallis, Sherlock, et al., 2019), point-of-care prompts (Gold et al., 2021) and postal reminder letter (Shimoda et al., 2022). As for the factorial RCT, 11 of the comparison arms were significantly more effective. Specifically, it was reported that those intervention arms with SMS reminders were found to significantly increase general health check uptake. Leaflets were not effective in improving general health check uptake (Gold et al., 2019).

5.5.7 Meta-analysis

All uptake outcome data were available for all trials. A random-effect meta-analysis using inverse-variance weighting was used to estimate the summary effect, assuming there was a different true effect amongst studies given the different identified intervention types. A total of 78,353 participants were included in the meta-analysis. The overall pooled effect size suggested the interventions were effective in improving the uptake rate of the general health check, with an odds ratio of 1.30 with a 95% confidence interval between 1.15 to 1.46. (Figure 5.4). There is evidence of heterogeneity and was found that 84% of the variation was caused by variation across studies and not by random sampling error ($df = 7$, $p < 0.00$, $I^2 = 84\%$). However, there were not enough studies to explore the heterogeneity. In the absence of further investigation, the direction of the intervention effect of individual studies was reviewed (Deeks et al., 2020). six out of eight studies were statistically effective in improving general health check uptake, which is aligned with the direction of the summary effect estimate.

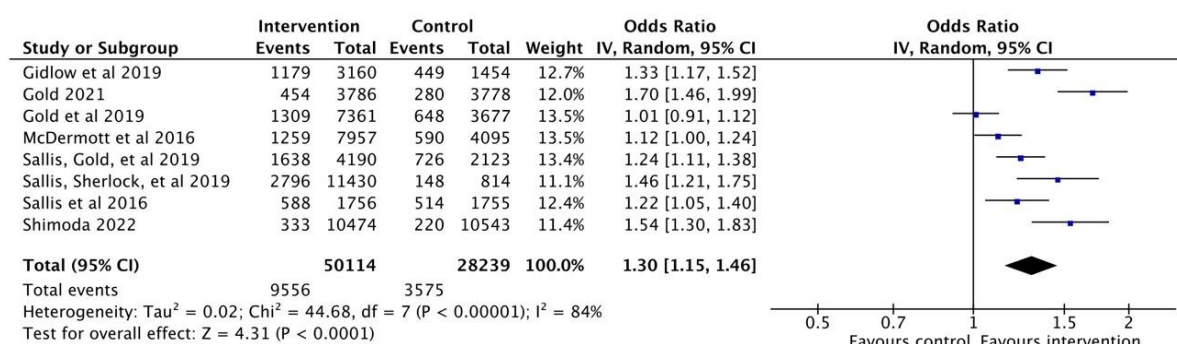


Figure 5.4 Meta-analysis results

5.5.8 Subgroup analysis

No subgroup analysis was conducted as limited studies and intervention types were identified in this review.

5.5.9 Sensitivity analysis

No specific RCTs reported high risk of bias in all domains. Sensitivity analysis was not performed to explore the potential impact of risk of bias on the results.

5.6 Discussion

This chapter reports a systematic review focused on the interventions to improve general health check uptake and synthesized the best available evidence to determine the overall effectiveness of the interventions to improve general health check uptake. It also provided the evidence to understand how these interventions increase service uptake by identifying the associated BCTs with these intervention types. Eight RCTs were included in this review. The current evidence suggests that interventions have been considered in the invitation stage to improve general health checks, including a range of enhanced invitation letters, telephone invitations, question-behaviour-effect questionnaires, financial incentives, leaflets, pre-notification, and reminders of different and opportunistic invitations using computer prompts. Furthermore, based on the meta-analysis results, the existing interventions were significantly more effective than the control condition in improving general health check uptake, with the leaflet being insignificant to improve general health check uptake. This implies that the rest of the identified interventions could be considered in future intervention designs to improve general health check uptake of the older population. As general health checks share parallel functions with preventive eye examination, the results have values in supplementing the evidence base for intervention to improve preventive eye examination uptake.

Despite the interventions being effective in improving the general health check uptake, the uptake reported in these eight RCTs was reported lower than 50%. The usual uptake rate in the UK was around 45% - 50% (Tanner et al., 2022). Service uptake rate can be influenced by multiple factors, such as the characteristics of the intervention recipients and geographic locations. Age has been frequently identified as a factor that influence general health check uptake (Dryden et al., 2012). It was observed that from the included studies in this review, there are more people from the younger age groups than in the older age group, this may explain the below-average uptake rate observed across these individual trials. Another issue that arises from this review is how the individual who received the intervention makes sense of the behaviour change technique. Future studies could be conducted to understand this question to provide possible explanations for the intervention's effectiveness to improve general health checks (Miles et al., 2022) and explore other strategies to improve service uptake.

Other strategies could be considered to improve general health check uptake but were not included in this review given the non-RCT study design. For example, an observational study analysed previous general health check uptake in Japan (Murayama et al., 2021) and found that

the removal of out-of-pocket payment was more likely to attract people to use general health checks. More specifically, this strategy was more useful for people from the older age group than the younger age group (Murayama et al., 2021). In the UK, there are discussions on other possible strategy includes delivering the health check service at community pharmacies (Acharya et al., 2019; McNaughton et al., 2011). But given the difficulties in implementing these strategies, they were yet to be tested in the RCTs.

Identifying the BCTs of an intervention help explain the variation observed in service uptake across these trials. For instance, telephone invitations and point-of-care prompts both involved clinical staff to initiate the invitation. Social support is the BCT commonly identified in these two intervention types, suggesting the benefit of social factors in influencing service uptake. In contrast, the receipts of the invitation letter relied on the participants to call back for an appointment. Although it is still effective, it may lead to lower effectiveness when compared to telephone invitations. On the other hand, the use of prompts and cues in invitation letters is effective if such cues and prompts were displayed in their surrounding environment, such as on the fridge.

Even when a BCT was identified in two intervention types, there was also a difference in the information provided and was varied between UK and Japan. For the UK, the action planning cues include the date and time to attend the appointment while in Shimoda et al. (2022) study, it involved providing the available service provider that is nearest to the participant. It reflects that while the same BCT was identified, the content provided could be different. The main differences in this were whether the service was provided free-of-charge. It was reasonable to provide service availability for the participants to choose from.

It was also noticed that the identified intervention types were mainly text-based and there are also different forms involved postal, computer prompts and reminders that utilised specific services to calculate personalised messages for indicating the service closest to the participants. Given the various setting and intervention modes, future studies would benefit from understanding the cost-effectiveness of these BCTs in improving service uptake.

High heterogeneity although was found in this meta-analysis, it was anticipated given the type of intervention types was not limited to specific type. Following the Cochrane review handbook guidance, we explored the potential reasons for high heterogeneity and the attempt to address the high heterogeneity in the analysis (Deeks et al., 2020). Regarding clinical heterogeneity,

there were obvious variations in the intervention types and intervention content which were all included in the same analysis. There were some variations in the age range of the included participants. Some studies included more participants from a younger age group, e.g. below age 50. As for the methodological heterogeneity, there were slight differences in the data extraction method. Most studies extracted the general health check completion records from an electronic system, while some studies provided no information regarding this aspect. Another noticeable difference was the classification of outcome measurement. While five trials defined outcome as the full completion of a general health check, one trial considered the completion of both the blood test and general health check as a full NHSHC attendance. The difference was that the latter required the subjects to attend two separate sessions and the blood test was taken in a different order across the four practices in that trial (e.g. the blood test session was either scheduled before or after the general health check session) (Sallis et al., 2016a). The author highlighted that this could be a potential hurdle for the people as they would require extra effort to attend both sessions. However, as the main objective of that trial was not focused on investigating the effect of the timing of blood test taken on general health check uptake, there was no information on the proportion of people who only attended one session (either blood test or general health check). It cannot be certain if the timing of the blood test taken would influence the uptake rate and therefore the effectiveness of the intervention on increasing general health check uptake. A random-effect meta-analysis was performed to obtain an overall effect estimate given the findings on the heterogeneity. However, due to the small number of included studies, subgroup analysis and meta-regression analysis as suggested by the guidance cannot be performed. No studies were excluded from the meta-analysis due to a high risk of bias or obvious outlying results. Therefore, this systematic review provided useful information to understand the overall effectiveness of these behavioural interventions to increase general health check uptake as the main objective, but the variations in the effectiveness by different intervention types remain to be explored when more studies are available in the future.

5.6.1 Limitations

Apart from the high heterogeneity, some other limitations of the review are identified. First, the number of RCTs yielded may be limited by the search strategy, for example including those published in English only. Second, the majority of the RCTs were conducted in the UK, where the NHS is a publicly funded healthcare system in which there is no direct financial barrier to receiving service. Therefore, it could be argued that, from a healthcare-level perspective, the

findings of BCTs and intervention types may not be generalizable to other healthcare systems that impose a user fee for service (Acharya et al., 2019) or have a different health insurance policy (Murayama et al., 2021). The inclusion of the Japanese study revealed while the intervention type could be similar to the one implemented in the UK (i.e., text-based intervention reminder letter in the Japanese study and enhanced invitation letter in the UK studies), the strategy included were different. For example, the UK invitation letter focuses on providing the appointment date and time, while the Japanese study provided information on service availability. It may be useful to explore in future studies how BCTs can be tailored to suit different contexts and how would this impact the effectiveness in improving general health check uptake.

The small number of included studies has limited further investigation of the reasons for high heterogeneity and the potential publication bias. Despite recognising the importance of these analyses in result interpretation, it is not recommended to perform further analysis when there are less than ten included studies as the power will not be sufficient to provide reliable results (Sterne et al., 2011). The conclusion of the overall effectiveness of these interventions used to improve general health checks would be weakened. However, most of the interventions identified in this review were associated with significant improvement in general health check uptake and so the BCTs included in those intervention types could be considered in future intervention design and warrant further investigation.

5.6.2 Implication

The results could be generalizable to a setting where the general health check service is delivered systematically to the population or a healthcare system with an established invitation system. The findings also suggest that when developing an intervention one must consider the contextual differences, for example, whether the service is fully subsidized.

Although the identified interventions can significantly improve the uptake rate, a wider range of intervention types could be considered as the current review found few published interventions, such as those implemented beyond the invitation stage. For example, future studies could address how interventions targeting other factors such as service delivery or health communication (a detailed description of all the possible influences can be found in the Atkins et al. (2020) review), might improve general health check uptake; and whether

combining invitation methods, such as the provision of clinical service information on the letter, with other interventions have additive effects on the uptake rate.

5.6.3 What can we learn from general health check services and what else are still lacking?

Considering general health checks share parallel functions with preventive eye examinations, the findings obtained from this review can be used to supplement the evidence base to support the intervention design decision. Although the findings have provided supporting evidence for the application of intervention strategies, the type of intervention identified was limited to invitation methods. Multiple factors were found to influence preventive eye examination behaviour (Lau et al., 2024). This implies that enhancing invitation methods alone may not be comprehensive enough to improve the service uptake. Furthermore, considering the implementation scenario of the included RCT involved a fully subsidised general health check, the findings on the effectiveness of these RCTs may not be fully translated to the Hong Kong scenario where there is no fully subsidized eye examination programme. The findings from this systematic review have addressed the effectiveness aspects of the APEASE criteria somewhat. To ensure the appropriateness of including these techniques, other factors such as the acceptability and practicability of the intervention strategies should be investigated.

5.7 Chapter Summary

This chapter describes the results of a systematic review on intervention to improve general health check service. The findings were used to supplement the lack of evidence for preventive eye examination. The findings in Chapter 4 provided the necessary evidence to justify and supplement evidence used to support the intervention design for improving preventive eye examination for older adults, especially on the intervention type and BCTs used among these interventions.

Chapter 6 Using the Behaviour Change Wheel to develop an intervention to improve regular uptake of eye examinations by elderly centre members

6.1 Chapter overview

In Chapter 5, the decision-making process of older adult to use preventive eye examination was explored. Several key barriers were found to influence their perception of the need to utilise the service, their confidence in accessing the service. In addition, older adults also hold expectations of service delivery which were yet to be fulfilled. Together this has led to the difficulties to prioritise preventive eye health among the on-going healthcare needs.

This chapter demonstrates a systematic approach to develop intervention strategies that can address these barriers. The anticipated result was the proposal of theory-driven and evidence-based strategies to encourage the older adults to use the preventive eye examination in Hong Kong. The development process was informed by the Behaviour Change Wheel (BCW) framework. The finalised theory-and evidence-based strategies were informed by the evidence obtained from systematic reviews (from general health check and diabetic retinopathy screening) and supplemented by advisory group discussions.

The intervention proposed targeted at increasing psychological capability, social opportunity, physical opportunity, reflective motivation, and automatic motivation to encourage the older adults to use preventive eye examination regularly. The finalised intervention strategy require effort from both service provider and elderly centre to empower the older adults to engage in preventive eye examination.

6.2 Background

With the lack of qualitative evidence, it was unclear how intervention should be designed to improve the uptake of preventive eye examination by the older adults in Hong Kong. Therefore, a qualitative study was conducted to explore the decision-making process to use eye

examination of the Hong Kong older adults (Lau et al., 2023), which was reported in Chapter 5 of this thesis. The findings suggested that older adults were not prioritizing preventive eye examination, especially when most elders had other health care needs to address. A range of psychological and external factors were found to have prevented them from using preventive eye examination. Older adults perceived low need for preventive eye care. They also encountered difficulties in accessing the service due to low perceived self-efficacy of service utilisation. The motivation of the older adults to engage in preventive eye examination was lowered with the unmet service expectation. These factors could be altered with behaviour change intervention.

Behaviour change intervention describes intervention that are designed to encourage or inhibit specific behaviour with a hope to bring about a more ideal health behaviour. Developing health behaviour intervention require iterative steps before the intervention can be implemented. The first stage is intervention development. This stage is an important stage and, if done properly, the intervention being developed would have a higher likelihood of being effective in achieving behaviour change.

To take a holistic approach to understand the options of intervention that could be considered, this study utilised the Capability-Opportunity-Motivation Behaviour (COM-B) model and the BCW framework to guide the intervention development process. The COM-B model was part of the BCW framework which were designed to facilitate a systematic and comprehensive approach to intervention development. The BCW framework was selected as an overarching framework for two main reasons. First, this approach can avoid the researcher from overlooking other potential useful strategies by understanding the behavioural drivers that influencing factors to eye examination utilisation behaviour using the COM-B model. Second, the BCW allowed researchers to link the evidence collected from the COM-B analysis to a range of theoretically effective intervention designs. The BCW framework was also designed to link with an intervention characterisation system called the Behaviour Change Techniques Taxonomy (BCTTv1). Together, using these behavioural frameworks ensure the comprehensiveness of options being proposed and the transparency of reporting of intervention components. This, in turn, would have benefitted future investigation on the intervention effectiveness. The subsequent part of this chapter discusses the methods and findings of the intervention development stage.

6.3 Aims and objectives

The goal of the intervention development was to bring forward strategies that could be considered to improve uptake of preventive eye examination by the older adults. This part of the project addresses **Objective 2** of this thesis.

The specific objectives to be addressed in this chapter were:

1. To conduct a deductive analysis using the COM-B model to identify the nature of barriers reported in the decision-making process of the older adults (Chapter 5).
2. To identify the theoretically effective intervention functions that could be considered to address the barrier to preventive eye examination uptake.
3. To propose the intervention strategy to encourage the older adults to use preventive eye examination.

6.4 Methods

This study has been approved by the Hong Kong Polytechnic University Institutional Review Board (reference number: HSEARS20210422005-01).

Informed by the qualitative evidence obtained in Chapter 5, the intervention development process was guided by the eight-step intervention development procedure detailed in S. Michie et al. (2014). Apart from theory-driven and evidence-based development process, the stakeholder involvement was also valued to ensure the strategies are aligned with the acceptability of the stakeholder. With this, an advisory group was set up which consisted of service researchers, optometrists (service provider), elderly centre staff and older adults (service user).

The BCW-guided intervention development process would have produced an extensive list of potentially useful intervention opinions and BCTs (S. Michie et al., 2014; Michie et al., 2011). To narrow down the list, the opinions from the relevant stakeholders were also sought (S. Michie et al., 2014). The advisory groups were involved to ensure the identified design components were appropriate for implementation in the context of improving eye examination by the older adults in Hong Kong. Figure 6.1 illustrates the relevant chapters and the contribution from advisory group that were used to inform the intervention development.

6.4.1 Recruitment of advisory group

All the advisory members were recruited through convenient sampling. They were interviewed separately to learn about their opinions and views on the preliminary intervention proposal. Two members were board of optometric association, who were identified by the supervisor and recruited through convenient sampling to collect their thoughts and sought their insight about the proposed intervention strategy.

General older adult population was recruited from the Hong Kong Polytechnic University Research Centre for Gerontology and Family studies (formerly known as Institute of Active Ageing “IAA”). The reason for recruiting from IAA was based on the consideration that the volunteers were involved in elderly activities and would be willingness to voice their opinions. Two volunteers aged 65 years or above were interviewed. One volunteer attended an in-person discussion, and the other was a phone discussion.

Staff from two elderly centres which agreed to participate in the qualitative study were invited for a discussion on the preliminary proposal to receive their feedback and suggestions on the strategy that perceived to be useful to encourage older adults to undergo an eye examination. As the intervention included involvement from the elderly centre, the aim of arranging these discussion sessions were to check whether the strategies listed would perceive to be effective from their understanding of the centre members and whether it would be practical to be considered from the perspective of the elderly centre. These two elderly centres were approached through email and phone call. The discussion was held through zoom and phone discussion, respectively. Throughout all discussion sessions, notes were taken by the research student (WYL), who summarised the notes were and discussed the findings with the supervisors to finalise the intervention strategy.

The preliminary intervention strategy proposal was sent to the advisory group members (Appendix C1). The optometrists involved in the discussion of all the strategies. A slightly modified version of the components was sent to the older adults by highlighting the points that are relevant to the service user (Appendix C2). This was done to ease the reading of the document ass the interviewed individuals were older adults. The strategies related to the service provider were not discussed with the older adults.

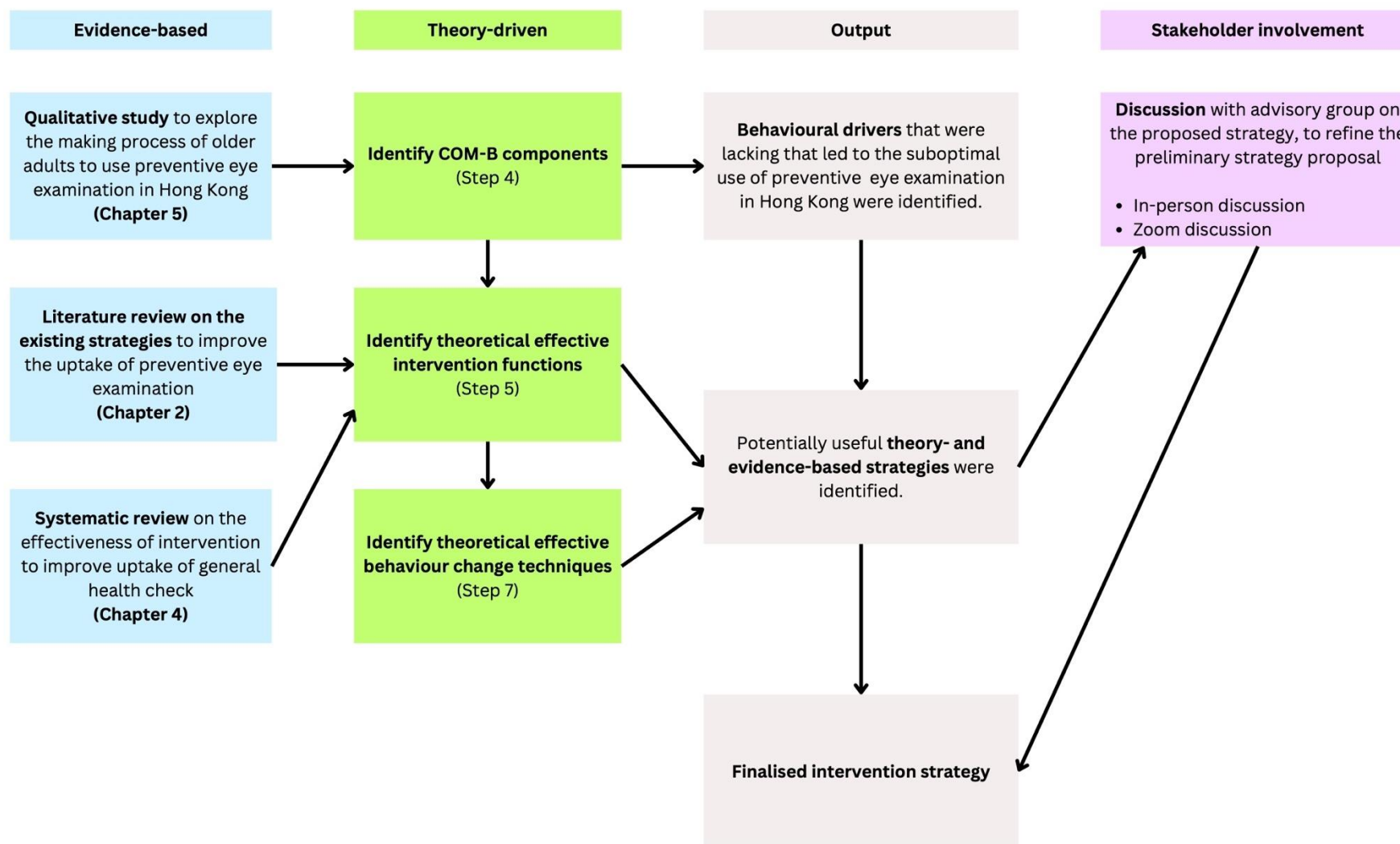


Figure 6.1 Linking previous thesis chapters to the key steps of BCW to develop the intervention strategy

6.4.2 Intervention development context

Understanding the implementation context is crucial for intervention development (Kathryn Skivington et al., 2021). To facilitate later interpretation of the results, a brief description on the context in which the intervention was designed was provided.

The intervention was intended to be implemented in Hong Kong, where preventive eye examination is provided in the private sector where out-of-pocket payment is required. The service fee is known to vary by service providers.

Also, the intervention designed would require the involvement of elderly centres. Based on the latest available official statistics updated on 29 December 2023, there are 173 of elderly centres within the 18 districts in Hong Kong (Social Welfare Department, 2024). These elderly centres aimed to “create a caring environment” for the elderly people in the community by providing various activities, including “providing health education, volunteer development”, and “provision of information on community resources and referral services” (Social Welfare Department, 2021). While it is common that adults aged 65 years or above are considered an “older adult” in Hong Kong, the eligible criteria for registering for the elderly centre membership are individual aged 60 years old or above (Social Welfare Department, 2021).

6.4.3 A BCW-informed intervention development process

The BCW framework was used to identify intervention strategies to improve eye examination. The qualitative study provided the data to support the analysis of behavioural drivers to preventive eye examination utilisation behaviour under the Hong Kong local context. The findings were described in terms of COM-B model components which allowed further identification of intervention functions and the relevant policy categories for implementation options in terms of BCW framework. Other framework such as the Theoretical Domain Framework (TDF) was used to provide greater details to describe the nature of the behaviour (Cane et al., 2012). The BCTTv1 was used to characteristic the description of the intervention strategy components.

Figure 6.2 shows the eight-step approach to intervention development, which can be grouped under three stages (Michie et al. 2014, p.31): understand the behaviour (Step 1 – 4), identify intervention options (Step 5 – 6) and identify content and implementation options (Step 7 – 8). Throughout the intervention development process, decisions were made regarding the

inclusion and exclusion of identified suggested intervention options and implementation options. The **APEASE** criteria was introduced by S. Michie et al. (2014). It highlights that the appropriateness of any intervention did not depend on **effectiveness** alone, but other factors as well. Additional factors to consider would be whether it was **practicable, acceptable, and affordable and cost-effective** to be implemented in a context. It also asked whether there would be any **side-effect, safety issues** of implementing the proposed intervention.

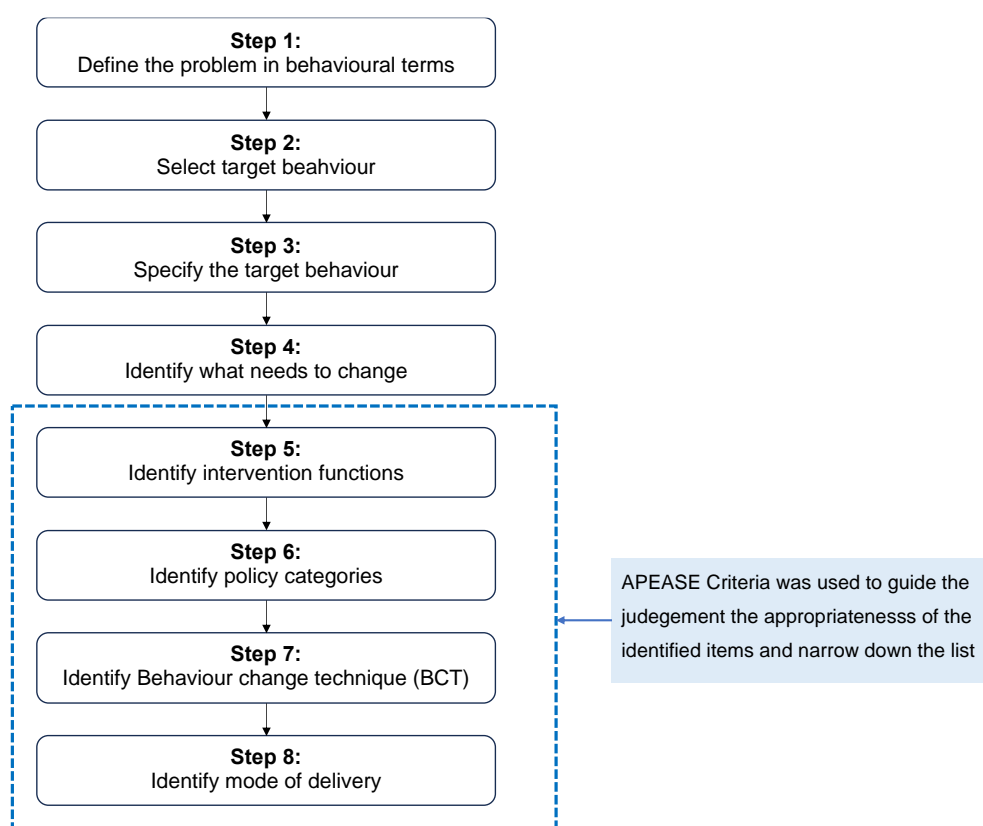


Figure 6.2 A BCW-informed intervention development process

6.4.3.1 Step 1 – 3: Define the problem in behavioural terms, select and specify the behaviour

This step involved defining a behaviour target that could address the health problem. This served as the rationale for developing a new intervention. The health problem was defined specifically by indicating the target group, the specific behaviour required for behaviour occurrence and the necessary context in which the behaviour was performed. A list of candidate

behaviour can influence the occurrence of the target behaviour (i.e. older adults to undergo eye examination regularly). The behaviour was specified in terms of six criteria: “who”, “what”, “when”, “where”, how often’ and “with whom”.

Considering there was a clear research objective to target at the use of eye examination by the older adults in Hong Kong, Step 1 to Step 3 (which allowed the researcher to brainstorm the list of behaviour that were important to carry out the intended behaviour) was of peripheral to the design process. However, appreciating the need for transparent reporting of the development processes, Step 1 to Step 3 were provided in the result section.

6.4.3.2 Step 4: Identify what need to change

This stage involved using the COM-B model to analyse the qualitative study to understand the behaviour drivers to use eye examination by the older adults. To further supplement the theoretical understanding, the TDF was also used to further supplement the analysis.

According to the practical design guide, COM-B can be used as the first step to identify the major components of the behaviour drivers, while TDF can be used to supplement to provide a specific domain for the intervention target (Cane et al., 2012; S. Michie et al., 2014).

The analysis was based on the qualitative study described in Chapter 5 (Lau et al., 2023). This was done by mapping the COM-B components to all the 14 sub-themes, then the domains of the TDF were further identified. Before mapping, the PhD research student reviewed the manuscript again to familiarise with the data. Then, the mapping of behavioural drivers was followed. Mapping was completed by the PhD research student alone. To ensure research quality, the subthemes were identified independently by a researcher. Discussion with a supervisor was followed to confirm the appropriateness of the mapping results. Any discrepancies were resolved through discussion. After the findings of the COM-B was finalised, the relevant TDF was followed to supplement the detailed focus for the intervention. This stage was completed by the PhD research student.

The results obtained from Step 4 were then used in Step 5 – Step 8 to identify relevant intervention functions and behaviour change techniques.

6.4.3.3 Step 5: Identify intervention functions

The identification of the intervention functions followed the suggested intervention-COM-B linkage identified in the guide (S. Michie et al., 2014, p. 150). Following to the definitions provided in the guide (S. Michie et al., 2014, pp. 259-283), WYL also evaluated the appropriateness of including the intervention functions. The APEASE criteria was used to evaluate the feasibility to consider specific strategy. During this stage, it was noticed that not all the criteria could be supported by empirical evidence. Of these six criteria, two indicators stood out, which are practicability and acceptability. These two indicators can be judged by the research student supplemented with the opinions and suggestions obtained from the advisory group members who have the experience with working with older adults (elderly centre staff), familiar with the service provision (optometrists) and were also the target of the service user (older adults). The other indicators such as effectiveness, cost-effectiveness was difficult to judge given the lack of empirical evidence. Nonetheless, effectiveness of behaviour change techniques that are associated with the effective intervention could be obtained from other service that share parallel function as preventive eye examination. Safety and side-effect of the intervention strategy were less of a concern for the current proposed intervention strategy.

A literature search was conducted in PubMed to identify if there were any existing systematic reviews focused on intervention to improve preventive eye examination. As there was no systematic review available, a systematic review was conducted to identify intervention used to improve general health check uptake (Chapter 5). The findings were used to supplement the judgement of the selected intervention components in this project.

The results were recorded in an Excel file. To identify the intervention functions, intervention function that were not relevant for the specific context was labelled as “not relevant”; and those that are relevant but have little practicability were labelled as “not practical”. Those that are considered appropriate was labelled as “Yes”. A detailed mapping results with APEASE criteria can be found in the Appendix C3.

6.4.3.4 Step 6: Policy categories

In this intervention development, policy categories were not the key focus, and it is out of the scope of the current study to make judgement on the implementation at policy level.

Nonetheless, to facilitate future discussion on the potential policy implication, the potential policy categories was also identified using the matrix published in S. Michie et al. (2014).

6.4.3.5 Step 7 and Step 8: Identify Behaviour Change Technique and mode of delivery

As there were an extensive list of BCTs for consideration (93 BCTs was listed in BCT taxonomy) and that not all BCTs was relevant for the selected intervention, the list would have to be narrowed down. This was achieved in twofold. First, as recommended by the guide, the most frequently used BCTs was considered, followed by the less frequently used BCTs (S. Michie et al., 2014, pp. 151-155). The research student followed the definition of each BCTs to judge whether it would be relevant in the context of improving eye examination, then the potential effectiveness of improving preventive eye examination uptake by the older adults was considered. Although there was no study that specifically evaluate the BCTs used in intervention to improve comprehensive eye examination, an existing systematic review which included BCTs used in intervention to improve the uptake of diabetic retinopathy screening (Lawrenson, Graham-Rowe, Lorencatto, Burr, et al., 2018) and general health check (Chapter 5) were considered.

The identified BCTs were collated into a strategy summary which was used to discuss with the advisory group (researchers, optometrists, elderly centre staff and older adults). Results were tabulated and narratively discussed.

6.4.4 Advisory group discussion

Results from the advisor group were organised by the PhD research student. Discussions were initiated by the research students with a specific focus on ensuring acceptability, and practicability. The open-ended discussions were followed to allow advisory group members to discuss their thoughts and supplement their thinking freely. Each of the strategies was discussed with the advisory group members, notes were collated after the meeting.

The findings were presented in a tabulated format. The findings were presented narratively and discussed in terms of the APEASE criteria.

6.4.5 Results

6.4.6 Step 1 – 3: Define the problem in behavioural term, select and specify behaviour

The problem of visual impairment influencing older adults are well documented in the literature. The decision to target at this problem was motivated by evidence of significant of vision loss and the benefit of regular eye examination in detecting vision problem. As describe in Chapter 1, avoidable visual impairment is an international and local public health issues. as reflected by a suboptimal statistics of regular eye examination utilisation by the older adults reported (Sum et al., 2022). Yet, there are very few strategies that have been considered effective to improve the uptake of preventive eye examination. To maintain the visual health of older adults, early detection of any abnormalities or detection of change in refractive error is need. The most effective way to obtain an overall visual health evaluation is undergoing a preventive eye examination. This service is provided by Part I Optometrists in Hong Kong. The behaviour to be addressed in this project is the problem of “suboptimal utilisation of preventive eye examination of community-dwelling older adult aged 65 years or above in Hong Kong”.

There was a clear rationale to address the suboptimal use of preventive eye examination by the older adults in Hong Kong. Undergoing an eye examination is seen as an effective way to engage in regular visual health monitoring. Targeting this behaviour will have a spill-over effect as after an eye examination was conducted, patients will be recommended by the Part I optometrist on the behaviour that would help them maintain eyesight. So, targeting at the uptake of preventive eye examination as a behavioural target will have an impact on their follow-up behaviour that would be relevant to maintain their eyesight. Ideally, for older adults who are not under secondary or tertiary eye care, they should seek the regular preventive eye examination from Part I Optometrists every one to two years to monitor their visual health.

6.4.7 Step 4: Identify what need to change

As described in Chapter 5 (qualitative study), three key themes were found led to low motivation to seek regular eye examination, all of which were influenced by the key theme of previous health seeking behaviour. All the themes highlighted in the qualitative study were mapped to the COM-B components accordingly (Table 6.1). The mapping revealed that there was deficit in behavioural drivers, which impacted the need appraisal, perceived self-efficacy and the service expectation. All the COM-B components except physical capability was

identified. The COM-B analysis revealed that older adults lacked five behavioural drivers that is psychological capability, social opportunity and physical opportunity and have low automatic and reflective motivation.

Table 6.1 Mapping qualitative findings to COM-B components

Themes	Sub-themes	Capability		Opportunity		Motivation	
		Psychological	Physical	Social	Physical	Reflective	Automatic
Previous healthcare utilisation	1. Symptom-driven and externally cued health seeking behaviour			x		x	
	2. Greater reliance on the public health sector			x	x	x	
	3. Health care expenditure as financial burden				x		
Need appraisal	4. Symptom-driven preventive eye care needs	x				x	x
	5. Social influences on preventive eye care need perception			x		x	
	6. Limited understanding of the significance of preventive eye care	x				x	
	7. Competing with other healthcare needs					x	
Perceived self-efficacy of service utilisation	8. Concern over service fee for preventive eye care	x		x	x	x	
	9. Limited information on service availability	x					
	10. Limited social support			x			
	11. Limited health literacy	x		x			
Service expectation	12. Perceived qualities of a good vision care provider: patient-centred service and competence			x		x	
	13. Acceptable service fee				x		
	14. Accessible location					x	

6.4.8 Step 5: Identify intervention functions

Based on the mapping results, the suggested theoretically useful intervention functions were Education, Persuasion, Incentivisation, Training, Environmental restructuring, Modelling and Enablement (Table 6.2). Of the nine intervention functions, only restriction and coercion were

not considered as it was not relevant to the context of encouraging the uptake of preventive eye examination. Although the qualitative study found that there are competing healthcare needs the older adults would need to take action to maintain health, this type of healthcare seeking behaviour should not be restricted or should not be linked with any negative association. This treatment-seeking behaviours are their right and therefore Restriction and Coercion were not deemed to be relevant and appropriate to be included in the strategy.

Table 6.2 Suggested intervention functions guided by BCW

Themes/ Sub-themes from qualitative study	COM-B Components	Education	Persuasion	Incentivisation	Coercion	Training	Restriction	Environmental Restructuring	Modelling	Enablement
Previous healthcare utilisation										
1. Symptom-driven and externally cued health seeking behaviour	Reflective motivation	x	x	x	x					
	Social opportunity						x	x	x	x
2. Greater reliance on the public health sector	Reflective motivation	x	x	x	x					
	Physical opportunity					x	x	x		x
	Social opportunity						x	x	x	x
3. Health care expenditure as financial burden	Physical opportunity					x	x	x		x
Need appraisal										
4. Symptom-driven preventive eye care needs	Reflective motivation	x	x	x	x					
	Automatic motivation		x	x	x	x		x	x	x
	Psychological capability	x				x				x
5. Social influences on preventive eye care need perception	Social opportunity						x	x	x	x
	Reflective motivation	x	x	x	x					
6. Limited understanding of the significance of preventive eye care	Psychological capability	x				x				x
	Reflective motivation	x	x	x	x					
7. Competing with other healthcare needs	Reflective motivation	x	x	x	x					
Perceived self-efficacy of service utilisation										
8. Concern over service fee for preventive eye care	Psychological capability	x				x				x
	Social opportunity						x	x	x	x
	Physical opportunity					x	x	x		x
	Reflective motivation	x	x	x	x					
9. Limited information on service availability	Psychological capability	x				x				x
10. Limited social support	Social opportunity						x	x	x	x
11. Limited health literacy	Psychological capability	x				x				x
	Social opportunity						x	x	x	x
Service expectation										
12. Perceived qualities of a good vision care provider: patient-centred service and competence	Social opportunity						x	x	x	x
	Reflective motivation	x	x	x	x					
	Automatic motivation		x	x	x	x		x	x	x
13. Acceptable service fee	Physical opportunity					x	x	x		x
14. Accessible location	Reflective motivation	x	x	x	x					

After excluding the components that were highly unlikely to be targeted, i.e. sub-themes identified in previous healthcare utilisation. Table 6.3 shows the frequency of intervention function being identified across all sub-themes. Education have been identified with highest frequency, suggesting its importance in educating the older adults about the importance of

preventive eye care their role in maintain eyesight, as well as providing them with appropriate service-related information for them to better judge their ability to seek help. This was followed by Enablement, highlighting an enabling and empowering environment should be considered to facilitate the strategy to improve psychological capability and opportunity to seek preventive eye care service. Considering techniques that could effectively persuade the older adult to use the eye examination service have also been identified. Training providing to elders to empower them seek service could also be considered. Restructuring the environment to allow more exposure to opportunity to seek preventive eye care should also be considered. Creating incentivisation to encourage older adults could be considered. Training the older adults to seek relevant information and ways to access the service could also be considered.

The intervention options can be implemented in policy levels were communication and market, establishing guideline, improving regulation, improving environmental and or social planning and service provision. Of the seven policy categories, fiscal measure and legislation was not relevant. Fiscal measures include “reducing or increasing financial cost through taxation”. It was not relevant to create negative association with preventive eye examination uptake. For legislation, it was not relevant in this context.

Table 6.3 Frequency of feasible intervention functions being identified across all sub-themes (N = 48)

Suggested Intervention function	Frequency
Education	15
Enablement	12
Persuasion	7
Environmental restructuring	6
Training	4
Incentivisation	3
Modelling	1

6.4.9 Selecting behaviour change techniques

A total of 29 BCTs and 15 BCTs were identified from systematic review of DR screening uptake and general health check uptake, respectively. Table 6.4 shows theoretically effective BCTs with the supported proven evidence in general health check literature.

Table 6.4 Evidence-based BCTs identified in general health check and diabetic retinopathy screening literature

Intervention	BCT(s)	Usage ^a	Evidence-based ^b
Education	Feedback on behaviour	Most	DRS
	Information about health consequences	Most	DRS, HC
	Information about social and environmental consequences	Most	DRS, HC
	Prompts/ cues	Most	DRS, HC
	Information about others' approval	Less	DRS, HC
	Self-monitoring of outcome(s) of behaviour	Less	DRS
Persuasion	Credible source	Most	DRS, HC
	Feedback on behaviour	Most	DRS
	Information about health consequences	Most	DRS, HC
	Information about social and environmental consequences	Most	DRS, HC
	Framing/ reframing	Less	HC
	Information about others' approval	Less	DRS, HC
	Salience of consequences	Less	DRS
	Social comparison	Less	DRS, HC
	Verbal persuasion about capability	Less	HC
Incentivisation	Feedback on behaviour	Most	DRS
	Commitment	Less	DRS
	Self-monitoring of outcome(s) of behaviour	Less	DRS
	Social reward	Less	DRS
Environmental restructuring	Adding objects to the environment	Most	DRS
	Prompts/ cues	Most	DRS, HC
	Restructuring the physical environment	Most	DRS
	Restructuring the social environment	Less	DRS
Modelling	Demonstration of the behaviour	Most	DRS
Training	Behavioural practice/rehearsal	Most	DRS
	Demonstration of the behaviour	Most	DRS
	Instruction on how to perform a behaviour	Most	DRS, HC
	Graded tasks	Less	DRS
	Self-monitoring of outcome(s) of behaviour	Less	DRS
Enablement	Action planning	Most	DRS, HC
	Adding objects to the environment	Most	DRS
	Goal setting (behaviour)	Most	DRS
	Goal setting (outcome)	Most	DRS
	Problem solving	Most	DRS
	Restructuring the physical environment	Most	DRS
	Review behaviour goal(s)	Most	DRS
	Social support (practical)	Most	DRS
	Social support (unspecified)	Most	DRS, HC
	Anticipated regret	Less	HC
	Commitment	Less	DRS

	Comparative imagining of future outcomes	Less	HC
	Framing/ reframing	Less	HC
	Graded tasks	Less	DRS
	Incompatible beliefs	Less	HC
	Restructuring the social environment	Less	DRS
	Salience of consequences	Less	DRS
	Self-monitoring of outcome(s) of behaviour	Less	DRS
	Social support (emotional)	Less	DRS
	Verbal persuasion about capability	Less	HC

BCT = behaviour change technique; DRS = diabetic retinopathy screening; HC = health check; Most = most frequently used BCT for an intervention function; Less = less frequently used BCT for an intervention function.

^a This refers to whether the BCT(s) are most frequently or less frequently used for the corresponding intervention function.

^b Evidence was based on a systematic review on intervention to improve DRS attendance and an unpublished systematic review on intervention to improve general health check uptake.

6.5 A summary of the preliminary intervention strategy

After having shortlisted all the possible intervention functions and the behaviour change techniques, the next stage involves organising these techniques into an intervention strategy (Appendix C1).

This intervention intended to encourage the use of eye examination by the older adults under a system that can link service provider and service users under the help of elderly centre. To create an enabling environment that can empower the elders to seek regular eye examination, there are four components that can be considered. This intervention aims to improve psychological capability, opportunity, and motivation of the community-dwelling older adults. While financial barrier has been a major perceived barrier reducing the confidence of older adult in accessing the service, opportunity was identified, with the help of BCW that creating an enabling environment can reduce other perceived barriers that were perceived to be barriers to seeking information. Creating an enabling environment to empower older adults to equip with the necessary information and expose to social support that can provide information that needed to improve psychological capability.

6.6 Feedback from advisory group discussion

Overall, advisory group members were supportive of the proposed intervention strategies to improve the uptake of preventive eye examinations. All members agreed that service providers and elderly centres could work together to provide a more enabling environment to encourage

older adults' preventive eye examination behaviour. Below is the feedback on the key intervention components listed in the preliminary proposal. The original planning for the advisory discussion was to focus on exploring the acceptability, and practicability of the intervention strategies. The perceived effectiveness and affordability of the intervention strategies were also discussed by the advisory group members.

6.6.1 Community optometrist network

Both the service provider and service users agreed that community optometry network would be an acceptable and practical strategies (Table 6.5). However, the way service is provided by the service provider would depend on the company's operation mode. From the perspective of the service provider, no significant barriers were perceived. The elderly centre staff was supportive of this idea as they shared that health promotion activities were rare over the past years. They believed the establishment of the community optometrist network working closely with the elderly centre would be useful and welcomed by the elderly centre staff and elderly centre members

Table 6.5 Feedback summary regarding establishing community optometrist network

Anonymised advisory group member	Comments were relevant to the following aspect(s):				Comment(s)
	Acceptable	Practical	Effective	Affordable	
A, public health researcher (male)	△		△		In order to implement this strategy, it would rely on the interest of the service provider and the elderly centre – whether they would be interested in such programme. What were the incentive for these parties to engage in this programme? Suggestion: consult service provider.
B, optometry researcher (male)		△			As this would be a community-engagement programme, the proposal should include individual activities that would allow stakeholders to interpret their role and activities required.
C, senior optometrist, clinic-in-charge (female)	✓	△			It is possible to carry out these activities with optometrist. However, the feasibility of implementing these strategies would depend on the company mode- some are one-man so their schedule would be more flexible and may be more available in the morning. There are incentives to take part in these activities.
D, senior optometrist (male)	✓	✓			Being part of the association, we are happy to provide the support and potential networking opportunities to facilitate future discussion on intervention implementation. The proposed strategies align with the vision of the association which is to promote primary eye care.
E, senior optometrist (female)	✓	✓	✓		Acceptable strategies and potentially effective ones. I think the strategy would be more focused on those aged 65 years or above and make good use of elderly centre that may address some of the barriers perceived by the older adults in accessing the service.
F, older adult (male)	✓		△		Agreed that this will be important to build trust between service provider and service user. It would be better if the service can be provided in a more integrated manner, avoiding unnecessary multiple visits.
G, older adult (female)	✓				Agreed that it would be useful.
H, elderly centre staff (male)	✓	✓			There were some activities regarding eye care previously, but it was very rare. For our centre, we only collected brief information about their eye disease(s) when they registered their membership. It would be great if we have more activities held.
I, elderly centre staff (female)	✓				Agreed it would be useful as there are very few activities provided by the optometrists.

✓ = agreed; x = disagree, considered removing or amending the content; △ = agreed, with suggestions provided.

6.6.2 Service provision: service fee, service mode, location

Strategies proposed regarding service provision received the most comments (Table 6.6). It was observed that there were discrepancies in the way service user, and service provider. It was perceived to be unacceptable to ask older adults to pay for an eye examination for HKD 400. The elderly centre staff also perceived it would be not accepted by the elders as it was unlikely that elders could afford to pay HKD 400 for an eye examination. Elderly centre staff believed that services that were higher than HKD 100 would not attract the interest of the elders. The elderly centre staff believed that unless the service is provided free of charge (i.e. service fee being fully funded or subsidised), such strategies in reducing service fee to a more affordable range may have little success in improving the service uptake. Older adults shared that strategies that could proactively encourage them to access the service are needed. Reminding them of the entitled eligibility to use healthcare vouchers to cover the payment was also shared. One older adult shared that as the elderly mainly relied on the public health system, there could be a chance that they did not know healthcare vouchers and the usage eligibility for eye examination services. As for the service provider, while the service cost varied in the market, a reference service fee could be quoted that might be possible to consider was providing the preventive eye examination at HKD 150. This cost was aligned with the services that were currently provided in the District Health Centre. For Part I optometrist, the eye examination they provide should not be “free” as stated in their code of practice. However, it could be subsidized. These are practical considerations that were not aware by the older adults from the advisory group, nor from the interviewees of the qualitative study.

Two service modes were discussed: mobile service provided at the elderly centre or eye examination provided at the community optometric clinics or optical stores. For older adults, the main comment was concerning the convenience. One older adult shared that it is rare for older adults to seek eye examination service let alone requiring them to travel to the clinic themselves. It was suggested that offering transportation to the clinic may increase their motivation to seek such service. He believed that with the help of the elderly centre, the arrangement of transportation should be feasible, though it would be up to the clinic whether they had the availability to accommodate a group of older adults.

On the other hand, elderly centre staff believed that the location of the centre normally cannot accommodate having equipment that allows comprehensive eye examinations to be undertaken. They believed, however, that having transportation arranged may face certain logistic

difficulties. For example, the arrangement of transportation depends on whether there are sufficient elderly members to join the activities on certain days, usually the number of elderly would be limited. Unlike the older adults, the centre staff believed that the elderly might not opposed to the idea of having to travel, given the eligibility for the government-funded public transportation concession scheme where the elderly aged 60 years or above pay HKD2 per trip.

From the service provider perspective, there could be difficulties in providing specific services for the older adults in the mobile service and the service provided may not be as “comprehensive” as those provided in the clinics. This means that there could be a chance that some users might require a second visit to the clinic to receive the necessary examination assessment as advised by the service provider. This was not preferred by the older adults as they would prefer to receive all the services at one location. The sustainability of the service is a factor to consider. Providing an eye examination in the form of mobile service with the equipment transported to specific elderly centres might be a possible idea but depends on the centre venue availability to accommodate all the equipment and whether there would be available funding to purchase equipment to conduct comprehensive eye examination. Nonetheless, mobile service is still considered a possible option that is worth investigating.

Table 6.6 Feedback summary regarding service provision

Anonymised advisory group member	Comments were relevant to the following aspect(s):				Comment(s)
	Acceptable	Practical	Effective	Affordable	
A, public health researcher (male)	X				Words related to providing service being “free” is inappropriate. Optometrist will need to comply with code of practice (point 5.4 of code of practice)
B, optometry researcher (male)	X	△		△	We don’t know what would consider an “affordable” price for older adults. The word “voucher” should not be used as eye examination are considered professional services which required payment.
C, senior optometrist, clinic-in-charge (female)	✓	△		✓	<ul style="list-style-type: none"> • Mobile service is possible option, however, it would depend on the available resources. Some centres may only be able to do simple vision screening. • The use of word “voucher” should be retrained as we cannot provide “free” service. Subsidized would be a better terminology. • The eye examination fee varied by service provider – how affordable the service fee could be set would depends on the company or the service provider taking part in this programme. Usually an eye examination would be around HKD 300 - HKD500. • One of the ways to further reduce the financial barrier is to provide elders with affordable spectacles for them to choose from. For optometrist, we can bring along a sets of affordable spectacles for older adults when we visit the elderly centre. • We consider an affordable glasses would be around HKD 400 – HKD 700. • The practicability of these strategy would depends on the available funding to support successful implementation.
D, senior optometrist (male)	✓	✓	✓		<ul style="list-style-type: none"> • There are different ways to reduced financial barriers for older adults. In Hong Kong, we have elderly healthcare voucher. People may have access to other subsidy to cover the eye examination fee. I believed the service fee may not be the most important aspect, rather it would be more important to make older adults aware there are service available to them. • There are incentive to provide mobile service as optometrist can self-refer the patient back to their clinic for any follow-up eye examination if needed.
E, senior optometrist (female)	✓	✓		✓	<ul style="list-style-type: none"> • I think it is a possible option. For reference, ,the district health centre currently charges HKD 150 for an eye examination. • From service provider perspective, an affordable glasses would be around HKD400 – HKD 600.
F, older adult (male)	✓	✓		X	<ul style="list-style-type: none"> • HKD 400 for an eye examination is considered too expensive. We would only pay for an eye examination if your vision is deteriorating significantly, potentially leading to blindness. Even if the service is provided “free-of-charge” we would consider this service as a fraud, not something that would happen in real-life. If the eye examination fee is below HKD 400 then this may be more acceptable for older adults. • For service location, I believed that elders will not go to the optometric clinic themselves. Service provides at the elderly centre would be a more acceptable option as elderly centres are usually located within the neighbourhood. Alternatively, transportation arrangement could be a way to let elders to receive eye examination at the clinic.

G, older adult (female)	✓	△		X	<ul style="list-style-type: none"> I think HKD 400 for an eye examination would be too expensive for me. Elderly centre members are people without income so we couldn't afford much and would not pay HKD 400 for an eye examination. If we could know about having elderly healthcare voucher could be useful it would be better as some elders may rely on public service and were not aware of that the elderly healthcare voucher could cover the eye examination fee. If the service is provided at the clinic or in the community, then we would also require transportation to the service. If the service fee includes transportation, it may be more attractive to the elders.
H, elderly centre staff (male)	✓	△		△	<ul style="list-style-type: none"> I believed elders is unwilling to pay anything more than HKD 100. They usually prefer free services. From past experiences, we would need to find funding sources to cover the service fee in order to provide service for the members. For our centre, we don't have the venue capacity to organise such big events for older adults. Transportation to clinic may be practical but this would depends on the frequency of the service provided. Alternatively, some elders may be willing to travel to clinic considering the trip fare only costs HKD 2 per trip for elderly.
I, elderly centre staff (female)	✓	△		△	<ul style="list-style-type: none"> Asking elders to pay HKD 400 for an eye examination is not possible for majority of the elders. Unless there is a system that can streamline the eye care process, for example, allowing the elders to be referred to the hospital when they required other type of eye care services. I understand this would be unlikely to happen yet. It would have logistic difficulties organising transportation to clinics or optical store. Some of the elders may have difficulties travelling to elderly centre – this group of elders may refer door-to-door service at the residency.

✓= agreed; x = disagree, considered removing or amending the content; △= agreed, with suggestions provided.

6.6.3 Empowerment activities for elderly centre staff, peers and elders

The proposed strategies regarding empowerment activities to increase social support and make use of social influence to increase motivation to undergo eye examination were highly accepted by both service users and elderly centre staff (Table 6.7). In general, elderly centre staff shared that health promotion activities were insufficient. There were some concerns regarding sustaining a group of peers to serve as volunteers or eyesight ambassadors. However, it was not perceived to be a serious concern that may reduce the practicability of implementing this strategy in the future.

Health promotion activities –The format of disseminating health-related information was important as service users perceived that playing video clips at the elderly centre would not be an effective way to improve motivation to use preventive eye examinations. Providing information in written format may not benefit the elderly that much if their motivation is not sufficient for them to proactively seek regular eye examinations. Having interactive activities that can translate the same information in a more creative way was preferred. The content in which the information was perceived to be important as well. All older adults agreed that the information on the significance of preventive vision care, and the impact of visual loss is important. The information on the service component of a preventive eye examination would allow the older adult to make more informed decision-making after their understanding of the significance of eye examination and the procedures they are required to take to get an evaluation of their visual health status. There are also discussions on the ways to attract older adults to engage in these activities. Elderly centre staff welcome the activities being held in the elderly centre; they anticipated that the members of the elderly centre would be interested as well suggesting the acceptability of these strategies.

The role of the elderly centre – qualitative study findings found that members of the elderly centre perceived the elderly centre as an important information source, therefore strategies to engage the elderly centre in information dissemination were included. While discussing this with the elderly centre staff, they highlighted that they have to avoid conflict of interest. It would only be appropriate for them to provide information on any service provider who attended the health promotion activities. From the service user perspective, there were concerns that the elderly centre might not be willing to work with the optometrist to provide the service to the older adults given the tight agenda the elderly centre already had. However, discussion with elderly centre staff revealed that this strategy was welcomed and highly accepted by them.

Specifically, the strategies involved in empowering the elderly centre staff were appreciated by the centre staff. They shared that they had limited information on regular eye examinations, they shared that knew very little about the service availability. They believed that if appropriate training were given to them, they would be more confident in assisting the elderly who approach them with enquiries. Older adults shared that they trusted the information provided by the elderly centre.

Introducing eyesight ambassadors to increase motivation – Older adults were highly interested in the idea of an eye care ambassador and that they would be more likely to go for an eye examination if they experienced a similar experience shared by their peers. However, for this strategy to be practical for implementation, the elderly centre staff reminded that there should be enough volunteers who are willing to take part. Staff believed that this strategy was acceptable and still practicable to consider in the future by referencing the successful implementation of volunteer assistance for taking blood pressure at the elderly centre. The staff shared that there had been volunteers who were responsible for taking blood pressure at the elderly centre. Therefore, the idea of having a peer ambassador engage in peer sharing of the experience of undergoing an eye examination is feasible. However, as highlighted by the elderly centre staff, it depends on the proportion of elders who would be willing to take part in these activities. They would anticipate that the ones who are interested in this role would be the young-old (i.e. below 65 years old). As the membership eligibility at some elderly centres allows those aged 50 or above, some centres may have more younger older adults than others.

Table 6.7 Feedback summary regarding empowerment activities for elderly centre staff, peers and elders

Anonymised advisory group member	Comments were relevant to the following aspect(s):				Comment(s)
	Acceptable	Practical	Effective	Affordable	
D, senior optometrist (male)	✓	△	△		<ul style="list-style-type: none"> The role of eyesight ambassadors does not need to limit to peer sharing. These volunteers may consider providing service to accompany older adults to get an eye examination. This is especially useful after dilation when vision becomes blurry. The strategy will only be useful if the group of volunteers can be sustained in long term.
E, senior optometrist (female)	✓		△		<ul style="list-style-type: none"> From previous experience, it might be better to target the elders' carers (domestic helper assistant) or their family members. These are the people who will accompany the elders for an eye examination.
F, older adult (male)	✓		X		<ul style="list-style-type: none"> Any activities would be great, as long as the content are appropriate, interesting and provided professionally and being organised at elderly centre. The content would also need to be informative. Agreed that elders needs to be more informed about what examination components were being conducted. This may motivate us to continue to use the service if we believed it was important.
G, older adult (female)	✓	△	△		<ul style="list-style-type: none"> Organising interactive activities would be more effective to engage elders. Reading any written materials will be troublesome and inconvenient for elders. Even if there were website available, elders may rely on others for assistance. I think peer sharing, interactive activities will increase the motivation to proactively engage in preventive eye examination. We trust information provided by the elderly centres.
H, elderly centre staff (male)	✓	✓	△	△	<ul style="list-style-type: none"> Health promotion videos is unlikely to be effective to improve service uptake as elders will not watch these video when they came to the centre. From an organiser perspective, it could be a feasible option to organise health promotion activities, however, it would depend the amount of elders who will be interested to attend these activities. Depending on the registration number, we might need to restrict the registration quota. We have had free health educational talk previously. Means of information dissemination varied. We have monthly publication prepared for our members. Regarding providing service-related information, we would retrain providing information about specific service provider as it may have conflict of interest. But we might be able to provide information if it was a service provider who came to deliver a health educational talk. Including eyecare ambassadors is also possible. We have volunteers at the centre who provides assistance for taking blood pressure. We would assume that the group who would be interested to be a volunteer being those from the young-old age group around (60 - 65 years old). However, there is very few of the members from the young-old categories. There are potential difficulties to sustain a group of volunteers who would be able to share their experiences. Elderly centres is operated under a specific agency, it may be possible to create a network of volunteers to achieve this. Training materials for volunteers is possible but this would require extra work from optometrist to deliver the training. We welcome staff training about eye care as the staff themselves have little knowledge regarding service provision.
I, elderly centre staff (female)	✓	✓	△		<ul style="list-style-type: none"> The proposed strategy is good as we have very few activities related to preventive eye care. Providing health promotion activities is feasible. How effective these would be depends on the content being delivered.

✓= agreed; x = disagree, considered removing or amending the content; △= agreed with suggestions provided.

6.6.4 Ways to encourage next eye examination attendance by older adults

Based on evidence gathered from systematic reviews and qualitative studies, reminder was included in the preliminary intervention components. Older adults agreed that providing reminders was important to ensure they would attend the appointment. One older adult shared that they would prefer telephone reminders rather than other forms of electronic reminders. Elderly centre staff has shared that they would provide registration slips for their members who signed up for an activity.

Some of the strategies perceived to increase motivation to use preventive eye examinations, such as providing coupon discount codes were not accepted by the service provider (Table 6.8). Researchers and optometrists have consistently highlighted throughout the discussion that the code of practice which highlights that eye examination, which was considered a s professional service should not be provided “free” or “discounted” (Optometrists Board Hong Kong, 2022).

While incorporating encouraging statements (BCT that focused on social influence) were thought to be theoretically effective, it was perceived to be ineffective by the service user. Based on the suggested BCTs linked to social opportunity, it was initially stated that optometrists can include statements that praise the patient who attends the appointment annually. However, from a service perspective, as shared by the older adults, these were meaningless to them. Shared from the previous experience, one adult shared that she valued good interaction during consultation (service experience). These are the key factors that determine whether they will go to the same optometrist or engage in eye examination in the future. The importance of effective health communication was agreed upon by the optometrists and they believed more could be done to make the client feel welcomed and comfortable while using the service. One optometrist shared that from their experience, the role of caregiver, or family members or relative should not be neglected as they are the person who accompanied the elders to a preventive eye examination. The optometrist recalled that the caregiver accompanied an older adult to the appointment. Therefore, the suggestion was proposed that perhaps caregivers or family members could also target, rather than relying just on older adults.

Table 6.8 Feedback summary regarding strategies to encourage elders to come back for another eye examination

Anonymised advisory group member	Comments were relevant to the following aspect(s):				Comments
	Acceptable	Practical	Effective	Affordable	
B, optometry researcher (male)	X				<ul style="list-style-type: none"> Providing "discount" is not an appropriate phrase to use. It would give an impression that the eye examination is free. Eye examination is a professional service.
C, senior optometrist, clinic-in-charge (female)	✓	✓	✓		<ul style="list-style-type: none"> It would be more important to have reminder. It was a common reason for no show for an eye examination. Some elders forgot to attend the scheduled appointment.
D, senior optometrist (male)	✓		✓		<ul style="list-style-type: none"> Making sure that older adults are aware of the available resources to reduce financial barriers is important (e.g. elderly healthcare voucher can be used on optometric services).
E, senior optometrist (female)	✓	✓	✓		<ul style="list-style-type: none"> Agreed that health communication is an important factor influencing service uptake. Apart from focusing the strategy on the service user, we could also focus on the people who provide care for the elderly. Scheduling appointment for the elderly is acceptable and possible.
F, older adult (male)	✓		✓		<ul style="list-style-type: none"> Arranging the next appointment for the service user is considered effective. This would allow the elders to organise their activities accordingly. This also provides opportunities for elders to note down in their calendar. For reminder, it would be best to call the elderly. I believe there are not much of the older adults would know how to use WhatsApp.
G, older adults (female)	△		X		<ul style="list-style-type: none"> I don't think adding encouragement phrases on the appointment letter would be any useful/effective to improve service uptake. From my past experience, service quality and experience were more important and are useful motivation to continue to use an eye examination.
H, elderly centre staff (male)	✓	✓	✓		<ul style="list-style-type: none"> Elderly centre usually will print out reminder slip for their members to attend an activity. If the eye examination interval is not that frequent, then I would suggest adopting the similar approach currently being done at the public hospital. They will have a follow-up appointment letter. I believe providing such information will make the elders want to use eye examination as the logistic and the way to access service will be more familiar for the service user. Elders have various appointments to attend. If the appointment letter for eye examination is designed to be user-friendly, it would help older adult to organise their reminder slips more easily.
I, elderly centre staff (female)	X	X	△		<ul style="list-style-type: none"> Personally, I would be more concern about the steps that comes after an eye examination. For example, if the elders required any follow-up examination or treatment. How would the referral process facilitate the compliance. In general, I think the strategy proposed would be effective, as these are the service that elders required but currently have little access to it. Convenience is the key to ensure service uptake, especially attending the next appointment. If the service required the user to attend at different clinics or the service components were not performed in one-go, this increase the chance of people not attending the follow-up assessment.

✓= agreed; x = disagree, considered removing or amending the content; △= agreed with suggestions

6.7 Amendment to the preliminary proposal and finalised intervention strategy

Considering the feedback, strategies were generally perceived to be effective and accepted by all interested stakeholders. Several amendments were incorporated into the finalised intervention strategy to improve the acceptability, practicability and affordability of the proposed strategies. The amendments were as follows:

1. To make the strategy accepted for implementation with the help of optometrists, statements that might violate the code of practice were removed.
2. Statements to encourage attendance for the next appointment and video clips played at the elderly centre were perceived to be ineffective in encouraging older adults to use preventive eye examinations were also removed.
3. Although the examination fee can be set to a “more affordable range”, the price would depend on the service provider. Different views on the service fee were also evident among the older adults as well as supplemented by the qualitative results. Considering this, strategy can also include a clear and transparent price list to allow the user to be well-informed about the necessary service-related information. In addition, the information about how a set of affordable spectacles would be available for the user to choose if they needed to purchase any optical aid could also be included. This decision was made after considering the mapping results from Step 4 to address the belief of capability to engage in preventive eye examination. Providing such information was perceived to ease the decision-making process to use a preventive eye examination or not for the older adults.

A detailed summary of the finalised intervention strategy can be found in the Appendix C4.

6.8 Discussion

This chapter illustrated a systematic approach to designing an intervention strategy that is relevant, feasible, acceptable, and practical for potential implementation in Hong Kong. It was found that capability, opportunity, and motivation were lacking which led to the older adults not considering using a preventive eye examination. Based on the analysis of COM-B components, seven functions could be considered to improve the uptake of preventive eye

examination for older adults. With the help of the advisory group members, the preliminary intervention strategy was further refined to ensure acceptability, practicability, and feasibility for future intervention implementation.

Previous literature on intervention to improve eye examination focused on educating the target group (Dan et al., 2015; Ellish et al., 2011; Owsley et al., 2013; Owsley et al., 2009). In this study, it found additional strategies that may help improve the uptake of preventive eye examination. Using the BCW framework together with COM-B and TDF it can be understood that education is not the only intervention function that could be considered. Using the BCW, it identified the “enablement” function. Creating an enabling environment can be considered to empower older adults to make the decision. Older adults shared they may lack the ability to understand or access the information, with an environment with social support and information, the older adults would be more likely to receive the necessary information they require to make the decision. A range of activities can also be considered to enrich the environment to empower older adults. During the discussion with the older adults, they shared how useful it would be to provide incentives for them to proactively engage in the service. Based on the proposed strategies and discussion with advisory group members, different activities can be considered that have education, and persuasion elements in delivering health information. It was found that older adults have different opinions towards the ways these activities could be delivered. However, the older adults agreed that providing activities would encourage proactive participation which they perceived would facilitate more effective information dissemination than passively being given the information.

Intervention strategies with an “environmental restructuring” function should also be considered by incorporating different cues and prompts in the environment to remind older adults of the importance of regular uptake of preventive eye examinations. In addition to this, providing the service to the older adults at the elderly centre as a mobile service can also be considered. However, for it to be feasible for implementation, further discussion on the logistics should be followed.

As the qualitative study (Chapter 4) identified the role of social influence in the motivation to use preventive eye examination, the mapping of the COM-B components identified that older adults have limited social opportunities to access useful preventive eye health-related information and have limited discussion on preventive eye examination with healthcare professionals. Intervention with a modelling function can be considered to address this deficit

in behavioural drivers by incorporating peer sharing of experience of using eye examination as well as presenting videos of other older adults receiving an eye examination.

6.8.1 Challenges encountered using BCW framework as an overarching framework

While using the BCW framework to develop an intervention has many benefits and hence the inclusion of such framework to be the overarching framework for this project, challenges were encountered during its application in this project which are worth mentioning and discussing the ways the issues have been dealt with and how future study can be improved.

BCW framework is designed to be user-friendly and with online resources to support the application of many aspects of the framework. However, there were challenges when following the guide. First, the BCW framework is more related the psychology and other social science topics, the use of terminology may be more likely to be understood by researchers of similar backgrounds without confusion. When collaborating with researchers with a different background, this framework must be used carefully. To ensure the reliability of the results, the mapping results were independently analysed by the student researcher which was then followed by a review of quotes and discussion with other researchers. The different understanding of the wording, especially those concerning intervention function should be explained and confirmed that the understanding was aligned with the definitions used in the framework. Collaboration with other researchers with similar backgrounds ensures the reliability and validity of the result while collaborating with other researchers from the field could provide insight which may be overlooked by the researcher who is familiar with the data. This study was limited to having one student researcher who was able to conduct the analysis, the advantages of support from a multidisciplinary group were not possible for this study. It should be noted that following BCW can be a time-consuming task. There are other quantitative methods to obtain a behavioural diagnosis on COM-B, such as the COM-B questionnaire which has been preliminarily designed to collect relevant data using simple questions (S. Michie et al., 2014). When qualitative studies are not possible to be conducted due to time constraints, this quantitative questionnaire could be used to understand what behavioural drivers are missing in terms of COM-B components that prevent behaviour occurrence.

Second, since the use of the BCW framework has generated a list of potentially useful intervention options as well as implementation strategies, APEASE was introduced to guide

the judgment on the inclusion of “appropriate” intervention. The usage of this criteria has encountered several challenges as highlighted by previous studies in the application of different health problems and implementation problems (Bennett et al., 2023; Ekberg et al., 2021; Smits et al., 2018). Without solid evidence, previous studies have used APEASE criteria to guide discussions with stakeholders and advisors. In the current study, two criteria were specifically focused on: acceptability and practicability were explored. The discussion has also led to several amendments made to the preliminary strategy. However, the effectiveness of the proposed strategy in improving the uptake of preventive eye examination remains unknown without the support of empirical evidence. Nonetheless, it is believed that the issue with effectiveness and the lack of evidence can be subsequently achieved when sufficient empirical evidence is available for evidence synthesis.

While minor challenges in using the APEASE criteria were encountered, the findings of this study have indicated potential research gaps to be addressed in the future. It would be constructive to start collating evidence relevant to the APEASE from the early stage of intervention development. Obtaining evidence at the earlier stage, potentially after identifying the deficit in behavioural drivers, would help shortlist intervention options, policy categories and BCTs that were supported by the best available evidence. This pool of evidence would also allow researchers to brainstorm other innovative strategies that might not have been implemented or investigated in the literature. This would also facilitate constructive discussions between stakeholders who might not be equipped with enough information to make certain suggestions. Considering this, a scoping review could be conducted to collate all the available evidence to understand which indicators in the APEASE criteria have more evidence. This information can help modify the criteria for selecting appropriate intervention functions best suited for the topic of investigation. However, it is aware that this would not always be a feasible option as conducting reviews can be a long process or was not possible to conduct due to lack of funding. However, if time allows, conducting a scoping review can help understand the depth of the available evidence that could be utilised. Any difficult terminologies should be translated into layman's terms to ease understanding and facilitate constructive discussion with the general population.

6.8.2 Limitations

As mentioned in the previous section about the challenges of the application, the application of BCW to inform intervention development would further benefit from a more

multidisciplinary collaboration who were aware of how the BCW works. It would ensure more discussions to be brought up among researchers. To maximise the possibility of strategies that could be considered, a group of stakeholders were individually consulted to further brainstorm the ideas. By doing so, this addresses the limitation of the BCW framework which could be argued to only provide a rigid structure and systemised approach, innovative ideas were also discussed with the stakeholders and further the feasibility of potential implementation. This was done to capture other possible strategies that were not identified with the guidance of the BCW framework.

In this study, two criteria of the APEASE criteria were mainly focused during the discussion. Open-ended discussion was followed to allow all the advisory group members to have an opportunity to express freely about the strategies or other ways to encourage the uptake of preventive eye examinations. During the project planning stage, it was believed that focusing on acceptability and practicability to initiate the discussion would be appropriate. Acceptability and practicability could be collected in the prospective stage before intervention implementation (Sekhon et al., 2017). In contrast, other indicators (cost-effective, effective, affordability) would require more detailed and in-depth research to achieve appropriate evaluation. More importantly, there is no existing literature that was available to obtain an overall understanding of the cost-effectiveness and affordability of the proposed strategies. However, during the discussion with the advisory group members, it was noticed that they considered the *perceived* effectiveness of the strategies and the anticipated influence on changing current behaviour. While the discussion of the advisory group members has supplemented the judgement of the APEASE criteria, information that can objectively reflect the effectiveness, affordability and cost-effectiveness should be collected to better understand the potential of the proposed strategies. These should be collected after implementation, in pilot trials or formal programme evaluation.

6.9 Chapter Summary

This chapter describes the systematic approach taken to reach the final intervention strategy that can be considered to improve the use of regular eye examinations by older adults. Not all BCTs identified were useful for consideration and the consultation with stakeholders has helped to reduce the techniques to fit with the local context. At this stage, all the identified linkages of intervention functions and BCT are mainly theoretically effective with feasibility

confirmed with the help of the advisory group. More information needed to be collected to inform the proposed theory-based and evidence-based (to some extent) intervention design as there are different ways to implement these strategies. How these strategies are best combined remains a question to be answered. The final intervention strategy document was used to inform the next stage of the project which involved designing a DCE questionnaire to elicit the preferences of the older adults towards the intervention designed to improve the uptake of regular eye examination.

Chapter 7 Older adults' preference for the strategies to improve regular eye examination uptake: a discrete choice experiment

7.1 Chapter overview

In Chapter 6, the evidence-based and theory-driven strategies have been developed to improve the uptake of eye examination by older adults. The characteristics of the strategies can be described by five attributes, with varied levels of each attribute. Whether the elders would have preferences on the characteristics of the strategies? If so, which level of the attribute would they prefer? These are the questions remaining to be answered and important to further optimize the design of the strategy.

This study aimed to elicit elders' preferences on the characteristics of the strategies designed to improve the uptake of eye examination and to estimate the potential uptake rate of the most preferred strategy. To gather insights on preferences, a discrete choice experiment (DCE) was conducted with older adults aged 65 and above attending elderly centers. Subjects completed an interviewer-administered DCE questionnaire that included five attributes that described the strategies: service location, specified fee range, appointment booking, appointment reminder, and level of awareness about eyecare needs and services. Each attribute has two levels. The main effect orthogonal design led to the inclusion of eight choice sets presented in a pairwise format with an opt-out option. Results were analysed using the conditional logit model, and the potential predicted uptake rate for the preference-based strategy was calculated.

A total of 93 subjects completed the survey which resulted in 744 choice sets consisting of 2232 profiles being analysed. The subjects have significant preferred level for all the attributes that would encourage them to undergo an eye examination. Subjects preferred a mobile eye examination service provided at the elderly centre, with a specified fee range indicated, having the next appointment arranged by the service-provider, and with appointment reminder provided. They also preferred to have a supportive elderly centre environment to enable them to obtain the necessary information they needed. Under a scenario consisting of three comparisons, the strategy with all the preferred levels was estimated to have a potential uptake of 90.6%.

Elders have specific preferred level on all five attributes describing the strategies to improve the uptake of the eye examination. The strategy can be further refined with their preferred level of attributes, which was potentially effective in improving the uptake rate.

7.2 Background

The utilisation of preventive eye examination was suboptimal reported in different countries (Gupta et al., 2020; Mohammed & Munsamy, 2023; Vela et al., 2012; Wagner & Rein, 2013). The common reasons for visual impairment are uncorrected refractive and cataract (Q. S. You et al., 2020), which are treatable. There is a need for preventive eye examination, but the demand for such service cannot meet the need. Consequently, the prevalence of vision loss is expected to increase under the impact of population ageing (Chen et al., 2024). To safeguard the visual health of older adults, effective strategies to improve the uptake of preventive eye examination are necessary.

After conducting the literature review chapter (Chapter 2), it was found that previous investigated intervention strategies included the use of health educational intervention and mobile service. However, the impact of these strategies on improving preventive eye examination utilisation has not been optimal in terms of the reported uptake rate and the effectiveness obtained from the RCTs. The uptake rates of the intervention reported in existing RCTs were mostly below 70% and/or with no supporting evidence suggesting that health educational intervention was significantly better than the comparison group in improving the uptake of the preventive eye examination. Health educational intervention including providing information in the form of video presentation (Dan et al., 2015), printed materials such as poster (Owsley et al., 2013) and newsletter (Ellish et al., 2011). The uptake rate reported for the intervention condition for health education ranged from 33.3% to 72.9%. The study reported 72.9% was without a control group (with no education element) so it was uncertain how effective it could be in improving the service uptake (Ellish et al., 2011). This specific study found no additive effect enhancing the information from targeted at group level to tailored for individuals (Ellish et al., 2011). The mobile service was providing the service at the home of the participants (Katibeh et al., 2020). This study found supportive evidence of using mobile service in comparison to conventional methods (receiving an eye examination at the centre). The uptake rate of the mHealth arm were 35.6%, and the conventional methods (eye examination performed at a local health centre) was 32.7% , compared to the control group of

15.2% (Katibeh et al., 2020). While there was a significant improvement in the intervention condition, the reported uptake rate was still considered suboptimal. The eye care utilisation being measured were arguably leading towards referral behaviour rather than preventive eye examination behaviour.

Within the literature, there was limited evidence supporting the effectiveness intervention to encourage the uptake of preventive eye examination by the older adult. In addition, there was a lack of evidence being conducted in Hong Kong. As suboptimal preventive eye examination is also an issue in Hong Kong (Sum et al., 2022), this indicates there is an opportunity to investigate different strategies to improve the uptake rate further.

HKSAR has a mixed of public and private health care system (Food and Health Bureau, 2008a). Most of the preventive eye examination services are provided in the private section and require out-of-pocket payment without direct government subsidy. A population-based survey of eligible healthcare voucher recipients found about one in five older adults have not ever had an eye examination (22.2%); and 38.7% of them did not have regular eye examination (defined as at least once every two years) (Sum et al., 2022). As the value of the healthcare voucher could cover the cost of an eye examination and mid to lower end spectacles, clearly there were other barriers that were deterring older adults in our population in respect of the eye examination. To lower these barriers necessitated the design of different intervention strategies, with the overall goal of creating an enabling environment for information and service access.

To improve the effectiveness of the intervention, one approach is to engage the target population by seeking their preferences. To this end, a Discrete Choice Experiment (DCE) was used to elicit the older adults' preference for the intervention. In the DCE study, an intervention can be described in different attributes with different levels of each attribute (Ryan et al., 2008). The subjects' preferences can be revealed after answering a series of hypothetical questions with different alternatives being presented. Subjects will make trade-offs between all the included attributes with varied level of each attribute and choose the one that they believed have the highest usefulness in encourage them to use the preventive eye examination (Lancaster, 1966; McFadden, 1974).

In Chapter 6, strategies to improve the uptake of preventive eye examination have been proposed. These strategies can be described in different attributes each with different levels. Different intervention profiles were then formed by combining these strategies together. In this

DCE study, the older adult would be completing a questionnaire where their preference for these strategy characteristics were elicited. The findings obtained from this study would be used to inform the intervention design.

The aim of this study was to elicit the preferences of the older adults for the intervention to improve the use of preventive eye examination using DCE. The primary objective was to elicit the preference of the older adults for attribute level of the strategy designed to improve the uptake of preventive eye examination. The secondary objective was to estimate the potential uptake rate of preventive eye examination programme that consisted of the preferred attribute levels.

7.3 Methods

7.3.1 Overview on the DCE design

This DCE study follows the suggested guidelines (de Bekker-Grob et al., 2015; Johnson et al., 2013), with the development flow as shown in Figure 7.1. DCE is grounded in random utility theory which assumes people are rational decision maker who strive to maximise their utility between choices being given (Lancaster, 1966; McFadden, 1974). Subjects were asked to make choices between alternatives by making trade-off between the different attribute levels. Subjects were required to complete a series of hypothetical questions.

A steering group was set up to oversee the project, member of this group provided opinions and insight into the design of the DCE. The steering group consisted of the supervisors of the student researcher and a professor in Health Economics. An advisory group consisted of two elderly centre staff, two chairmen of optometric association and two volunteers from a university research centre. The aim of setting up an advisory group was to incorporate stakeholder involvement in the design which can ensure the attributes were appropriately described and understood by the older adults and that the included attributes were realistic for future implementation. The first draft of the DCE questionnaire (Version 1) included nine attributes each assigned with two levels. Version 1 was fine-tuned, and the resultant questionnaire included five attributes each assigned with two levels (Version 2). Version 2 of the questionnaire was used in formal data collection.

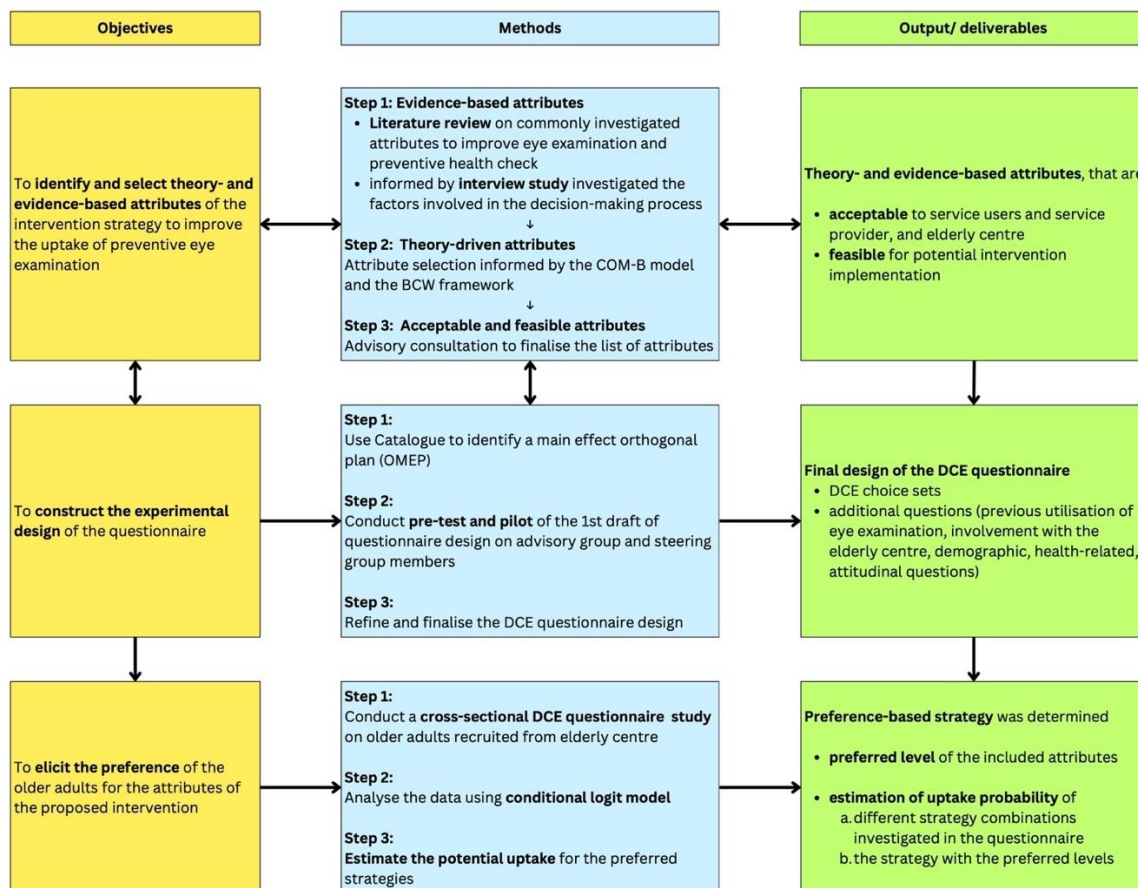


Figure 7.1 Overview of the DCE development process

7.3.2 Identification and selection of attributes and levels: the preliminary list

To identify a list of attributes and levels to be included in the DCE design, the literature was first scoped to identify the commonly included attributes. The intervention strategy that proposed based on the qualitative study was extracted. The preliminary list of attributes and levels were finalised after the discussion with advisory group members consisting of interested stakeholders (researchers, optometrists, elderly centre, and older adults).

To start off with attribute identification, the literature was scoped for the existing evidence on intervention to improve uptake of preventive eye examination which further led to the scoping of evidence from preventive service with a specific focus on general health check service (Chapter 2). The literature review stage aimed to provide information to judge whether the existing attributes were sufficient and appropriate for the current project.

After literature review, no DCE study was identified for preventive eye examination. Only one empirical study was identified for diabetic retinopathy (Yeo et al., 2012) which is a disease-

specific screening. For general health check, two systematic reviews (Brain et al., 2022; Kleij et al., 2017) and three empirical studies were identified (Chua et al., 2022; Grauman et al., 2021; Larsen et al., 2020). Table 7.1 presents the list of attributes included in the preventive health check. While access-related attributes are relevant to the context of the current study, other attribute types were leaning towards service components and outcome-orientated attributes and have little applicability for this DCE study which has a focus on changing the behaviour of the older adult.

Table 7.1 List of attributes included in previous DCE study to elicit preference for primary healthcare or preventive health check

Attribute type	Levels	References
Access to service	Type of healthcare provider; appointment time flexibility; appointment date; appointment type; travel time; location	(Brain et al., 2022; Chua et al., 2022; Kleij et al., 2017; Larsen et al., 2020)
Screening procedures	Sensitivity; specificity; diagnosis; prescription; attention of the HCP on the health problem; influence over the case chosen; the amount of information given about medical history; the type of written results; type of notification methods for assessment results; consultation time period; waiting time to receive the results; provision of follow up call; provision of lifestyle recommendation; level assessment; how advise was provided to the user; level of shared decision-making	(Brain et al., 2022; Chua et al., 2022; Grauman et al., 2021; Kleij et al., 2017; Larsen et al., 2020)
Cost-related	Out-of-pocket; cost to health services; cost to follow up	(Brain et al., 2022; Chua et al., 2022; Grauman et al., 2021)
(Health) Outcome	Reduction in mortality; risk of overtreatment; surgical outcome; change in behaviour; health status; improvement in knowledge; chance of receiving the best treatment	(Brain et al., 2022; Kleij et al., 2017)

With limited evidence on preventive eye examination, the attributes were identified from the potential intervention strategy (reported in Chapter 6) which was proposed based on the evidence obtained from an interview study exploring the factors in the decision-making process of the older adults to use preventive eye examination in Hong Kong (see Chapter 5 for the findings). From the intervention strategy, a list of potential attributes was shortlisted.

The attribute selection was theory-driven, informed by the Behaviour Change Wheel (BCW) framework and the Capability-Opportunity-Motivation Behaviour (COM-B) model (Michie et al., 2011). The COM-B model describes the three key behavioural drivers (capability,

opportunity, and motivation) to behaviour change. Lacking any of these behavioural drivers could be overcome by specific intervention functions listed in the BCW framework (Michie et al., 2011).

All the strategies that were proposed to target at the behavioural driver were first drafted into a summary document which were then further discussed with the steering group and advisory group members to ensure the strategy collated were acceptable and feasible to consider for potential implementation. (see Appendix C4 for the detailed intervention strategy with COM-B and intervention function indicated).

7.3.2.1 Selecting the appropriate attributes: a process guided by behavioural science frameworks

Based on the developed strategies in Chapter 6, a preliminary list of eleven attributes was identified to describe the characteristics of the developed strategies as follows. All these eleven attributes were classified according to their functions which specifically addressed the deficit behavioural drivers informed by BCW. This approach would broaden the selection on the attributes not only related to the service components, but also related to behaviour change (Mansfield et al., 2016). The preliminary list of eleven attributes:

1. Community optometrist network
2. Service provision mode
3. Service price
4. Trained staff
5. Peer ambassadors
6. Appointment booking
7. Reminder
8. Educational content
9. Providing information at the centre
10. Peer sharing
11. Involvement of caregivers

Further, this potential list was refined with the following two consideration after the discussion among the steering group. First, the included attributes should be plausible and actionable. Second, the levels within an attribute should reflect the realistic scenario. Considering the

above, three changes were made which reduced the list from eleven to a total of nine attributes as follows.

The first change was to exclude “community optometrist network” from the attribute list. This was the essential component of the strategies, i.e. the intervention implementation would only be feasible with the inclusion of community optometrists. Therefore, community optometrists should not be included as an attribute but as an essential and available network mentioned in the decision scenarios.

The second change was regarding the levels attached to the attribute “education content”. There were originally four levels for this attribute to demonstrate the level of comprehensiveness of educational content.

Level 1: Standard information only (refers to the normal scenario)

Level 2: Comprehensive information

Level 3: Comprehensive information + visual stimulation

Level 4: Comprehensive information + visual stimulation + training activities

It would be important to elicit elders’ preference on whether to have interactive empowerment activities (e.g. visual simulation and training activities) that would potentially improve the uptake of eye examination. As shown in Table 7.2, all levels have a primary intervention function – to “educate” the older adults. Increase in one level reflects an additional function. Given the common functions identified, it was deemed appropriate to drop or combined the levels. First, the inclusion of standard information could be dropped as it is in the current practice that whenever elderly centre holds any educational content, education information will be provided to the audience. It would be more useful to set “Comprehensive information” as the lowest level to reflect the idea of improved adequacy of educational information and having the other two levels combined so that the highest level of a two-level attribute reflects a combination of three intervention functions (Education, Persuasion and Training). The attribute was renamed to “activity content” to shift the attention from only having “Educational” element in the activities.

Table 7.2 Attributes levels for "Education content" and its associated COM-B components and intervention functions

Attribute levels for educational content	COM-B component(s)	Intervention functions
Level 1: Standard information only	Psychological capability	Education
Level 2: Comprehensive information	Psychological capability	Education
Level 3: Comprehensive information + visual stimulation	Psychological capability Reflective motivation	Education Persuasion
Level 4: Comprehensive information + stimulation + training activities	Psychological capability Reflective motivation	Education Persuasion Training

The third change was regarding the actors included in the attributes. Social influence was a key factor identified in the qualitative study, which is family members (or can be termed as “caregiver” for a wider application), staff and peers. These people all had different roles in influencing preventive eye examination utilisation behaviour of the older adults. Among the three actors, caregiver was more likely to involve in the health care decision, so the programme could be targeted at elderly and caregiver or just elderly. The staff and peers cannot be combined because they served different roles in influencing the decision-making of older adults.

With the above, the preliminary list was reduced from eleven to nine attributes, each at two-level (Table 7.3). Having two levels for each attribute could reduce the potential cognitive burden on the older adults while keeping the scenario as realistic as possible. Table 7.3 shows the description for each attribute and level which were included in the DCE questionnaire version 1. Based on our previous qualitative study (Lau et al., 2023), it was known that older adults lacked psychological capability, social opportunity, physical opportunity and motivation to engage in preventive eye examination (Chapter 6). The included nine attributes had seven functions (i.e. Education, Persuasion, Incentivisation, Training, Environmental restructuring, Modelling and Enablement) to address the deficits in not taking up a preventive eye examination. The descriptions of the attributes were further confirmed with the optometrists from the advisory group.

Table 7.3 Attributes and levels used in DCE design (version 1)

Attribute	Levels	Descriptions
Programme target	Level 1: Elderly only Level 2: Elderly and carer	This is the people who will be taking part in this programme.
Activity content	Level 1: Comprehensive information Level 2: Comprehensive information and empowerment activities	These are the activities provided to the elderly.
Specific training for staff	Level 1: No Level 2: Yes	This describes whether the elderly centre staff would receive specific training on eye health related knowledge and skill to self-check vision using simple tools and know where to access service-related information.
Eyesight ambassador involvement	Level 1: No Level 2: Yes	This describes whether the elders at the elderly centre would be appointed as eyesight ambassador who would involve in peer sharing and discussion during programme activities
Providing information at the centre	Level 1: No Level 2: Yes	This describes whether there will be items provided at the centre (e.g. leaflet/ pamphlets/ simple tool to check eyesight)
Service location	Level 1: Mobile service provides at elderly centre Level 2: Optometric clinics in the community	This describes the location at which elders would receive the eye examination.
Fixed package	Level 1: No Level 2: Yes	This describes whether a pre-defined price (fixed within a range) is offered by the service provider.
Appointment booking	Level 1: You book your next appointment yourself Level 2: The service provider has booked your next appointment	This describes the person who would be responsible to book the next eye examination appointment.
Appointment reminder	Level 1: No Level 2: Yes	This describes whether the elder would receive a reminder to attend the reserved appointment. The reminder could be in any format (e.g. text, SMS, WhatsApp, WeChat, or phone call).

7.3.3 Generating experimental design and questionnaire development for the 1st draft of DCE questionnaire

This DCE was designed to elicit the main effect of attributes levels on the decision to undergo an eye examination by the older adults. To construct a DCE design, a full factorial design which allowed investigation on all effects of attributes on all choices, was first considered. A design with nine 2-level attributes (denoted as 2^9) would result in 512 combinations which would be impractical to complete by the subjects. Alternatively, a fractional factorial design (a subset of the full profile) was considered.

7.3.3.1 Using Catalogue to identify an experimental design

Catalogue was used to select an appropriate subset of the full profile (Hahn et al., 1966). It is a manual way of select an experimental design that can investigate the main effect of attributes levels on the choices (also known as orthogonal main-effect plan). As this study was only interested in the main effect of the attribute levels on the preference, Catalogue was an appropriate tool to identify the subset.

Catalogue includes different “plan codes”, with each included a subset that fulfil certain statistical assumptions (e.g. main effect independent of two-factor interaction) and design properties (e.g. number of choice sets required). The selected plan code includes a master plan where specific combinations for the subset are identified. The index for the plan code for a design of nine 2-level attributes with no interaction effect is 9-9-0-0-0. Plan code 8a fulfilled the above design and statistical requirement.

According to Plan code 8a in Catalogue (Hahn et al., 1966), twelve tests were required to test the main effect of attribute levels on user preference. The subset was constructed using any of the nine columns in Master plan 4. No further means was adopted to reduce the number of question required as 12 choice sets were within a reasonable range (within nine to sixteen choice sets), as reported in previous systematic reviews on DCE application (Brain et al., 2022; Clark et al., 2014).

7.3.3.2 Development of the 1st draft of the DCE questionnaire

The 1st draft of the DCE questionnaire adopted an unforced pairwise design. Subjects were presented with two programme alternatives and an opt-out alternative. Under this design, the subjects were not forced to choose between the two programme alternatives if they believed

both alternatives would not encourage them to undergo a preventive eye examination. The opt-out alternative was included to collect data revealing potential non-uptake of the older adults. Non-uptake rate was relevant to the programme design to understand whether people would not participate despite affording such a programme. The three alternatives were labelled generically as “Programme A”, “Programme B” and “Neither”. Generic label was used as there was no specific branding or factors involved in the design that would have significantly influence the preference.

A coding level was assigned to each attribute level (Table 7.4). To construct a pairwise DCE, a shift technique was used (Johnson et al., 2013). This technique required shifting the coding so that $0 \rightarrow 1$ and $1 \rightarrow 0$. This was done to ensure minimal level overlap to increase the information obtained from the DCE findings.

Table 7.4 Attributes and levels of DCE (version 1) with coding levels

Attributes	Levels	
Programme target	Elderly + carer	Elderly only
Activity content	Comprehensive information	Comprehensive information + empowerment activities
Trained elderly centre staff	No	Yes
Eyesight ambassador involvement	No	Yes
Providing information at the centre	No	Yes
Fixed package	No	Yes
Service location	Mobile service provides at elderly centre	Optometric clinics in the community
Appointment booking	You book your next appointment yourself	The service provider has booked your next appointment
Appointment reminder	No	Yes
Coding level	0	1

After the alternative choices were created, all twelve choice sets (consisted of 24 alternative scenarios) were examined to check whether the property of an orthogonal design was fulfilled. The properties considered were level balance, minimal overlap, and orthogonality. All the checking for level balance and orthogonality (obtaining the correlation coefficient) were performed in Excel.

To minimise the level of cognitive burden from completing twelve choice sets, images were initially included with an intention to improve the subjects' understanding. These images were only included in the explanation of the attributes and levels. These images were not included in the actual choice set. This decision was made to avoid overcrowding the content on one page as there were nine attributes in total.


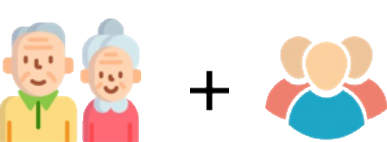










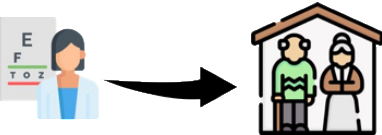





Programme target		
Activity content		
Specific training for elderly centre staff		
Eyesight ambassador involvement		
Providing information at the centre		
Fixed package		
Service location		
Appointment booking		
Appointment reminder		

Figure 7.2 Images used to explain attributes and levels in DCE questionnaire (version 1)

7.3.3.3 *Reliability and validity*

A dominant choice set was included before the twelve formal DCE choice sets (Table 7.5). This was done to ensure the internal validity of the test so that the theoretical underpinning of DCE, i.e. choosing the alternative with the highest utility, were not violated. The dominant choice set included levels which the researcher assumed would be considered “more superior” than the other attributes by the older adults (Lancsar & Louviere, 2006). The levels assumed to be a “better option” was the levels indicated the presence of attributes presence with a level labelled as “yes”; for programme target being “elderly + carer”; service location being “optometric clinics in the community” and appointment booking being “the service provider has booked your next appointment”.

The rationales behind the selection of these levels being a “better option” was based on the assumptions that having the inclusion of attributes would have higher utility than those that were absent. Having a wider programme target would have greater social opportunity to carry out the desired behaviour of using eye examination service. Optometric clinic in the community provides more services to the service users and there were more clinics to choose from. In comparison, mobile service was restricted to the elderly centre. Having the appointment booked by the service provider was assumed to have higher utility as the older adults would not have to contact themselves which was assumed to be more troublesome for them.

Table 7.5 Dominant choice set included in DCE design (version 1)

	Programme A	Programme B	Neither
Programme target	Elderly only	Elderly + carer	
Activity activities	Comprehensive information	Comprehensive information + empowerment activities	
Specific training for elderly centre staff	No	Yes	
Eyesight ambassador involvement	No	Yes	
Providing information at the centre	No	Yes	
Fixed package	No	Yes	
Service location	Mobile service provides at elderly centre	Optometric clinics in the community	
Appointment booking	You book your next appointment	The service provider has booked your next appointment	
Appointment reminder	No	Yes	
Please select your answer:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

7.3.3.4 1st draft of the full questionnaire

The questionnaire used in data collection consisted of three parts. The first part included obtaining information on the previous use of eye examination and involvement with the elderly centre, and attitude towards the use of eye examination. This was followed by the twelve DCE questions (Appendix D1). The last part was the demographic and health related information and opinions toward information availability.

For the piloting the 1st of the DCE questionnaire, an additional section was added to collect opinions regarding the questionnaire design, with a specific focus on the potential difficulties in understanding the questionnaire (how to complete the questionnaire) and the understanding of attributes and levels (clarity). As part of the evaluation on the preliminary design, rating and ranking questions regarding the perceived attribute importance were added to find out the most relevant (rating exercise) and important attributes (ranking exercise) to the older adults.

The question being asked to obtain the rating results was:

“Do you think the following attributes are an important attribute that encourage you to get a regular eye examination? Please rate the attributes with either “important” or “not important.”

The question being asked to obtain the ranking result was:

“Of these five attributes, which are the most important attribute that you consider would encourage you to get a regular eye examination? Please rate them from 1 to 5 without repeating the ranking. Ranking an attribute with 1 indicates it is the most important attribute and 5 indicates as the least important attribute”.

The relevance of attribute to the subject was determined by the frequency which subjects rated an attribute as “importance”. The relative importance of the attribute among the nine attribute was determined by the number of times the subjects ranked the attributes within Top six.

7.3.3.5 Pre-testing of DCE questionnaire (version 1)

Prior to formal piloting of the 1st draft of the questionnaire, pre-testing was conducted on convenience sampling of family members and research team to get a sense of the flow of the questionnaire and identify any issues with understanding and presentation of the questionnaire design.

On experts (research team): The pre-testing of the questionnaire with the experts was conducted via online meetings using Zoom. The experts all received an electronic copy of the questionnaire beforehand. The think-aloud technique was used to verbalise their decision-making process as they completed the questionnaire; or share their thought retrospectively to supplement their thought process. Notes were taken by the researcher during data collection and later collated in a summary report for discussion with the research team.

The members from the research team revealed that not all the attributes were considered. They all expressed having different preference for the attributes. The research team member verbally expressed the attributes that were most important to them. Among the four research team members, the service-related attributes were considered more important than the elderly centre-related attribute by the research team members: “appointment booking” (n = 3), “fixed package” (n = 3), “appointment reminder” (n = 2), “service location” (n = 2). The team also shared that the elderly centre related attributes were not fully considered by them, i.e. “programme target”,

“activity”, “trained centre staff”, “eyesight ambassador”, “environment restructuring”. Although these comments were expressed, more pilot study were required to be conducted on actual older adults, as the background of the research team were significantly different from the actual subject of the DCE.

There were also comments regarding the difficulties remembering all the explanation for the attributes, while two members expressed the concern of having too many attributes to consider in each choice set. All of these comments suggested potential cognitive burden in completing the 1st draft of the DCE questionnaire.

An experienced DCE researcher commented the number of attributes should be kept at a more manageable number (e.g. to a list of four to six attributes). Before deciding which attributes should be collected, additional information on the subjective (perceived) importance of the attributes to the subjects were collected. A ranking and rating exercise were included in the formal pilot of the 1st draft of the DCE questionnaire.

Further comments on the description for the attribute levels were raised, especially on the “fixed package” and the “environmental restructuring”.

- For the “fixed package” attributes, it was unclear on how the service fee could be covered. There was a need to ensure that all the subjects would understand that the service could be covered by the elderly healthcare voucher. Also, one researcher from the team also raised the concern that there may be potential interaction between fixed package and service location. It was thought that the preference for these attributes would depend on the quality of the service provided. There was a need to ensure the description of both attributes considered this so that both attributes were mutually exclusive from one another.
- As for the “environmental restructuring”, the name used to define the attributes was ambiguous. It was advised to adopt a more straightforward and laymen naming to avoid confusion for the older adults.

On family members: Two family members of the student researcher was invited to take part in the pre-testing of the questionnaire. These two members were aged 65 or above and were not a member of the elderly centre. Both subjects completed the questionnaire face-to-face individually with the interviewer in a room without interruption. Notes were taken during the session. This was followed a discussion where the subjects were invited to share any feedback

about the questionnaire design. The time required for the questionnaire (including obtaining informed consent) was recorded.

The two family members were able to complete the questionnaire within 45 minutes. Both subjects shared that “appointment booking”, “appointment reminder” were important attributes to them, while one also valued the involvement from the elderly centre. One member expressed that the current living location was also considered and would impact on the choices. This mainly concern whether there was an available elderly centre near to the current living location. These comments all highlighted the importance of piloting the questionnaire on actual participants who were members of the elderly centre.

7.3.3.6 First pilot group (volunteers from a university research centre)

This first pilot group was designed to check the subjects' understanding of the attribute descriptions and choice of wording and how they made choices when completing the DCE. The perceived importance of attributes to the older adults were also collected using rating and ranking exercise. To achieve this aim, three older adults were recruited from the Research Centre for Gerontology and Family Studies (RCGFS) of the Hong Kong Polytechnic University (formerly known as Institute of Active ageing, hereafter “IAA”). This research centre was chosen because the volunteers from this centre had been involved in elderly-related projects. The inclusion of this group of elderly could provide insight that may be constructive to refine the DCE design, in comparison to the general older adult population recruited from elderly centres who might be hesitant to share with the researchers about their opinions. During the completion of the DCE questions, think-aloud technique was used to learn about the decision-making process of the pilot subjects. Both the ranking and rating exercise and think-aloud content were used to justify decision on the DCE questionnaire design amendment.

Three elders were invited who were members of elderly centre. They were aged between 62 to 65 years. The questionnaire completion was between 61 – 78 minutes either in person or online (average: 71 minutes). The pilot finding revealed that it was possible for older adults to complete both the rating and ranking exercise.

- From the rating exercise, attributes that were considered important by all three pilot subjects included “Programme target”, “fixed price range for service fee”, “appointment booking” and only one subject rated “providing information at the

centre” as important. The rest of the five attributes were considered important by two subjects.

- From the ranking exercise, there was a difference in how attributes were valued among the subject. In general, the three of the least important attributes were “eyesight ambassador”, “providing information at the centre”, “appointment reminder”. These three attributes had been ranked mainly at 7th to 9th for the perceived importance among the nine attributes by the pilot subjects.

IAA members thought the explanations on attributes were clear and that they all understood. They thought that the inclusion of nine attribute was comprehensive, so they did not consider other factors when making the choices. They claimed that there was no problem with considering all nine attributes at once. The reasons for not considering it as “difficult” was because the subjects started to notice the pattern in the questionnaire design. They learned how to answer the questions by considering some attributes (which are important to them) first. When being asked whether they have compared all the attributes of the alternative, one subject admitted that he might not have considered all the attributes and that the justification he gave during think aloud was tailored against the choice he made. One subject who completed online expressed slight discomfort in the eye after having to stare at the monitor for a long time. This suggests that online data collection may not be the best mode to deliver the current questionnaire.

After the first pilot was conducted, the response sheet was revised by adding four questions in a new A4 paper to allow note taking by the interviewer to collate the opinions on the DCE questionnaire design. The four additional questions were as follow.

- *Do you think having nine attributes are too much to considered?*
- *What are your thoughts on having 9 attributes?*
- *Can you make trade-off among nine attributes at the same time?*
- *What are your thoughts on having to complete 12 questions? (Cognitive burden)*

7.3.3.7 Second pilot group (DCE subjects from elderly centres)

The second pilot group aimed to identify potential issues in the intervention design in older adult that matched with the eligibility criteria of the formal DCE study so the information collected could be applicable to the formal data collection. To achieve this, the second group

of the pilot subjects were recruited from the existing data pool of a previous DCE study. Think-aloud technique was also used to learn about the thought process while completing the questionnaire. The subjects from this second pilot group also completed the ranking and rating exercise on the perceived importance of the attributes.

The existing data pool allowed the researcher to identify elders who reported they did not have any eye examination by an optometrist or ophthalmologist in the past 24 months and were not under regular ophthalmologist care at the time of the participation in the previous financial incentive project. Within the existing data pool consisting of 20 elderly centres, some centres have a limited number of eligible subjects for recruitment. To avoid exhausting the existing list of eligible subjects for some elderly centre, the three elders were purposively selected from a centre (in Sham Shui Po District) which had more eligible subjects.

After obtaining informed consent, the researcher introduced the aim and structure of the questionnaire to the elders. This was followed by an explanation of the attribute and levels and scenarios. For the face-to-face questionnaire survey, the scenario, attribute/level description and choice set were printed out in A4 paper size. The attributes and levels were explained with the images. For online DCE completion, all the instructions, questionnaire choice set, and explanation were presented on the screen for the pilot subjects to view.

After clarifying the understanding of the attributes and levels, each subject was asked to rate the importance of the attributes using a binary rating (yes/no) and rank the nine attributes in the order of their perceived importance without repeating the ranking, where 1 = most important, and 9 = least important. Then the researcher instructed the elders to answer the 12 choice sets using think-aloud techniques. Think-aloud aloud content was not recorded. The researcher noted down their justification of the answers separately. After the DCE questionnaire section, additional questionnaires were completed to obtain demographic, socioeconomic status and health-related information of the subjects. After successfully completed the DCE study, subjects were given a shopping voucher as a token of appreciation.

All the pilot subjects were able to complete all the DCE questions. Although all the subjects claimed he/she had considered all attributes before providing an answer, through the think-aloud session it seemed that only one subject has considered all attributes before answering the questions. From the observation of the interviewer and information provided in think-aloud by the subjects, two subjects seemed to only consider “fixed price range for service fee” when

making choices – suggesting a strong preference for this attribute. The subjects shared that they preferred having “fixed price range for service fee” because having a transparent and set price range to help them make plan and decision whether to use the service, e.g. they would know whether they could afford it, or whether they could pay the service fee with elderly healthcare voucher.

During the questionnaire completion, two subjects had shared that they started to think that “fixed price range for service fee” would be the most important factors to them. The slight difference in the think-aloud part and the ranking exercise could be due to two reasons:

1. the elders were not familiar with the attributes when being asked to complete the ranking exercise
2. the elders started to consider what attributes were important to them as they were completing the DCE choice sets. Two subjects shared that the way the questionnaire designed, that is having conducted the rating and tanking exercise, help them realise what attribute(s) are important to them.

As for the attribute “Programme target”, while it was perceived to be an important attribute, one subject shared that there are concerns of that the eligibility of the programme would have complicated the issue, especially, the eligibility criteria for “elderly + carer”. It was believed that the programme should only be eligible for older adults aged 65 years or above to avoid the issue of lack of manpower and that could potentially result in poor service experience. Also, as the programme would already be targeted at the older adult, whether including the carer was perceived to not make a big difference. In fact, the subject also raised concerns of creating other potential barriers in attending the service as the time availability to attend the eye examination service could be different (carer tend to be younger).

7.3.3.8 Changes to DCE design after considering feedback from the piloting of 1st draft of DCE questionnaire

Considering all the comments and feedback from the pre-testing and piloting of the 1st draft of the DCE questionnaire, the following decision were made to make amendment in the next version.

1. Reducing the number of attributes

Both an expert and pilot subjects raised the inability to trade-off nine attributes in their decision making to choose the preferred strategy. There was the need to reduce the number of attributes with discussion among steering group and working group members in next version (see Section 7.3.4 below).

2. Collecting additional information to facilitate data interpretation

Once the attributes were reduced by combining certain attributes, additional questions should be collected to further explore the potential preference differences. This involved adding information regarding their subjective knowledge of eye examination (recommended examination interval, service provision), subjective perceived needs for seeking preventive eye examination service, and attitude about information availability.

3. Removing the images and opt for a more layman description to explain the attributes and levels.

Based on the advice given by experts group, the description on the attributes and levels were decided to be amended in a more layman but specific pattern to the elders in the next version.

4. Revising the dominant choice set

It was found that people had different preference for the service location, therefore the dominant choice that included the authors' assumed level that are more superior may not be appropriate. It would be more appropriate to set the level for service the same (e.g. mobile service provides at the elderly centre) and elevating all the rest as "yes" being the more superior.

7.3.4 The finalised DCE design and questionnaire

7.3.4.1 Finalised list of attributes and levels

To further reduce the number of attributes, the 1st draft of the DCE consisted of nine attributes were firstly grouped into two key types of attributes, namely elderly centre-related attributes, and service-related attributes (Table 7.6).

Table 7.6 Changes made to the attributes of DCE questionnaire (Version 1)

Version 1	Amendment in Version 2
Programme target	Discarded
Activity content	Combined as a new attribute “How well-informed you are about eyecare and the service”
Trained elderly centre staff	
Eyesight ambassador involvement	
Providing information at the centre	
Fixed package *	Kept in Version 2, renamed it as “Specified fee range”
Service location *	Kept in Version 2
Appointment booking *	Kept in Version 2
Appointment reminder *	Kept in Version 2

Bolded are the elderly-centre related attributes.

* Service-related attributes.

Based on the pilot study, older adults focused more on the service-related attributes than the elderly centre-related attributes when answering the questions. They perceived the social influence from peer and ambassador was not essential to them, though these two attributes were seen as supplementary to each other. They did not make trade-off between these elderly centre-related attributes with other service-related attributes, as supported by the content provided in the think-aloud session. Considering this, the elderly centre-related attributes were collapsed into one attribute. This decision also considered the potential issues in future programme implementation. It would be unusual to implement an intervention programme with peer ambassador who received training but had untrained staff in the centre. Elderly centre staff is a gatekeeper to the elderly centre community, and it would make more sense that the empowerment activities were available to all the community actors (i.e. staff and members who volunteer as eyesight ambassador).

One way to collectively address all the discarded attributes in one attribute was adopting a laymen description of the attribute by describing how the environment could empower the older adults to obtain the information they needed to make the decision to use a preventive eye examination or not. Consequently, a new attribute termed “**how well-informed you are about**

eye care needs and service” was included. The two levels were “without supportive environment” and “with supportive environment”. The supportive environment was defined as having different activities to empower the older adults, having more health promotion activities having trained staff and volunteer to provide the information they need. The supportive environment aimed to exploit the advantage of the social influence in motivating the older adults to use the eye examination services.

The attribute ‘Programme target’ in the 1st draft of DCE was discarded because of concern of unclear eligibility of programme target. Also, as older adults were already the target of the programme, this attribute was therefore included in the explanation of the decision scenario.

Therefore, the number of attributes was further reduced from nine to five attributes as the final version as follows. The final list of five attributes:

1. Service location
2. Specified fee range
3. Appointment booking
4. Appointment reminder
5. How well-informed you are about eyecare and the service

It was aware that the preference on service location and specified fee range could be influenced by service quality. Given the comprehensive eye examination is provided by the registered Part I optometrists with the standard practice, the DCE assumed that regardless of service location and specified fee range, the service quality was the same.

All the five attributes in the final version still initiate seven intervention functions (to address the behaviour driver deficits in the non-uptake behaviour (Table 7.7)

Table 7.7 Attributes and levels in the finalised DCE questionnaire and the associated COM-B components and intervention functions

Attribute	COM-B	Intervention functions
Service location	Physical opportunity	Environmental restructuring
Specified fee range	Physical opportunity Reflective motivation	Incentivisation
Appointment booking	Automatic motivation Reflective motivation	Enablement
Appointing reminder	Psychological capability	Enablement

How well-informed you are about eyecare needs and service	Psychological capability Social opportunity Physical opportunity Reflective motivation	Education Persuasion Training Environmental restructuring Modelling Enablement
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To ensure that all subjects were clear about the attribute description, all subjects received the identical detailed description of the attributes as shown in Table 7.8.

Table 7.8 Descriptions of attributes and levels used to define programme to improve uptake of eye examination

Attribute	Levels	Description
Service location	Level 1: Optometric clinic in the community	Assuming the service quality are the same regardless of the service location, you can either receive the eye examination at the elderly centre via mobile service. Or, you can visit the optometric clinics in the community.
	Level 2: Mobile service provided at elderly centre	
Specified fee range	Level 1: No, not specified	Assuming the service quality are the same regardless of the service location, whether the service provider will state the service fee range.
	Level 2: Yes, specified	
		<p>If it is stated, it means that before you use the service, the service provider will state the fee range for the eye examination and glasses (if required). There will be a range of affordable glasses for you to choose from. You may upgrade the frame and lenses if you want. Otherwise, the service fee range will not change.</p> <p>If not stated, you will not know the service fee range in advance. It means that when you use the service, you will have to pay for the service, i.e. eye examination and glasses (if needed), based on the price set by the service provider, which can vary by different service providers.</p> <p>Note 1: you can use the elderly healthcare voucher to pay for the optometric services</p> <p>Note 2: Service quality refers that service will be provided by Part I Optometrists who are well-trained to provide eye examination and that they can all provide you with appropriate clinical advice/decision according to examination results.</p>

Appointment booking	Level 1: You book your next appointment	This describes how the next eye examination appointment is reserved.
	Level 2: Your service provider has scheduled your next appointment	
Appointing reminder	Level 1: No reminder	This is whether you will receive any reminder to attend the scheduled appointment. Any format can be considered (SMS, text message, phone, WhatsApp, WeChat, etc.)
	Level 2: Yes, with reminder	
How well-informed you are about eyecare needs and service	Level 1: Without supportive environment	Whether there will be a supportive environment to inform you well about the need for an eye examination and service-related information. For example, your centre staff, volunteers will be well-trained to provide you with the necessary eyecare information (knowledge). The centre will also disseminate information about the eye health and the service whether that is via the form of leaflet or educational activities.
	Level 2: With supportive environment	

7.3.4.2 Experimental design

A design with five 2-level attributes generated 32 combinations (2^5). It was not feasible to complete all 32 questions given the cognitive burden imposed to the subjects and the time constraint per each data collection session at the elderly centre (ideally each questionnaire should be completed within 45 minutes). Therefore, a subset of fractional design (fractional factorial design) was considered.

Following the steps in designing the 1st draft, Catalogue was used to look for an orthogonal main effect plan for five attributes with 2 levels for each attributes (Hahn et al., 1966). This directed to the initial identification of Plan Code 4a (Table 7.9). However, it was not the right plan for this study as it considered the two-factor interactions while this study did not hypothesize any interaction effect. Extended search in Catalogue was conducted using the techniques of “collapsing the attributes” (Hahn et al., 1966), i.e. we can look for the design for four levels for those attributes with two levels because the four levels can be collapsed into a two-level attribute by reassigning the level later. For example, instead of looking for the design for five attributes with 2 levels each, we can look for

1. four attributes with 2 levels and one attribute with 4 level; or

2. three attributes with 2 levels and two attributes with 4 levels; or
3. one attribute with 2 levels and four attributes with 4 levels

This directed to another five plan codes (each representing a design) being found in Catalogue (Table 7.9). However, only plan code 91 was finally considered because it required only 8 choice sets, which has the fewest number of choice test required among all and most feasible number for elders to complete. It is the design for four attributes with 2 levels each and one attribute with 4 levels.

Table 7.9 List of potential experimental plans

Plan Code	Total no. of variable	Number of variables at specific level				No. of test required	Any main effect independent of 2-factor interaction	No. of independent 2-factor under assumed model	Master plan no.
		2-level	3-level	4-level	5-level				
4a	5	5	0	0	0	8	Yes	1	2
27	5	0	0	5	0	16	No	0	5
82	5	1	0	4	0	16	No	0	5
86	5	2	0	3	0	16	No	0	5
89	5	3	0	2	0	16	No	0	5
91	5	4	0	1	0	8	No	0	2

Plan code 91 was used to construct the choice tasks in the 2nd draft of the DCE questionnaire.

7.3.4.3 Constructing the choice sets

The strategies to improve the uptake of eye examination can be finally described by 5 attributes which were

1. Service location (assigned to the 4-level attribute which were then collapsed into a 2-level attribute);
2. Specified service fee range (2 levels);
3. Appointment booking (2 levels);
4. Appointment reminder (2 levels); and
5. How well the older adults are informed about eye care needs and service (2 levels).

The specific steps that performed to collapse the levels can be found in Appendix D2.

The DCE design was a pairwise, unforced design (include a neither alternative). The properties were checked which fulfilled the orthogonality, and level balance (Table D2.6 and Table D2.7

in Appendix D2); all the checking were performed in Excel (frequency counting for level balance and obtain a correlation coefficient on the choice sets to check for orthogonality). Finally, the property of minimal overlap was achieved through adopting a shifting design in creating a pairwise DCE design. Adopting a shifting design ensured the information between two alternatives would not be the same (the property of minimal overlap was not violated). It could generate more information about the preference of the older adults for the strategies to improve preventive eye examination utilisation. To construct the choice set which consisted of two forced alternatives, a shifting design was used (Table 7.10). The attribute with a coding of 0 were coded to 1 and vice versa (Table D2.4 in Appendix D2).

Table 7.10 An updated coding levels of attributes and level used in final DCE design (version 2)

Attributes	Levels	
Service location	Optometric clinics in the community	Mobile service provides at the elderly centre
Service fee range	<i>Yes, stated</i>	<i>No, not stated</i>
Appointment booking	You make the next appointment	The service provider has scheduled your next appointment
Appointment reminder	No	Yes
How well are you informed about eye care needs and service	Without supportive environment	With supportive environment
Coding level	0	1

The new sets of choice sets were incorporated into the 2nd draft of the DCE questionnaire. Dominant choice set was a choice set which included five attribute levels that were considered more superior than the others. The levels assumed to be more “superior” were mobile service provides at the elderly centre for service location, with a stated service fee range, the next appointment being booked by the service provider, with appointment reminder and with supportive environment to allow the older adult to be well informed about eye care needs and service.

As there were no specific factor that would influence the preference (such as branding), the alternatives were labelled generically as “Programme A”, “Programme B” and “Neither”. A dominant choice task was added as a rationality test to ensure internal validity of the results.

Figure 7.3 and Figure 7.4 shows the English version and Chinese version of the example choice set, respectively. The overall question that set the decision-making scenario for the subjects to complete the eight choice sets was:

“Please compare the two programmes. Which programme would encourage you to use eye examination regularly? If you think neither programme would encourage you, you can choose “neither” option.”

	Programme A	Programme B	Neither
Service location	Optometric clinic in the community	Mobile service provides at the elderly centre	
Specified fee range	No	Yes	
Appointment booking	You make the next appointment	The service provider has scheduled your next appointment	
Appointment reminder	Yes	No	
How well are you informed about the need and service	With supportive environment	Without supportive environment	
<i>Which programme would you prefer?</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Figure 7.3 Example DCE choice set (English version)

例子

請比較方案一和方案二，然後指出你哪個方案更可能令你去定期驗眼。
或者如果你覺得兩者都不會鼓勵你驗眼，你可以選“兩者都不會”。

	方案一	方案二	兩者都不會
驗眼地點	在社區視光診所	在長者中心提供流動車服務	
指定服務收費範圍	沒有	有	
預約方式	自己聯繫服務提供者	服務提供者已幫你排期	
預約提醒	有	沒有	
提供資訊支援	有	沒有	
你會選擇哪個方案？	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Figure 7.4 An example DCE choice set presented to the subjects for explanation purpose (Chinese version)

7.3.4.4 *Developing the 2nd draft of questionnaire*

The full questionnaire included three parts.

1. Part 1 of the questionnaire comprised of a series of questions to collect information on previous use of eye examination, subjective knowledge about eye examination and their elderly centre utilisation behaviour.
2. In Part 2 of the questionnaire, an explanation on the DCE questionnaire was provided to the subjects. The hypothetical scenario, attribute and levels were explained. The responses of the rating and ranking of attribute importance were collected. Subjects were asked to complete a warm-up question, rationality test and eight formal DCE questions. Subjects were not aware there was a rationality test. The subjects would also complete three debrief questions on collect information on understandability and the way they completed the choice sets. This was followed by the completion of debrief question by the interviewer.
3. Finally, in Part 3 of the questionnaire involved questions on demographic, health-related questions (self-reported and self-perceived health status) and attitude towards information availability. Questions were taken from the thematic report on older adults (Census and Statistics Department of The Hong Kong Special Administrative Region, 2022).

The Chinese version of the questionnaire was used in formal data collection (Appendix D3).

7.3.4.5 Piloting the 2nd draft of the DCE questionnaire

The preliminary 2nd draft of the DCE questionnaire was further piloted on four actual DCE subjects (aged 65 years or above) to ensure the understandability of the attributes and levels, check for potential cognitive burden and the including of additional questions added in Part 1 and Part 3 of the questionnaire (knowledge on eye examination and eye examination service and attitude towards information availability).

The pilot findings revealed that older adults could complete the questionnaire within 50 minutes and that they did not express any cognitive burden during questionnaire completion.

Regarding the understanding of the attributes, the pilot subjects shared that the explanation was clear for the first four attributes (service location, specified service fee range, appointment booking and appointment reminder). However, the term used to describe the fifth attribute has caused slight confusion to the subjects. The attribute described having a supportive environment to empower the older adults to access the information about eye health and service. Initially the literal translation was “information network” (提供資訊網絡). The translation concerning the word “network” (網絡) was interpreted as internet-related information seeking. Older adults shared they understood the attribute as “*information will be disseminated through the internet*”. As a results, the attribute “how well you are informed about eye health and service” were translated into 提供資訊支援, which highlight the “support” provided to the older adults, to avoid confusion in the understanding of the attributes. Nonetheless, it was aware that a short attribute name was unlikely to capture the essence of “supportive environment”. Therefore, the interviewer would need to ensure the description of this attribute included different elements within a supportive environment. It was decided that in the formal DCE survey, the standard information to describe the ‘supporting environment’ would be given by the interviewer to ensure the subjects could understand this attribute to the same level.

Furthermore, it was noticed that older adults tended to imagine a scenario of treatment-seeking behaviour, e.g. seeking help from an ophthalmologist for treatment. The interviewer would need to further confirm with the older adults and highlight the hypothetical scenarios.

Table 7.11 Example of dominant choice set

Choice 0	Programme A	Programme B	Neither
Service location	Mobile service provides at the elderly centre	Mobile service provides at the elderly centre	
Service fee range	No	Yes	
Appointment booking	You make the next appointment	The service provider has scheduled your next appointment	
Appointment reminder	No	Yes	
How well are you informed about eyecare needs and service	Without supportive environment	With supportive environment	
Which programme would you prefer?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

7.3.4.6 Finalised questionnaire

The Chinese version of the DCE questionnaire (version 2) was used in the formal data collection. The full version of the DCE questionnaire (Chinese and English version) can be found in the Appendix D3 and Appendix D4 , respectively.

7.3.5 Sample size calculation

The minimal sample size was estimated using the rule-of-thumb calculation (Orme, 2010): $n \geq 500c/ta$, where c is the highest level of attributes (2), t = the number choice set required (8), a = the number of alternatives (3). Following this calculation, a minimal sample size was calculated (i.e. $500 \times 2 / 8 \times 3 = 41.6$). A minimal sample size for this study was 42 subjects. The minimal target sample size was set at 60 subjects after considering a 30% drop out rate. Considering the common range for a DCE commonly involved 100 to 300 subjects (de Bekker-Grob et al., 2015; Kleij et al., 2017) and availability of the existing data pool for invitation, a final number of subjects to be approached targeted between 100 and 125 .

The sample size required for each centre was calculated based on the distribution of the elderly population in each district in Hong Kong. The elderly proportion per district was extracted from Table 5 of the “Population and household statistics analysed by district council district” document published in 2021 (Census and Statistics Department, 2021, p. 26).

7.3.6 Centre recruitment and subject recruitment

Overview: The subject for this study were recruited from an existing elderly centres cohort who have participated in a previous funded DCE project conducted between 2020 and 2021 (Research Fund Secretariat, n.d.). This previous project recruited 731 elders who were aged 65 years or above attending 20 elderly centres with random selection of the elderly centres across 18 geographical districts in Hong Kong. They represented the group of older adults who were community-dwelling individual attending an elderly centre. Among the 731 subjects, 82.6% were female.

The previous DCE study consisted of information that would allow selection of eligible subjects for the current DCE study. The inclusion criteria of the current DCE study were:

- 65 years or above
- Hong Kong citizen
- Who had not had an eye examination in the past 24-month and were not under the ophthalmology care at the time of completing the previous DCE project
- Who was able to provide informed consent; and
- Who was able to attend an in-person individual interview at the elderly centre.

As the previous DCE project had the same criteria on age and background, it could be certain that all the previous subjects would fulfil the age inclusion criteria and was a community-dwelling Hong Kong citizen. This study aimed to recruit subjects who were eligible for preventive eye examination but did not access to any eye examination in the past 24month based on their reported status to the following questions when participating in the previous DCE project. Therefore, for those reported ‘Yes’ to the question “Have you received comprehensive eye examination check by an ophthalmologist/ optometrist in the past 24 months?” (請問您過去 24 個月有冇去眼科醫生 或者視光師度驗過眼呢？) were excluded. Further, for those reported ‘No’ to the above question (i.e. no access to eye examination) but reported ‘already followed up by an ophthalmologists’ were excluded because they were not eligible for preventive eye examination. For those reported a one-off checkup by an ophthalmologist were still included as they are still eligible for preventive eye examination.

Among the original 731 subjects in the previous DCE project, after excluding those who have self-reported previous use of eye examination within 24-month ($n = 232$) and among those self-reported no use of eye examination but already followed up by an ophthalmologist ($n = 213$),

a total of 286 subjects from the previous DCE study cohort were eligible for invitation to the current DCE study.

7.3.6.1 Centre recruitment

For centre recruitment, the elderly centre received an email invitation to take part in the DCE study (Appendix D5). A phone call discussion with the centre-in-charge (or responsible staff member) was followed within a week of sending the invitation to confirm willingness to participate. Reasons for not participating were recorded. A centre was considered “unapproachable” if five phone calls were made and unable to contact with the centre-in-charge. A centre was considered as “declined invitation” if the centre-in-charge replied they had no intention to take part. Specific reasons for declining the invitation were recorded.

7.3.6.2 Individual recruitment

After the centre agreed to participate, the names of the subjects from the previous study were extracted with the approval of the principal investigator of the project. Then the password-protected name list was emailed to the centre staff for their assistant to invite the elders (Appendix D6). No direct contact was made between the researcher and the subjects during the recruitment period. The elderly centres were given one to two weeks for individual subject recruitment. For those who declined the invitation, reasons were recorded by the responsible centre staff. Pre-defined criteria were “could not be reached by phone call”, “not available”, “not interested”, “mobility-handicapped”. Other reasons were grouped together if available. For the older adults who did not answer the phone call within the recruitment period were considered “could not be reached by phone call”.

For older adults who agreed to take part, the centre staff would schedule a timeslot with them. After the end of the subject recruitment period, the password-protected name list was sent back to the researcher. The elderly centre staff would make a reminder phone call to the older adults one day prior to the scheduled appointment.

7.3.7 Data collection

Data collection period was between September 2023 to October 2023. This DCE questionnaire was interviewer-administered. All subject visited the elderly centre to complete the

questionnaire in a quiet room. First, the interviewer explained the questionnaire aim and study to the subjects where they were asked to provide their written informed consent. Anyone who declined to give written consent was considered “did not consent to participate”. Once informed consent was obtained, the interviewer followed the guide to instruct the subjects to complete the questionnaire. Anyone who did not complete the full questionnaire regardless of reasons was considered as “withdraw from the study”. Reasons for withdrawal were recorded.

A question was added to ask the subjects’ previous eye examination within 24-month because it was two years now since their last participation in the previous DCE project to update the possible change in the service utilisation.

For subjects who completed the full questionnaire were given a shopping voucher as a token of appreciation.

7.3.8 Data management and data cleaning

After data collection, the data was entered by WYL who also confirmed the entry accuracy using double checking and visual checking (Barchard et al., 2020). The data was first entered as wide format where each subject occupy a row.

To prepare for DCE data analysis, the data were then restructured from wide format to long format (each row presents one observation) (Appendix D7). For this DCE study, each subject was asked to complete nine choice-based question (including one rationality test and the formal eight DCE questions). For each DCE question, there were three alternatives (Programme A, Programme B and Neither option). The outcome variable was the decisions of the subjects (Programme A, Programme B or Neither) which were categorical variables. The chosen alternative was marked as 0 for not chosen, and 1 for chosen.

All the attribute levels were dependent variables which were treated as categorical variables. All the attribute levels were dummy-coded, where 0 = attribute not selected, and 1 = attributes selected. As there was an “neither” alternative involved, given the DCE analysis was based on the change from 0 to 1, a column was added for “service location” attributes and “appointment booking” attributes to represent the scenario where there was an absence of the attribute for “Neither” option. Following this rule, each subject would have contributed 27 rows of data (include one rationality test and eight DCE choice sets), of which 24 rows are usable for analysis (8 choices with three alternatives, i.e. 8×3). Answer obtained as open-ended questions

were reviewed and grouped into categories accordingly. The details of variables that were recoded can be found in the Appendix D8.

7.3.9 Statistical analysis

Data analysis was performed in SPSS (version 29) and STATA (version 18).

7.3.9.1 Descriptive analysis

The sociodemographic characteristics of the subjects, subjective perception and knowledge regarding eye examination services, self-reported health, and self-perceived health, as well as the option on information availability were reported descriptively. The results of the ranking and rating exercises on the importance of the five attributes were also reported descriptively.

7.3.9.2 Analysis of DCE data

The probability of a respondent who will select a specified strategy to encourage their uptake of the preventive eye examination was modelled. The probability of choosing a given alternative is determined by the indirect utility function as below. The utility function included both deterministic part (specified in the DCE questionnaire as attribute levels) and random error term (ε), by assuming utility is linear and additive.

$$V_j = \beta_0 + \beta_1 SL_{clinic} + \beta_2 SL_{mobile\ service} + \beta_3 FR_{not\ specified} + \beta_4 FR_{specified} \\ + \beta_5 AB_{by\ service\ provier} + \beta_6 AB_{by\ user} + \beta_7 AR_{without} + \beta_8 AR_{with} \\ + \beta_9 WI_{not\ supportive} + \beta_{10} WI_{supportive} + \varepsilon$$

- Service location (SL)
- Specified service fee range (FR)
- Appointment booking (AB)
- Appointment reminder (AR)
- How well are you informed about eyecare needs and service (WI)

where V_j is the utility derived from a specified strategy (j) to encourage the uptake of the eye examination; beta (β) is coefficient representing the relative importance of each attribute level. Any beta (β) with a positive value (>0) implies a preference for the attribute level rather than the reference level.

The beta coefficients from β_1 to β_{10} were to be estimated from the above utility function. As dummy coding was used, the coefficient for the reference groups were constrained to be zero (Hauber et al., 2016). Significant value was set at $p < 0.05$. The alternative specific constant (ASC) (β_0) revealed the coefficient in the absence of the attributes, which was overall preference for their engagement in an eye examination when there was no intervention programme. A negative and statistically significant ASC suggested the subjects' tendency for not getting their eye examined when the attributes levels remained unchanged. In contrast, a positive and statistically significant ASC implied that the subjects' tendency to favour the programme alternative to encourage their uptake of eye examination.

Given the respondents were asked to choose between three alternatives (two strategies to encourage their uptake of eye examination and neither), DCE data were analysed using conditional logit model (CLM) (McFadden, 1974; Ryan et al., 2008), which is the most widely used discrete choice model (Clark et al., 2014; Soekhai et al., 2019; Train, 2009).

There are three underlying assumptions of CLM model (McFadden, 1974; Ryan et al., 2008). First assumption is that the preferences are homogeneous. Subjects recruited for this study were relatively homogenous in terms of all elders aged 65 years or above, attending elderly centres which represent the actively community-dwelling elders, and have not used eye examination provided by the ophthalmologist or optometrists in the past 24-month (based on the record reported at the time of completing the previous DCE study). In addition, there was no prior information in the current literature for the suspicion that the tastes or preferences might varied considerably across members of this group for some attributes. Therefore, the preferences were likely to be homogenous among this group.

The second assumption is the identical errors which refers to no change in individual choice behaviour, e.g. due to learning or fatigue. During the DCE design, the following procedure was adhered to minimize and monitor the possible cognitive fatigue (Johnson et al., 2019). There were 10 choice sets in total, including eight main choice sets, one warm up question, and one rational choice sets to test whether the subjects were actively engaged in making comparison between choices. During the first four DCE format questions, the researcher asked the subject to think-aloud their thought while completing the questionnaire to provide more information to judge their performance. If the subject was found to fail the rational question, the subject would be asked to explain their choice and the interviewer can judge whether the explanation was justifiable or not. For unjustified explanation the data would be excluded from the final

analysis. During the whole process, subjects can choose to have a rest any time in between the choice sets and the interviewer also observed the subject's effort in making decision between choice sets.

The third assumption was independent errors, e.g. one individual answering ten choice questions is same as ten individuals answering one question each. In this assumption, it was useful to check the Independence of Irrelevant Alternatives (IIA) property, which refers to the relationship between two options is not affected by inclusion or exclusion of a third option. Hausman-McFadden Test was used to examine the IIA property (Hausman, 1978) (Fry & Harris, 1998). This test would compare the full model with all three alternatives, with the second model by dropping out one of the three alternative each time to test if there are statistical differences in the coefficient obtained from the two models (Hauber et al., 2016).

7.3.9.3 Predicting potential uptake rate based on different scenarios

The utility value derived were used to calculate the probability of the older adults for choosing a strategy over other alternative strategy given in a hypothetical scenario. To calculate the potential uptake rate, three steps were considered (Ryan et al., 2008).

- **Step 1:** Specify a comparison scenario (i.e. the strategy with varied levels of each attribute to encourage the uptake of preventive eye examination) to predict the uptake rate.
- **Step 2:** Calculate the utility of each specific intervention strategy option involved in the comparison scenario, using the results derived from the CLM.

$$u_{jn} = \beta_0 + \beta_1 attr1 + \beta_2 attr2 + \beta_3 attr3 + \beta_4 attr4 + \beta_5 attr5 + \varepsilon$$

The deterministic part of the equation involved the characteristics of the intervention strategy that represent a specific alternative, which includes the coefficients of the five attributes ($\beta_1 - \beta_5$) and the constant term (β_0). Then, u_{jn} is the utility of a specific intervention strategy alternative j.

- **Step 3:** With the results obtained from Step 2, the utility of the specific intervention strategy can be used to calculate its potential predicted uptake rate, using the following equation (Ryan et al., 2008; Train, 2009):

$$\Pr(\text{Alt } i \text{ is chosen}) = \frac{e^{v_{int}}}{\sum_{j \in [1, J]} e^{v_{jnt}}}$$

This equation describes that the uptake probability exponential of utility of each specific intervention strategy divided by the sums of the all the included alternatives under the hypothetical comparison scenario. All the probability of all the available strategies included in a scenario comparison should add up to one. Below is an example how the probability of uptake was calculated in this study.

Example:

Consider a scenario of three available options, Programme A, Programme B and Neither programme, all of which are described by the following attribute levels and the utility was calculated for each programme.

Programme A *includes delivering the eye examination in mobile service (SL), not having a specified service fee range (SF), the appointment was booked by the service provider (AB), without an appointment reminder (AR), with a supportive environment to empower the older adults to be well-informed about the eye health and service-related information (WI). The utility for this specific intervention programme A can be calculated using the following equation.*

$$\begin{aligned} V_{\text{programme A}} = & ASC_A + \beta_2 SL_{\text{mobile service}} + \beta_3 SF_{\text{not specified}} \\ & + \beta_5 AB_{\text{by service provier}} + \beta_7 AR_{\text{without}} + \beta_{10} WI_{\text{supportive}} \end{aligned}$$

where ASC_A is the constant term for programme A. The different coefficients ($\beta_2, \beta_3, \beta_5, \beta_7, \beta_{10}$) represent the relative importance of the specific attribute levels include in a specific programme alternative.

Programme B *includes delivering the eye examination at the optometric clinic (SL), with a specified service fee range (SF), the appointment was booked by the service user (AB), with an appointment reminder (AR), without a supportive environment to*

empower the older adults to be well-informed about the eye health and service-related information (WI). The utility for this specific intervention programme B can be calculated using the following equation.

$$V_{\text{programme B}} = ASC_B + \beta_1 SL_{\text{clinic}} + \beta_4 SF_{\text{specified}} + \beta_6 AB_{\text{by user}} + \beta_8 AR_{\text{with}} + \beta_9 WI_{\text{not supportive}}$$

Where ASC_B is the constant term for programme B. The different coefficients ($\beta_1, \beta_4, \beta_6, \beta_8, \beta_9$) represent the relative importance of the specific attribute levels include in a specific programme alternative.

The utility of the opt-out option (neither programme), reflecting the option for not getting a preventive eye examination, was assumed to be zero.

$$V_{\text{no exam}} = 0$$

Then, to calculate the probability for all three options, the following calculated was performed.

$$\Pr(\text{programme A}) = \frac{e^{V_{\text{programme A}}}}{e^{V_{\text{programme A}}} + e^{V_{\text{programme B}}} + e^{V_{\text{no exam}}}}$$

$$\Pr(\text{programme B}) = \frac{e^{V_{\text{programme B}}}}{e^{V_{\text{programme A}}} + e^{V_{\text{programme B}}} + e^{V_{\text{no exam}}}}$$

$$\Pr(\text{no exam}) = \frac{e^{V_{\text{no exam}}}}{e^{V_{\text{programme A}}} + e^{V_{\text{programme B}}} + e^{V_{\text{no exam}}}}$$

The secondary objective was to estimate the potential uptake rate of preventive eye examination programme that consisted of the preferred attribute levels. Following the above calculation, the potential uptake rate for each of the profile included in the DCE questionnaire was calculated (a total of 24 profiles grouped by choice set, each choice set included two

programme alternatives and one opt-out option) to demonstrate the potential impact of different programmes in improving the uptake of preventive eye examination by the older adults. In addition, the ideal strategy consisted of the most preferred attribute levels (i.e. highest coefficient) for all attributes was also examined.

7.4 Results

7.4.1 Centre recruitment

All the 20 previously participated centre approached for invitation by sending an invitation email, 13 of them agreed to participate, with a participation rate of 65.0%. Reasons for declining the invitation by the centre included lack of manpower ($n = 4$), no interest to collaborate ($n = 1$).

7.4.2 Subject recruitment

A total of 141 older adults were approached by the centre staff for invitation, of which a total of 111 subjects agreed to take part in the DCE survey, as defined as those who verbally agreed to attend the questionnaire and scheduled timeslot (Figure 7.5). Reasons for declining the invitation included “could not be reached by phone call” ($n = 8$), not interested ($n = 8$), not available to attend ($n = 6$), mobility-handicapped ($n = 5$), deceased ($n = 2$), and in residential care ($n = 1$).

Due to extreme weather condition during early October 2023 in Hong Kong, the appointment scheduled for one centre in Yau Tsim Mong district had to be cancelled. As a result, six subjects required rescheduling the questionnaire survey and only three were able to reschedule by 21 October 2023 (the last day of data collection). Excluding the three subjects who were unable to reschedule by the deadline of data collection, a total of 108 subject agreed to take part and was scheduled an appointment to attend an in-person questionnaire session. The final acceptance rate for invitation was 76.6% (108/141).

Of these 108 subjects, six subjects did not show up at the scheduled appointment, leaving 102 subjects who attended the survey. Of these 102 subjects, three of them declined the participation, as defined as those who did not provide written consent to take part. Therefore, a total of 99 subjects agreed to participate in the survey.

Of these 99 subjects, four of them withdrawn from the study and did not complete the whole questionnaire. Reasons for withdrawal include, conflict of time schedule ($n = 1$), felt bored while the interviewer was explaining the DCE content ($n = 1$), unable to understand how to complete the DCE choice set ($n = 1$), and no intention to engage in preventive eye examination despite being a voucher eligible recipient ($n = 1$). These subjects accounted for 4% (4/99) of the total recruited sample size.

Among the 95 subjects who completed the questionnaire, two of them was excluded from data analysis. They were rated a “3” (“*Doubtful whether the respondent understood the task*”) on understandability by the interviewer. These two subjects displayed clear signs of inability to understand how to complete the DCE questionnaire. They were unable to share justifications on the way they completed the choice set. The interviewer also observed sign of confusion from their facial expressions.

- One of them completed the whole DCE questionnaire but was obvious that this subject did not understand how to choose between all three alternatives, as the explanation given reflected this subject did not consider “Neither” (the opt-out option) as a choice. This subject kept saying that “*I didn’t want to [undergo a comprehensive eye examination]*”, while there was an available alternative for her to reflect her intention to not engage in preventive eye examination.
- Another subject showed interest in the questionnaire at first and has given consent to take part. This subject was able to complete the rating and ranking exercise, however showed difficulties in the articulating the thought process. The interviewer also observed the subject had difficulties “comparing” and “considering” all the choice set before making a final decision, suggesting a high risk of lowering internal validity. Although the interviewer explained the entitled right to withdraw, this subject rejected and showed strong intention to complete the whole questionnaire survey.

Considering the above, these two subjects were excluded from the final analysis, leaving a total of 93 subjects being included in the final statistical analysis.

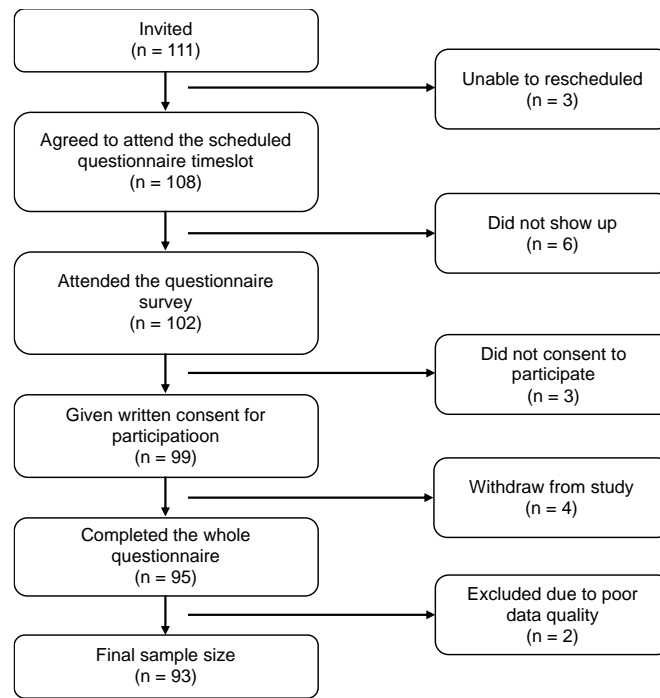


Figure 7.5 Flowchart for DCE questionnaire study

7.4.3 Descriptive statistics on characteristics of subjects

The 93 subjects were recruited from 13 centres which located across different 12 districts, covering all three regions in HK i.e. Hong Kong Island, Kowloon, and New Territories (Table 7.12).

Table 7.12 Number of subjects from twelve districts

	n	%
Central & Western	5	5.4
Kwai Tsing	6	6.5
Kwun Tong	19	20.4
Sai Kung	5	5.4
Sha Tin	4	4.3
Sham Shui Po	8	8.6
Southern	14	15.1
Tai Po	5	5.4
Tsuen Wan	7	7.5
Tuen Mun	7	7.5
Wan Chai	3	3.2
Yau Tsim Mong	10	10.8

7.4.3.1 Demographic characteristics of the subjects

Table 7.13 shows the subjective characteristics. The majority of the subjects were female (89.2%) and were from the 70 to 74 age group (30.1%). The personal monthly income reported was mostly within the range of HKD 2,000 – 4,999 (54.8%), with most elders relied on old age living allowance for their monthly living expenses. The subjects who self-reported they have ever been diagnosed with hypertension and high cholesterol, accounted for 65.6% and 57.0 % of the surveyed individual, respectively.

Table 7.13 Characteristics of subjects (N = 93)

	n	%
Sex		
Female	83	89.2
Male	10	10.8
Age group		
65 – 69	19	20.4
70 – 74	28	30.1
75 – 79	24	25.8
80 – 84	15	16.1
85 +	7	7.5
Education level		
Primary or below	51	54.8
Secondary or above	42	45.2
Marital status		
Single (never married/ widow/ divorce/ separate)	55	59.1
Married	38	40.9
Living arrangement		
Living alone	37	39.8
Living with others	56	60.2
CSSA		
No	80	86.0
Yes	13	14.0
Personal monthly income (HKD)		
< 2,000	2	2.2
2,000 - 4,999	51	54.8
5,000 - 9,999	19	20.4
10,000 or above	9	9.7
No income	4	4.3
Don't know	4	4.3
Refuse to answer	4	4.3
Source(s) of income		

Old age allowance	15	16.1
Old age living allowance	52	55.9
Disability allowance	1	1.1
Financial support from family members/ relatives	30	32.3
Saving/ Pension	15	16.1
Employment	3	3.2
Prefer not to say	5	5.4
Others	9	9.7
History of chronic illnesses ^		
Hypertension (yes)	61	65.6
High cholesterol (yes)	53	57.0
Diabetes (yes)	13	14.0
Cardiovascular diseases (yes)	12	12.9
Asthma (yes)	0	0.0
Cancer (yes)	10	10.8
Stroke (yes)	13	14.0

^ Percentage reported reflect the proportion of which older adult self-reported they have ever been diagnosed with the conditions by a doctor.

7.4.3.2 Self-perceived health

Table 7.14 shows the results of self-perceived physical health self-reported and self-perceived visual health status. Of the 93 subjects, 83.9% of them needed to wear optical aids. For self-reported visual health, the majority of the subjects reported they have presbyopia (84.9%), and more than half of the subject reported they have ever had cataract before (54.8%). Over half of the subjects had a history of cataract. Overall, the surveyed population considered themselves having “good” physical health compared to others of the same age (36.6%).

Table 7.14 Self-perceived and self-reported visual health status (N = 93)

	n	%
Self-perceived physical health status		
Excellent	10	10.8
Very good	24	25.8
Good	34	36.6
Fair	6	6.5
Poor	2	2.2
Don't know	17	18.3
Require optical aids (yes)	78	83.9
Self-perceived visual status		
Excellent	7	7.5
Good	28	30.1

Fair	53	57.0
Poor	5	5.4
Type(s) of refractive error*		
Myopia	23	24.7
Hyperopia	8	8.6
Astigmatism	37	39.8
Presbyopia	79	84.9
History of eye diseases^		
Age-related macular degeneration	4	4.3
Cataract	51	54.8
Diabetic retinopathy	0	0.0
Glaucoma	1	1.1
Others	16	17.2

*Total number does not add up to 93 as multiple answers were allowed.

^ Percentage reported reflect the proportion of which older adult self-reported they have ever been diagnosed with the conditions by a doctor.

7.4.3.3 Previous utilisation of elderly centre

Table 7.15 shows the previous utilisation of elderly centre service by the older adults. Overall, the subjects have had past experience engaging in the elderly centre activities. The majority of the subjects considered themselves as frequent users of the elderly centre (92.5%). Almost half of the surveyed individual had been a member at the elderly centre for more than ten years (48.4%). More than half of the subjects were involved in volunteer work at the elderly centre (59.1%).

Table 7.15 Previous utilisation of elderly centre (n = 93)

	n	%
Self-considered as a frequent user of elderly centre		
No	7	7.5
Yes	86	92.5
Elderly centre membership duration		
Within 10 years	40	43.0
More than 10 years	45	48.4
Forgot	8	8.6
Had previously participated in activities organised by the elderly centre		
No	4	4.3
Yes	89	95.7
Currently a volunteer at the elderly centre		
No	38	40.9
Yes	55	59.1

7.4.3.4 Subjective knowledge, attitude, and utilisation of eye examination service

Table 7.16 reports the subjective knowledge and attitudes of the subjects on eye examination services. Of the 93 surveyed subjects, more than half of them did not know about the recommended eye examination interval (64.5%). For those who claimed they knew where to access eye examination services, most shared they could use the service at the Public ophthalmic clinics/ hospital (12.1%). Although almost all subjects believed that regular eye examination is important (95.6%), more than half of the subject believed that they would only seek eye examination when they experienced symptoms (59.1%). Regarding the subjective perception of the information availability of eye examination services, 80.6% of the subjects perceived the information regarding preventive eye examination was “insufficient”. Among the surveyed individual, 48.4% of them shared they have never come across any information related to the eye examination service. Elderly centre and healthcare professional were the two most common sources of information which the subjects had received information about eye examination (Table 7.16).

Table 7.17 shows the previous utilisation of eye examination within 24-month when the subjects participated in this study. Just more than half of the subjects (52.7%, 49/93) self-reported they have not used any eye examination service within the 24-month. The reasons for non-service utilisation were mainly due to two reasons, namely the subject perceived no eye problem (49.0%, 24/49) and the ophthalmologist from their previous eye examination told them they were fine, and “no need” to come back for check-up (22.4%, 11/49).

Table 7.16 Subjects’ knowledge and attitude of eye examination utilisation and source of information about eye examination service

	n	%
Subjective knowledge about eye examination interval (n = 93)		
Don't know	60	64.5
Know	33	35.5
Knowledge about location to access eye examination service (n = 93)		
Don't know	35	37.6
Know	58	62.4
Location believed by subjects that provide eye examination services (n = 58)		
General public clinic / hospital	7	12.1
General private clinic / hospital	1	1.7
Public ophthalmic clinics / Hospital	31	53.4
Private ophthalmic clinic / hospital	9	15.5
Optometric clinic/ centre	7	12.1

NGO	5	8.6
Attitude about regular eye examination (n = 93)		
Not important	5	5.4
Important	88	94.6
Seek eye examination only when experience symptoms (n = 93)		
No	38	40.9
Yes	55	59.1
Think the information on eye examination is sufficient (n = 93)		
Not sufficient	75	80.6
Sufficient	18	19.4
Self-reported information source(s) on eye examination service* (n = 93)		
Family members/ relatives	4	4.3
Peers/ friends	3	3.2
Elderly centres	22	23.7
Advertisement / media (social media, internet)	8	8.6
Government leaflets / campaign	2	2.2
Healthcare professional, e.g. doctors, optometrists	15	16.1
Others	4	4.3
Never come across any information related to eye examination	45	48.4

*Question allows multiple answers.

Table 7.17 Previous utilisation of eye examination by an ophthalmologist or an optometrist within 24-month

	n	%
Had eye examination utilisation within 24-month (n = 93)		
No	49	52.7
Yes	44	47.3
Reasons for not undergoing an eye examination within 24-month (n = 49)		
Cost	3	6.1
Currently no eye problem	24	49.0
Not being told of the need to have eye examination	1	2.0
Already follow up by an ophthalmologist	1	2.0
Ophthalmologist from previous eye examination said "no need"	11	22.4
Pandemic	4	8.2
Unable to make an appointment	3	6.1

Don't know where to access the service	2	4.1
Reasons for undergoing an eye examination within 24-month (n=44)		
Regular follow up by an ophthalmologist (for known/ diagnosed eye diseases)	17	38.6
One-off check up with ophthalmologists^	5	11.4
Regular comprehensive eye examination	2	4.5
Glass prescription	12	27.3
Others*	8	18.2

^ Not regular check-up, e.g. eye infection, injuries, discomfort or other visual issues that were referred.

* Reasons for others included encouraged by others (n = 4) and having an eye examination being part of a health promotion activity (n = 4).

7.4.4 Preference for strategies to improve the use of eye examination

7.4.4.1 Result from rating and ranking exercise on attribute importance

Of the 93 subjects, all subject completed the rating exercise. All attributes were rated as “important” by at least 89% of the subjects, which suggested that all attributes were relevant to the subjects in their decision-making to seek eye examination services (Table 7.18).

Two subjects could not complete all the questions in the ranking exercise with one subject shared that “all the attributes were equally important”, and the other didn’t want to rank because this subject did not consider undergoing a preventive eye examination. Of the two subject, one ranked specified fee range as the most important.

The findings of ranking revealed that subjects valued the five attributes differently, with a tendency to rank service location, specified fee range and having a supportive environment (how well you are informed about eye care and service) as the most important attribute among the five (Table 7.19).

Table 7.18 Rating results on the importance of attributes (N = 93)

	n	%
Service location (important)	83	89.2
Specified service fee range (important)	87	93.5
Appointment booking (important)	90	96.8
Appointment reminder (important)	89	95.7
How we you are informed (important)	89	95.7

Table 7.19 Ranking results on the importance of attributes

	Service location (n = 91)	Specified fee range (n = 92)	Appointment booking (n = 91)	Appointment reminder (n = 91)	How well you are informed (n = 91)
	n (%)	n (%)	n (%)	n (%)	n (%)
Ranking					
1	28 (30.8)	23 (25.0)	4 (4.4)	11 (12.1)	26 (28.6)
2	25 (27.5)	26 (28.3)	14 (15.4)	15 (16.5)	11 (12.1)
3	18 (19.8)	15 (16.3)	30 (33.0)	13 (14.3)	15 (16.5)
4	14 (15.4)	11 (12.0)	29 (31.9)	20 (22.0)	17 (18.7)
5	6 (6.6)	17 (18.5)	14 (15.4)	32 (35.2)	22 (24.2)

7.4.4.2 Descriptive statistics of DCE results

Table 7.20 shows the descriptive statistics on the eight choice sets and the rationality test. For people to pass the rationality test, it was assumed that people would choose Programme B. Three subjects chose “neither” options. Two subjects perceived no need for regular eye examination (“eyesight is fine”), among which one shared that eye examination was only required for glass prescription. Another one was already taken care of at secondary eye care due to rare eye diseases and that the subject believed that primary eye care utilisation would be unlikely in the future. The three subjects who did not pass the rationality also answered “neither” for all eight DCE questions.

Table 7.20 Descriptive statistics DCE questions (N = 93)

	n	%
Rationality test		
Programme A	0	0.0
Programme B	90	96.8
Neither	3	3.2
Question 1		
Programme A	17	18.3
Programme B	61	65.6
Neither	15	16.1
Question 2		
Programme A	40	43.0
Programme B	37	39.8
Neither	16	17.2
Question 3		
Programme A	79	84.9
Programme B	6	6.5
Neither	8	8.6
Question 4		
Programme A	25	26.9
Programme B	56	60.2
Neither	12	12.9
Question 5		
Programme A	49	52.7
Programme B	29	31.2
Neither	15	16.1
Question 6		
Programme A	7	7.5
Programme B	77	82.8

Neither	9	9.7
Question 7		
Programme A	83	89.2
Programme B	4	4.3
Neither	6	6.5
Question 8		
Programme A	19	20.4
Programme B	59	63.4
Neither	15	16.1
Answered “Neither” for all 8 questions (Yes)	3	3.2

Table 7.21 shows the descriptive statistics on the debrief questions. Of the 93 subjects, 17 of them reported they found the DCE questionnaire “quite difficult” to complete. The reasons shared included “spending time to consider the most preferred scenarios”. There were also mentioned of having “multiple factors to consider” which took them longer to complete the questions. Seventeen subjects shared that they had considered other factors besides the five attributes when completing the questionnaire. A total of twenty factors were mentioned which could be categorised into six groups (Table 7.21).

- Six of them considered their intention to undergo an eye examination (at the time of completing the questionnaire), of which all these subjects had imagined a scenario where they wanted to get their eyes examined.
- Six subjects shared that they thought of their health status before making the decision, especially whether there were any competing health care needs, such as attending another appointment.
- Two subjects shared that they thought about having a trust-worthy service provider, though they all understood that the DCE choice sets was based on the attribute descriptions that regardless of the service location or having specified fee range or not, the same service quality was assumed to be the same.

One subject self-reported not comparing the programme alternatives before making the decision. However, from the think-aloud session to complete the DCE, the interviewer observed that this subject had considered all the attributes before making the decision. Therefore, this subject was not excluded from data analysis as the risk of lower validity was deemed to be trivial.

Table 7.21 Results of debrief questions completed by subjects and interviewer

	n	%
Subject's perceived difficulties to answer the DCE choice sets (n = 93)		
Very easy	6	6.5
Fairly easy	21	22.6
Neither difficult nor easy	48	51.6
Quite difficult	18	19.4
Did you compare both Programme A and Programme B (n = 93)		
No	1	1.1
Yes	92	98.9
Did you consider other factors before completing the questions?		
No	76	81.7
Yes	17	18.3
Other factors being considered (n = 20)^		
Convenience	3	15.0
Healthcare provider related (trust, service quality)	2	10.0
Self-perceived health status (general health, visual health)	6	30.0
Involvement of elderly centre	1	5.0
Intention to undergo an eye examination	6	30.0
cost related (voucher limit, low service fee)	2	10.0
Interviewer's rating understandability of the respondents (n = 93)		
Understood and performed task easily	74	79.6
Some problems but seemed to understand in the end	19	20.4
Interviewer's rating on the effort and concentration of the respondents (n = 93)		
Concentrated well and put a great deal of effort into completing choice sets	90	96.8
Concentrated fairly hard and put some effort	3	3.2

[^] Seventeen subjects considered other factors and some of them considered multiple factors. The factors were categorised based on the written notes.

7.4.4.3 Main finding of the DCE study

The 93 subjects each completed all eight choice sets, resulting in a total of 744 choice sets, equivalent to 2232 observations available for data analysis. The test on IIA suggested that the assumption was not violated ($p > 0.05$). The IIA results can be found in the Appendix D9. CLM was used to model the DCE findings.

Table 7.22 shows the coefficient of the programme attributes to improve the use of eye examination by the older adults. The negative, statistically significant ASC value revealed that older adults had a general preference for the Neither option. This suggests that older adults

generally preferred not to get an eye examination regularly, when there was no intervention programme (when all the attributes were kept at reference level).

The coefficient of the five attributes, which were all positive and statistically significant, revealed that all attributes significantly contributed to the decision of the older adult to engage in an eye examination uptake enhancement programme. The older adults preferred receiving the preventive eye examination in mobile service rather than having it at an optometric clinic in the community ($\beta=0.84$). They also preferred having a specified fee range to no specified fee range ($\beta=1.14$). For the appointment arrangement, the older adults preferred having the appointment booked by the service provider rather than the booking by the older adults themselves ($\beta=0.60$). They also preferred having appointment reminder to no appointment reminder ($\beta=0.78$). Finally, the older adults preferred having a supportive environment to without a supportive environment to empower them to access the necessary information about eye health and service ($\beta=0.43$).

Table 7.22 Preference weighting for attributes of programme to encourage uptake of eye examination of the older adults

	Coefficient (β)	P value	95% Confident interval	
			Lower	Upper
ASC (programme A)	-0.91	< 0.001	-1.31	-0.51
ASC (programme B)	-1.02	< 0.001	-1.46	-0.58
Service location (mobile service)	0.84	< 0.001	0.62	1.05
Specified fee range (yes)	1.14	< 0.001	0.92	1.35
Appointment booking (service provider)	0.60	< 0.001	0.40	0.80
Appointment reminder (yes)	0.78	< 0.001	0.57	0.99
How well you are informed (supportive)	0.43	< 0.001	0.23	0.63

ASC = Alternative specific constant. All attributes were dummy coded.

7.4.4.4 Sensitivity analysis

Since there were 44 subjects reported they had some form of eye examination in the past 24-month (Table 7.17), a sensitivity analysis was conducted to examine whether there was any difference in the preference for the attribute levels.

Table 7.23 shows the results of the CLM by subgroups of with and without eye examination in the past 24 months. The preferred level of each attribute was consistent between the groups with or without eye examination, with beta coefficients all positive and significant ($p < 0.05$). Since the preferred levels remained unchanged in the sensitivity analysis, the coefficient

derived from the full sample (Table 7.22) was used to estimate the potential uptake rate in the next section.

Table 7.23 Sensitivity analysis on the preference for attributes by previous eye examination utilisation groups

	Did not receive eye examination in the past 24-month (n = 49)			Received eye examination in the past 24-month (n =44)		
	Coefficient (β)	95% CI		Coefficient (β)	95% CI	
		Lower	Upper		Lower	Upper
ASC (Programme A)	-1.52*	-2.12	-0.92	-0.34	-0.90	0.23
ASC (Programme B)	-1.64*	-2.32	-0.97	-0.44	-1.04	0.17
Service location (mobile service)	1.21*	0.87	1.54	0.50*	0.22	0.79
Specified fee range (yes)	1.17*	0.84	1.50	1.14*	0.84	1.43
Appointment booking (provider)	0.65*	0.36	0.94	0.58*	0.30	0.86
Appointment reminder (yes)	0.93*	0.60	1.25	0.67*	0.38	0.96
Informed about needs and service (supportive)	0.49*	0.20	0.78	0.40*	0.12	0.68

ASC = alternative specific constant. All attributes were dummy coded.

* p < 0.05

7.4.5 Predicted eye examination service uptake

Table 7.24 presents the potential uptake rates based on eight DCE choice sets which consisted of a total of 24 profiles. The potential uptake rate was estimated using the coefficient derived from CLM results based on the full sample (n = 93).

Among the 24 profiles, the potential predicted uptake ranged from 4.3% to 88.1%. For Programme A, the uptake rate ranged from 9.5% (Profile 16) to 88.1% (Profile 19). For Programme B, the uptake rate ranged from 4.3% (Profile 20) to 79.5% (Profile 17). For the neither alternative (indicating not taking up an eye examination), the uptake rate ranged from 7.7% (Profile 21) to 16.5% (Profile 6), which these group of subjects would choose not to get an eye examination.

Among the 24 profiles, the scenario with the highest estimated potential uptake of 88.1%, which consisted of providing the eye examination in a “mobile service” at the elderly centre, have a “specified service fee range”, with the appointment being “booked by the healthcare provider” and “with appointment reminder” and “without a supportive environment” to empower them to access to eye health and service-related information.

The combination of the most preferred strategy consisted of providing the eye examination in a “mobile service” at the elderly centre, have a “specified service fee range”, with the appointment being “booked by the healthcare provider” and “with appointment reminder” and “with a supportive environment” to empower them to access to eye health and service-related information. The scenario that fulfils this combination of strategy was the question included in the rationality test (Table 7.11). The potential uptake rate for the preferred strategy was calculated based on such scenario. Under a three alternatives scenario (Table 7.25), the influence of the most preferred strategy can achieve a potential uptake rate of 90.6% when compared to a programme with mobile service and the rest of the levels kept at reference level (i.e. least preferred levels of an attribute) and an option to opt-out. The probability of uptake for the neither option suggest that 5.1% of the older adults would choose not to have an eye examination.

Table 7.24 Predicted uptake probability of the eight choice sets with percentage of subjects choosing specific options.

P	Alt [^]	Service location	Specified fee range	Appointment booking	Appointment reminder	How well you are informed	Utility	Predicted uptake (%)	% of subjects chosen
1	1A	Optometry clinic	Have specified service fee range	Booking by users	No Appointment reminder	Without supportive environment	0.22	16.9	18.7
2	1B	Mobile service	No specified service fee range	Booking by healthcare provider	Appointment reminder	With supportive environment	1.63	69.5	64.8
3	1N						0.00	13.6	16.5
4	2A	Optometry clinic	No specified service fee range	Booking by healthcare provider	Appointment reminder	With supportive environment	0.90	40.7	41.8
5	2B	Mobile service	Have specified service fee range	Booking by users	No Appointment reminder	Without supportive environment	0.95	42.8	40.7
6	2N						0.00	16.5	17.6
7	3A	Mobile service	Have specified service fee range	Booking by users	Appointment reminder	With supportive environment	2.27	85.4	84.6
8	3B	Optometry clinic	No specified service fee range	Booking by healthcare provider	No Appointment reminder	Without supportive environment	-0.42	5.8	6.6
9	3N						0.00	8.8	8.8
10	4A	Mobile service	No specified service fee range	Booking by healthcare provider	No Appointment reminder	Without supportive environment	0.53	26.2	27.5
11	4B	Optometry clinic	Have specified service fee range	Booking by users	Appointment reminder	With supportive environment	1.33	58.4	59.3
12	4N						0.00	15.5	13.2

13	5A	Optometry clinic	Have specified service fee range	Booking by healthcare provider	No Appointment reminder	With supportive environment	1.26	55.5	51.6
14	5B	Mobile service	No specified service fee range	Booking by users	Appointment reminder	Without supportive environment	0.60	28.7	31.9
15	5N						0.00	15.8	16.5
16	6A	Optometry clinic	No specified service fee range	Booking by users	Appointment reminder	Without supportive environment	-0.13	9.5	6.6
17	6B	Mobile service	Have specified service fee range	Booking by healthcare provider	No Appointment reminder	With supportive environment	1.99	79.5	83.5
18	6N						0.00	10.9	9.9
19	7A	Mobile service	Have specified service fee range	Booking by healthcare provider	Appointment reminder	Without supportive environment	2.44	88.1	90.1
20	7B	Optometry clinic	No specified service fee range	Booking by users	No Appointment reminder	With supportive environment	-0.59	4.3	3.3
21	7N						0.00	7.7	6.6
22	8A	Mobile service	No specified service fee range	Booking by users	No Appointment reminder	With supportive environment	0.36	20.7	20.9
23	8B	Optometry clinic	Have specified service fee range	Booking by healthcare provider	Appointment reminder	Without supportive environment	1.50	64.8	62.6
24	8N						0.00	14.5	16.5

P = Profile; Alt = Alternatives

^ The number refers to the number of choice sets and the letters refer to the alternative, where A = Programme A, B = Programme B, and N = Neither

Table 7.25 Potential uptake rate of the most preferred strategy

Alt	Service location	Specified fee range	Appointment booking	Appointment reminder	How well you are informed	Utility	Predicted uptake (%)
A	Mobile service	No specified service fee range	Booking by users	No Appointment reminder	Without supportive environment	-0.18	4.3
B	Mobile service	Have specified service fee range	Booking by healthcare provider	Appointment reminder	With supportive environment	2.87	90.6
N						0.00	5.1

Alt = alternative, A = programme A, B = programme B, N = Neither option
This choice set was included as the rationality test in the DCE questionnaire.

7.5 Discussion

Suboptimal preventive eye examination utilisation by the older adults was reported worldwide (Gupta et al., 2020; Mohammed & Munsamy, 2023; Vela et al., 2012; Wagner & Rein, 2013) as well as in the Hong Kong (Sum et al., 2022). Strategies are required to encourage more older adults to engage in such behaviour to safeguard their visual wellbeing. An intervention programme was designed with an aim to promote collective effort from service user, service provider and community workers, to promote the uptake of preventive eye examination by the older adults (Lau et al., 2023). To improve the likelihood of delivering successful intervention, stakeholder involvement in the design of the intervention was considered (Lindhiem et al., 2014; Salloum et al., 2017; Terris-Prestholt et al., 2019). This study used DCE to elicit the preference for the attribute levels used to describe the intervention strategies. Five attributes were used to characterise the intervention to improve the uptake of preventive eye examination each with two levels. The current study found that older adults preferred to receive an eye examination at the elderly centre in the form of mobile service, having the service fee range specified, with appointment reserved by the healthcare professional along with having appointment reminder. They also preferred to have a supportive environment to empower them with the necessary knowledge they needed regarding eyecare needs and eye examination service. The estimated potential uptake demonstrated the potential influence of the most preferred strategy on the uptake rate. The most preferred strategy has an estimated uptake rate of 90.6%. This suggest that if collective efforts from both service provider and elderly centre were available to empower the older adults, the uptake of preventive eye examination could be encouraged. This also provide supportive evidence that future intervention design should consider implementing an intervention with the preferred levels identified in this DCE study.

Before this study, no study has elicited preference of the older adults for an intervention designed to improve the uptake of preventive eye examination. DCE has been applied to study user preference in the context of primary healthcare consultation (Kleij et al., 2017), preventive general health check (Grauman et al., 2021; Larsen et al., 2020), cancer-related screenings (Hall et al., 2022; Mansfield et al., 2016) and diabetic retinopathy screening (Yeo et al., 2012). Depends on the subjective objectives, attributes included in the DCE questions varied (Kleij et al., 2017). These DCE were conducted mainly to investigate the ways to improve service provision and healthcare delivery where the focus has been placed at the service-provider side. Previous studies had also based on existing models to guide attribute selection have been found

in the literature such as the model of health care quality (Kleij et al., 2017) and 5A (ask, assess, advise, agree, and assist) conceptual model of behaviour counselling (Larsen et al., 2020). These models were more relevant to elicit the attributes relevant to the encounter between the HCP and the patients. Nonetheless, a systematic reviewer has suggested the use of health behaviour theories to guide the attribute selection to identify other attributes other than healthcare delivery-related attribute that may influence one's decision-making process (Mansfield et al., 2016). The current DCE study took a bottom-up approach to investigate the strategies that could potentially be useful to encourage the uptake of preventive eye examination utilisation. More importantly, this study provided evidence on how an innovative method could be used to inform the attribute selection process.

Prior to the DCE study, a qualitative study was conducted to understand the decision-making process of the older adults to use eye examination services in Hong Kong (Lau et al., 2023). The findings revealed that multiple factors were found to influence the decision-making processes to use an eye examination. These factors were individual-, interpersonal- and service-related. People would consider their need to engage in an eye examination, judged their ability to access the service and considered the service-related information such as affordability, accessibility, and the quality of the service provider. However, there were factors that influence their decision-making. Older adults in general hold a symptom-driven mindset when consider engaging in preventive eye examination service. It was found that older adult had limited knowledge on the eye health and service-related information, more dependence of others to motivate their eye examination seeking behaviour. Supported by these findings, an intervention was proposed address the identified factors (Chapter 6).

To link the qualitative evidence to inform intervention design and eventually to inform the DCE design, the BCW framework was used as an overarching framework (Michie et al., 2011). As documented in the method section all the decisions regarding inclusion, exclusion or modification of attributes followed the model of behaviour change – the COM-B model (Michie et al., 2011). The rationale for the final selection was aligned with the COM-B model which proposed that for people to perform or engage in a specific behaviour, one must have the sufficient behavioural drivers, that is having the right capability, opportunity, and motivation to perform a behaviour. Then guided by the BCW framework, the intervention designed was used to target at these three key behavioural drivers which were found to be lacking which reduce one's motivation to use preventive eye examination. During the design

stage, the COM-B model and BCW framework offered key indicators to determine the attribute selection, especially when decision was related to combining attributes into a new attribute. Furthermore, the feedback received from pilot study as well as the formal data collection further confirmed that the attributes included in the DCE was considered comprehensive and relevant to the decision-making. This further supports that using the COM-B model considered factors not only influence the perception of an individual but also the attributes related to the external environment that together had an impact on motivation to use a preventive health service. With a theory-based attribute selection process, the findings obtained from the study would also provide a basis to work on refining the intervention design with the support effectiveness evidence, when available.

Overall, the findings from this study support the importance of creating an enabling environment to empower the older adults to engage in preventive eye examination behaviour and that factors related to service, community and individual all were found significantly influencing their decision to engage in such service. The findings revealed that appointment booking, and appointment reminder were significant factors for the older adults to undergo a preventive eye examination. Similar results were found in general health check (Larsen et al., 2020). Larsen et al. (2020) conducted a DCE on general health check to understand how the service should be delivered to the service user. Both Larsen et al. (2020) and the current study highlighted the timepoint of arranging the appointment *after* an individual received an examination assessment. Although the impact of timepoint was not specifically studied in the current DCE study, the description of the attribute considered this aspect. This strategy was included to reduce intention-implementation gap and providing a plan for future appointment. Previous DCE study found that the date of the appointment (weekday or weekend) and the length of the appointment played a significant role in engaging in a new preventive service (Chua et al., 2022). The characteristics of the appointment arrangement is worth investigating in the future to provide suggestion on how the appointment system could be designed to assist the service provider to encourage the older adults to engage in the next preventive eye examination. The subjects from the current study provided the reasons for valuing having healthcare professional scheduled their next appointment was not only for convenience. They shared that such action didn't not require any of their own judgement as to when to seek the service. All the procedures required for appointment booking would be simplified for them such as without worrying if the booking procedures were too complicated to follow or having no one to pick up the phone to make a reservation. These all suggested that it would be difficult

for the older adults to proactively engage in a preventive eye examination and that having an intervention with an attribute of appointment booking by healthcare professional would have enabled them to attend one in the future. It was understood that 59.1% of the surveyed individual shared that they would seek eye examination only when they experienced symptoms. The appointment booking attribute may also encourage the older adults to take up an eye examination by reducing the change of having a symptom-driven eye examination seeking behaviour. However, further implementation issues of appointment booking, and reminder must be carefully designed, otherwise further barriers can potentially occur and hinder the older adults from using preventive eye examination.

Prior to the current DCE study, it was uncertain how older adults would have valued service location. Service location was a common attribute included in community-based chronic disease screening programme (Brain et al., 2022) and cancer screening programmes (Hall et al., 2022). Based on the general literature and the qualitative study evidence (Brain et al., 2022; Lau et al., 2023), it was anticipated that the subjects would prefer having more convenient location as informed by the qualitative study. The rating and ranking exercise on the attribute importance which were included before the DCE questions revealed that among the five attributes, service location was considered an “important” attribute by 89.2% (83/93) of the surveyed subjects. Reasons for considering it as “unimportant” included having good mobility to walk around, and that service location was unimportant unless they felt there was a need to seek for service. As the rating exercise adopted a binary rating (important versus unimportant), this information was only relevant to that one specific attribute and didn’t account of the other factors and how individual would have trade-off other intervention attributes. The DCE findings further confirmed that service location was a significant factor among the five attributes, and that older adults preferred to have their eye examination conducted at the elderly centre. This attribute was the second most valued attribute after having specified fee range. However, this study assumed that the service quality was the same regardless of the service location, it was unsure how service quality may have an impact on the potential uptake rate. Nonetheless, the findings revealed that if the service quality was assumed to be the same, older adults generally preferred to get their eye examination in the form of mobile service. This also implied that future strategy should also ensure the service quality is monitored.

Cost has been one of the commonly included attributes in the DCE literature (Brain et al., 2022; Kleij et al., 2017) although it was not included in this DCE as an actual cost attribute. Instead,

a very closely related attribute was included, that is whether service fee range was specified. This attribute focused on providing the necessary information to facilitate decision-making. In Hong Kong, older adults are eligible to use the healthcare voucher to cover service fee for a range of primary healthcare services provided at the private sector which include preventive eye examination. This DCE provided information related to the scenario for Hong Kong older adults where financial barriers were potentially reduced with the use of healthcare voucher and understood how having a default option and clear price information (specified fee range) were valued among the other attributes by the older adults. It was found that older adults preferred specified service fee range to no specified service fee range. This is in line with the previous qualitative study where subjects shared they didn't know the price of an eye examination and that the perception of their ability to pay were based on the wrong price (e.g. using treatment-related service fee to judge if they could afford a preventive eye examination) (Lau et al., 2023). The subjects from the current DCE study also shared that having to know about the price give them the information they required for budgeting as well as being psychologically prepared to spend a certain amount of money for getting a preventive eye examination. It also gave them a sense of autonomy to select the service that was considered best suited for themselves. However, a small portion of people who would not spend money on an eye examination. The reasons for that were not cost-related but health-related (such as health belief and having existing eye disease that would not be eligible for primary eye care). Therefore, the probability of uptake estimated for the "neither" option from the current DCE study may not best reflect the proportion of people who are in the precontemplation stage who have no intention to engage in an eye examination due to cost-related reasons.

Other than service-related attributes, this DCE also included attribute related to the elderly centre, which is the supportive environment to empower the older adults (How well-informed you are about eyecare and the service) and providing the eye examination at the elderly centre in form of mobile service. Some subjects shared they perceived the importance to get more educated about the significance of preventive eye care as well as service availability through having a supportive environment to empower them with the information they needed. Furthermore, some subjects also shared that having a supportive environment also served as a reminder for them to get their eye examined as there was relevant information in the elderly centre where they often visited on a daily or weekly basis. Apart from this the older adults also expressed their preference for certain health promotion activities. This implies that it will be important to consider the specific ways to enrich the environment around the older adults to

best increase the opportunity to expose to information, prompts, cues, or activities that could encourage the uptake of preventive eye examination. However, this required further investigation before more detailed suggestion could be made regarding how elderly centre could play a role in empowering the older adults to encourage the regular use of preventive eye examination.

7.5.1 Limitation

One apparent limitation of this study was the imbalance of female (89.2%) and male (10.8%). This study aimed to achieve an overall preference for the community-dwelling individual. As the subjects were recruited from a previous study also with an imbalance of gender, it naturally has more females than males eligible for this study as well. However, the results were still relevant to the elderly centre population. Future study should investigate whether female and males have a different decision-making process in preventive eye examination seeking behaviour. Answering this question would provide a rationale to conduct future study to elicit the preference.

Second, the population included were all recruited from the elderly centre population. Therefore, the findings would be more generalisable to the community-dwelling individual from the elderly centre. The findings from the source of information on preventive eye examination highlighted that elderly centre member does not solely rely on elderly centres to receive eye care-related information, they also reported to have received information from healthcare professionals. They suggest that it may be possible that general older adults who were not a member of an elderly centre would have different source of social support to create a supportive environment, especially when related to the attribute “how informed are you about eye care and service information”. Future study would be required to recruit other older adults from the general population to understand what actors would best serve as a source for creating supporting environment.

7.5.2 Implication

This study was the first to bring in BCW to inform the selection of attribute and levels to inform the DCE questionnaire design. This study serves as a proof-of-concept that BCW was a useful tool guide DCE design. Although this study adopted a simple DCE design (all attributes were kept at two levels) to elicit the preference for the attribute levels describing the intervention to encourage the uptake of preventive eye examination, the results have important implication on

preventive eye examination provision and how community centre can work together to improve the eye examination utilisation and maintain visual wellbeing of the older adults.

The result from this study is useful for service provider (practices) and social workers at the elderly centre to understand their potential role to empower the older adults to use the preventive eye examination to maintain their eyesight. For service provider at practice level, they can consider encouraging appointment booking after an eye examination and equip with a reminder system to reduce the workload. For elderly centre, training could be provided to the elderly centre staff and the members to exploit the power of social influence on eye examination seeking behaviour. Create a supportive environment with appropriate and accurate knowledge about preventive vision care facilitate more effective information dissemination where the information and cues are all naturally integrated into their environment. The ways in which these strategies be best implemented required further investigation, such as conducting RCT to systematically evaluate the potential effectiveness of these strategies in improving the actual eye examination utilisation behaviour.

This study adopted a novel approach to inform the inclusion attributes that are used to understand how the intervention could be improved. Our findings further supplemented the notion of of Terris-Prestholt et al. (2019) who highlighted the usefulness of DCE to inform the intervention design. This study has further added that a BCW-guided attribute selection process has been showed to be useful to link up all available evidence. Linking BCW and DCE together have allowed researcher to interpret the potential influence of these attributes on behaviour change and how the intervention could be further refined in the future.

The DCE findings only reflected the preference for the users. The stakeholder involvement from the service user was included during the intervention development stage and DCE questionnaire design process. Service provider is also a key factor to ensure successful implementation of an intervention. Therefore, the providers' preference for these attribute levels investigated could be explored in the future. This could help identify whether preference for each attribute was aligned. This information would be constructive to construct a comprehensive picture on how the intervention could be designed to encourage the uptake of preventive eye examination. The most important gap to be addressed to obtain evidence to support the effectiveness of the intervention strategy. This will provide further evidence to justify if the proposed intervention should be amended or how intervention programme evaluation should be followed to ensure all the potential factors are fully explored.

7.6 Chapter summary

This chapter describes the process of developing a DCE to elicit the preference for the strategies design to improve uptake of the eye examination by the older adults. It also demonstrated a proof-of-concept that incorporating behavioural science framework in deciding attributes and levels were feasible and useful to elicit preference for intervention design that are theory-based. The significant findings of the five attributes emphasis the need for a collective effort from elderly centre and eye care provider to work together to encourage the uptake of eye examination by the older adults. This study serves as a starting point to understand what matters to the older adults if a programme was to be implemented to improve their uptake of preventive eye examination.

Chapter 8 Discussion & Conclusion

8.1 Overview

This research project aims to enhance our understanding of why Hong Kong's elderly population is not actively engaging in preventive eye examinations. The findings from this study was used to develop a theory- and evidence-based intervention programme to improve the use of preventive eye examination. This intervention has been created using a systematic approach informed by behavioural science framework and supported by evidence gathered from various sources. The research used a mixed-method approach to explore the reasons for not using preventive eye examinations and put forward strategies that could encourage this behaviour. Before this study, there was limited knowledge regarding the preventive eye behaviour of Hong Kong's elderly population or their perspectives on a holistic community-based intervention programme designed to promote the use of these services. This project's novelty is its incorporation of a behavioural science framework to link all relevant evidence and inform the development of an intervention programme. The strategy proposed was evidence-based, theory-driven and preference-based. Unlike earlier studies, this research also elicited user preferences for the strategies included in the programme. The study's findings have provided valuable information that can facilitate the development of an intervention aimed at improving uptake of preventive eye examination among older adults to maintain their vision health. The results from two empirical studies are interrelated, with qualitative evidence supporting intervention design and Discrete Choice Experiment (DCE) used to elicit user preferences for attributes of the programme in the second empirical study to refine the intervention design. The Behaviour Change Wheel (BCW) framework links all findings together.

8.2 Main findings

8.2.1 Explanation for low motivation to engage in preventive eye examination by the Hong Kong older adults

In Hong Kong, suboptimal usage of eye examinations has been reported, as revealed by a survey study which showed that around 22% of participants had never undergone an eye

examination (Sum et al., 2022). The reasons behind this low uptake are multifaceted and have been explored in earlier research conducted outside Hong Kong. However, the applicability of these findings to the local HK context was uncertain due to a lack of evidence from Hong Kong itself. While quantitative studies, such as surveys, can provide some insight into this issue, qualitative methods are preferable because they offer more detailed and nuanced explanations that provide a solid foundation for intervention development. Specifically, a qualitative study (reported in Chapter 5) was carried out to investigate the decision-making process of older adults about preventive eye examinations (Lau et al., 2024).

This qualitative study identified factors that have been previously reported in similar studies conducted in different parts of the world. One commonly cited factor is a perceived lack of need for preventive eye examination service. This is also well-documented as people's perceptions of their ageing and symptoms often influence their appraisal of health needs (Biddyr & Jones, 2015; Leamon et al., 2014; Neyhouser et al., 2018). The qualitative study found that the subjectivity in this appraisal can lead to different tolerance levels of symptoms and adaptation strategies among individuals.

The results of this qualitative study provide insight into how older adults manage their visual decline while carrying out daily activities, despite the onset of age-related vision problems. For instance, technological advancements such as electronic tools to manipulate font sizes make it easier for older adults to reduce the impact of blurry vision (Lau et al., 2024). This reduces the necessity to address any visual issues they may be experiencing through regular eye exams. The similarity in reasons for not engaging in these services also suggests that decision-making regarding eye care is intuitive and likely guided by personal "common sense". This implies that certain factors, particularly related to physical symptoms, are common among older adults across different regions of the world.

This study expanded upon earlier research by exploring how social factors impact an individual's perception of their need for eye care services and their confidence in seeking such services (Lau et al., 2024). Previous studies have identified social support as a crucial factor influencing eye care utilisation, specifically related to traveling to the service location (Ahmad et al., 2015; Marmamula et al., 2022; Owsley et al., 2006). This study also found that social environment plays a significant role in an individual's need perception and judgment of their ability to seek eye care services (Lau et al., 2023). The results revealed that social support extends beyond peers and family members, as the elderly centre itself was identified as playing

a crucial information source. Although there may be a temptation to dismiss this finding due to the fact that participants were recruited from an elderly centre, it is essential to note that this was not the initial intention of the study. This discovery is in line with previous findings (Neyhouser et al., 2018) regarding social support's influence on eye care service utilisation. The results suggest that individuals' perceived need for such services is influenced by their social environment, and the elderly centre could provide a supportive atmosphere to empower older adults with essential knowledge about eyecare needs and service-related information and the necessary steps required to seek it out.

During the qualitative study, all follow-up questions were tailored based on the responses provided by the subjects. In the DCE study, where older adults ranked and rated the five attributes of an intervention designed to improve uptake of preventive eye examination, they also shared that perceived importance for mobile services at elderly centres was due to their familiarity and trust in these centres, as they were aware of the activities organized by them. This finding aligns with the evidence from qualitative research, which suggests that elderly centres have a role to play in health promotion and provide access to resources that are consistent with their expectation. The preference for elderly centres as an information source reflects an untapped opportunity to improve preventive eye examination uptake through more effective information dissemination, better connections between service users and providers, and the provision of social support to address barriers hindering older adults from accessing necessary health information. The DCE results also highlighted the importance of a supportive environment within the elderly centre community in empowering older adults to acquire the information they need. These findings suggest that elderly centres, an existing community resources, have the potential to be utilized more effectively as part of interventions designed to improve eye examination utilisation among older adults by addressing barriers and providing necessary support.

The qualitative study has also highlighted that past healthcare experiences play a significant role in an individual's motivation to use preventive eye care services (Lau et al., 2023). Our qualitative study showed that previous healthcare utilisation, especially social influence, have an impact on the perceived needs for eye examinations, and this was further supported through the findings of the DCE study. In the DCE study, over half of the respondents self-reported that they have not had an eye examination within 24-month by an ophthalmologist or an optometrist (52.7%, 49/93). The second most common reason for not using an eye examination in the past

24 months was the lack of healthcare professional-driven recommendation (22.4%, 11/49). Specifically, individuals who had ever received a diagnosis of cataract and undergone cataract surgery by an ophthalmologist believed they no longer required regular eye examinations because their doctors said their eyesight was fine and did not require to come back for a follow-up checkup. This finding highlights the importance of effective health communication between healthcare professionals and patients regarding preventive eye care needs. While respondents with a history of cataract surgery may have received treatment-focused information, there is a gap in health communication related to preventive eye examinations. Older adults generally have limited knowledge about preventive eye care services (Lau et al., 2023), so their interpretation of the advice provided by healthcare professionals may not accurately reflect the preventive aspects of these services. The repeated sharing among respondents with similar reasons for not engaging in regular eye examinations also suggests that healthcare professionals play a significant role in guiding older adults through the healthcare system (Lau et al., 2023). Future studies should collect more detailed information about patients' last encounters with eyecare professionals, such as the type of provider and the specific advice they received. These studies may reveal factors that contribute to compliance with preventive eye care recommendations and provide insights into how older adults navigate the healthcare system. The continued uptake of eye examinations is critical for capturing preventive eye care-seeking behaviour (Leamon et al., 2014). This information would enable a more comprehensive understanding of preventive eye examination utilisation patterns among older adults and identify potential barriers to maintain regular uptake of such service.

In line with previous evidence, this study has shown that older adults tend to prefer familiar services and value those with lower out-of-pocket payment, particularly when it comes to preventive eye examination services (Lau et al., 2023). While the use of healthcare vouchers for optometric services has helped some older adults access the care they need, the amount of the voucher often falls short of covering all expenses, including the purchase of optical aids (Sum et al., 2022). This concern is consistent with findings from other studies (Biddyr & Jones, 2015; Holmes et al., 2018; Leamon et al., 2014; Solomon et al., 2022). A UK-based focus group revealed that individuals would often opt for cheaper glasses that could be purchased without an eye examination (Biddyr & Jones, 2015), while another study found this to be true even in regions where eye examinations were funded (Shickle et al., 2018).

Apart from the cost of paying for healthcare services, costs spent on transportation to access to eye examination location also serve as barriers to accessing eye care services. In the UK, people with cars were more likely to utilize eye examination services due to better accessibility (Wright et al., 2019). Lack of an accessible transportation system leads to higher expenses for travel to healthcare facilities, which has been linked to lower rates of eye care utilisation (Ezinne et al., 2023; Solomon et al., 2022). However, in this qualitative study, the participants did not express concerns regarding transportation as they were willing to travel to clinics located within their district (Lau et al., 2023). The subjects participating in the face-to-face interviews appeared to have more active lifestyles and mobility compared to those who faced transportation barriers in previous research. They emphasized their preference for clinics that are easily accessible, implying a potential need for conveniently situated healthcare facilities. One of the possible explanations for the different findings can be due to how the public transportation works in Hong Kong. Hong Kong is considered a transit-orientated city (Wong et al., 2018), with a well-established public transportation system with relatively affordable fares. Hong Kong residents aged 60 or above can enjoy public transportation (e.g. Mass Transit Railway, often referred by the public as MTR) for HK\$2 per trip under the Public Transport Fare Concession Scheme which has been introduced since 2012 (Legislative Council, 2021). This means the cost arising from travelling to the clinics is kept to a minimal and could be a less of a concern. A thematic report published by the Jockey Club Age-friendly City (2022) found that 37% to 43% of adults aged 60 or above use buses for daily travel, with a habit of traveling less than 30 minutes. The report also noted that older adults preferred a transportation mode that can reach the destination with fewer interchanges (Wong et al., 2018). This aligns with the feedback from participants in the qualitative study who expressed a preference for accessing eye examination services within the same district and avoiding cross-district travel (Lau et al., 2023). However, the literature has not yet addressed the need for more in-depth investigation into optometric healthcare accessibility and public transportation preferences. It remains unclear to what extent accessible public transportation for optometric services could potentially influence the rate of preventive eye examination utilisation. The results from the current research, which differ from general literature, emphasize the importance of conducting a qualitative study to examine the reasons for the suboptimal preventive eye examination uptake in Hong Kong. Our research has expanded our understanding of the decision-making processes that contribute to the suboptimal utilisation of preventive eye examination among community elderly individuals. This information is valuable and has been used to guide the development of intervention strategies aimed at improving preventive eye examination uptake

by addressing the identified barriers. These interventions are specifically designed with a focus on promoting preventive eye examination uptake for the benefit of the elderly population in Hong Kong.

8.2.2 Intervention programme to improve uptake of preventive eye examination: a collective effort between community, healthcare professionals and service user

This section explores the various techniques and strategies employed in designing and eliciting preference for an intervention programme design, with a focus on the necessary collective effort needed for its successful implementation in the near future and the alternative options that need to be explored.

Using the BCW and the Capability-Opportunity-Motivation Behaviour (COM-B) model, an intervention programme has been designed for engaging older adults to use preventive eye examination regularly. The user preferences for these intervention components have been obtained through a DCE study. Unlike other preventive service that had focused on elicit preference for service component such as examination components and the outcome of the examination, this DCE study focused on how external environment were valued by the older adults to encourage the uptake of preventive eye examination, along with other attribute that could address the capability, opportunity and increase motivation to change the behaviour to engage in preventive eye examination (reported in chapter 7). Our findings suggest that a collective effort from three key sources is required: the older adults themselves (service user), primary eyecare service providers, and community elderly centres.

Older adults favor receiving their eye examinations at elderly centres with specified service fee range, having the next appointment booked by the service provider, and with appointment reminder. They also preferred a supportive environment to acquire necessary information for informed decision-making. The results are within expectations, considering the attributes were designed based on theories addressing barriers in the decision-making process. While it is positive that all factors contribute significantly to the decision-making process, careful implementation of the intervention programme from this study is essential in real-world settings.

Older adults' preference for mobile eye care services seems to be primarily centred on convenience and familiarity with location. Elderly centre members are older adults who dwell

within a close neighbourhood so the location will already be familiar to them. The idea of a mobile service implies offering the eye examination service at the elderly centre itself. The characteristics of the elderly centres participated in the DCE study varied in terms of capacity and proximity to housing neighborhoods. Some elderly centres might find it challenging to implement mobile services due to these factors, potentially requiring older adults to visit an optometric clinic in the community. With the advance of telehealth service, some of the service delivery barriers might be able to be overcome in the future. In a previous RCT (Katibeh et al., 2020), the use of mobile service were found to be effective in improving preventive eye examination utilisation. The RCT revealed that older adults would follow the referral advice to get their eye examination at the clinic. However, it should be noted that since the service location would be close to the neighbourhood, there would be a greater chance that the older adults would attend alone, this also highlighted how results should be explained to the older adults so they could be empowered and feel confidence of the steps needing to be followed after the receipt of preventive eye examination.

Under a specified range of services, older adults generally felt that the inclusion of this attribute was necessary to assess their ability to afford the available services. The DCE was conducted under the premise where the older adult could use the elderly healthcare voucher to cover the service fee (current situation in Hong Kong). This healthcare voucher places a limit on optometric services, allowing individuals to spend a total of HKD 2000 on such services every two years (Health Care Voucher, 2021a). Although the voucher amount can be accumulated over time, this was not possible for optometric services as they require immediate payment. In the DCE, we did not ask if participants were aware of their optometric service spending limit or how to check their voucher balance. Typically, voucher users can access this information through a website, through a hotline or an e-health application (Health Care Voucher, 2021c). Respondents of the DCE study stated that once a fee range is provided, they would be able to determine whether they had sufficient funds for the service or if they needed to pay out-of-pocket. The scenario that with a specified fee range also indicated that older adults would know whether there were glasses within their specified budget range. The inclusion of this attribute level was designed to allow older adults to become more informed about prices and service components, and therefore they could make better decisions regarding service access. The results of the DCE supported that specified service fee range was preferred to no specified service fee range, which highlighted the importance of price transparency (Sum et al., 2022)

and having clear information to facilitate decision making has on improving the uptake of preventive eye examination.

Older adults have a preference for the service provider to schedule their next appointments for them. The importance of appointment booking has been established in other preventive health services (Brain et al., 2022; Kleij et al., 2017; Larsen et al., 2020). Scheduling an appointment eliminates the need for additional reservation procedures and serves as an indicator of one's healthcare requirements. Older adults do not have to think about whether they need an eye examination or not, as it will already be scheduled, allowing them to attend according to the appointment time. This approach seems to help overcome a symptom-driven mindset, as older adults feel a sense of obligation and responsibility to attend their scheduled appointments. It also echoed with the findings that among the DCE respondents of the current study, over half of the people reported they did not get a preventive eye examination as the previous encounter with an eye care professional that there was "no need".

Providing reminders for older adults to attend their eye appointments were preferred, as older adults shared that they often find themselves forgetful, especially since eye examinations are generally conducted every one to two years. Reminders not only help them organize their activities better but also prevent scheduling conflicts with other necessary on-going healthcare appointments, such as those at public health hospitals. The DCE study revealed a general preference for reminders (regardless of the reminder format). However, during the think aloud session, participants expressed a variety of preferred methods for tracking healthcare activities. Some utilized the calendar function on their mobile devices or manually wrote appointment details down in a notebook. Others found electronic apps like HAGo have also been shared by some older adults who found it particularly useful. HAGo is an application that provides personalized health management and can notify users about upcoming appointments (Hospital Authority, 2021). The DCE has demonstrated supportive evidence for the importance of reminder attributes, but future researchers may consider using a more complex DCE with higher levels to further explore preferences for setting up a reminder system. Despite the apparent benefits of e-health applications, individuals from the older generation may not fully benefit from these technologies (Turnbull et al., 2021). Future research should focus on developing user-friendly supportive environments tailored to the needs of the older adults.

Strategies for improving preventive eye examination uptake among older adults have traditionally focused on educating the target group (Dan et al., 2015; Ellish et al., 2011; Owsley

et al., 2013). However, our findings suggest that older adults highly rely on others in health information seeking and valued a supportive environment that can empower them with knowledge, skills, prompts, cues, and social support to access useful information. A supportive environment could include various activities such as peer sharing, interactive workshops, and exposure to cues that encourage preventive eye examination uptake. In the DCE study, respondents were presented with identical examples of how a supportive environment might be implemented. There are numerous ways to create a supportive environment for older adults; innovative technology-based approaches can also help facilitate more effective information dissemination and improve user experience in information seeking. Future research will be required to explore how supportive environment could be implemented and the potential barriers and challenges that may encounter during the delivery of these technology-based intervention (Leung et al., 2023).

This study did not investigate the impact of interpersonal aspects of consultation encounters on service uptake, as this is more relevant to behaviour maintenance. The results will have generalisability to elderly centre members. Future studies are required to investigate whether the proposed strategies would be suitable to apply to general older adult population who were not a member of an elderly centre.

8.3 Limitations

While this study successfully demonstrates the use of a behavioural science framework for linking evidence together to inform intervention development, there is an overall limitation concerning the sampled population. The project ended up with a higher proportion of females than males, which can be attributed to two main reasons. First, all participants had previously taken part in another DCE study and were recruited based on available data from previous research that allowed for purposive sampling for the qualitative study and identifying those who reported not having an eye examination within the past 24 months. Second, using existing data pools helped reduce the workload for the elderly centre due to a tight schedule for data collection. Although the sample cannot be generalized to the entire general older adult population, it is possible to generalize the findings to the elderly centre population. While there is an overall understanding that females are more likely to engage in preventive behaviour than males, there is currently no evidence suggesting gender-specific differences in preventive eye care seeking among Hong Kong's older adults. Future research should investigate this further

to determine if there are indeed gender differences in engaging in or avoiding preventive eye care and explore potential reasons for these differences using models such as the COM-B model and other behavioural frameworks.

8.4 Implications

The Hong Kong healthcare system underwent reforms in 2008, with a focus on shifting from a treatment-oriented model to a preventive-focused model (Food and Health Bureau, 2008a). Recognizing the impact of the ageing population, this preventive-focused approach has remained a focal point in healthcare-related discussions over the years, as evidenced by the frequent mention of primary care initiatives in recent publications of Hong Kong Government Policy Addresses (Policy Address, 2018; Policy Address, 2019; Policy Address, 2021; Policy Address, 2022).

In response to these preventive healthcare efforts, multiple outreach programmes have been launched in Hong Kong with the aim of safeguarding older adults' eyesight through early detection of ocular abnormalities. These programmes share two key characteristics: they are designed to bring services directly to users (e.g., mobile services) and minimize financial barriers by offering fully subsidized services (one-off fully subsidized eye examination), which do not require any out-of-pocket payment from older adults to access an eye examination.

Our findings highlight the need for increased attention and collective effort from service providers, service users, and community workers in promoting preventive eye care in Hong Kong. The results of the DCE study revealed strategies that would be more suitable for individuals who are elderly and community-dwelling with good mobility. For further information on implementation options, researchers can refer to a detailed document outlining the behavioural drivers and potential intervention functions. The strategies options are likely to increase as evidence accumulated in the future, especially when the research on behaviour maintenance has been conducted.

Research into the knowledge and awareness levels of elderly centre staff is also important in order to determine how they can best be trained to support older adults in accessing eye examination services. The preference for mobile services provided at the elderly centre suggests that more research is needed on how such a service can be designed effectively. This

could involve considering attributes such as day of service provision, cost, and type of service provider, as is often done with general health check services.

The trust older adults have in the elderly centre implies that activities related to eyecare information should be held there regularly. However, any implementation must adhere to rules and regulations regarding optometrists and social workers at the centre.

In light of the ageing population and the subsequent importance of healthcare sustainability, it is crucial to explore how existing resources, such as optometrists, can be utilized for preventive eye care. The current study has investigated the potential of mobile services provided at elderly centres, but there are other locations that could be considered for similar initiatives, such as District Health Centres which welcome all Hong Kong residents for registration (District Health Centre, 2022).

The results of this study have significant research implications. By designing an intervention programme based on the preferred options identified by older adults, we can align the programme with their preferences. This study has provided evidence to support the potential effectiveness of the intervention to improve preventive eye examination. The next step should consider piloting these strategies, with specific focus on investigating the feasibility, and issues related to affordability, acceptability. This will provide the much-needed evidence to address the APEASE criteria to determine how the BCTs included in these intervention strategies would be prevented from implementing due to infeasibility issue observed in the future. It is also important to understand if a one-size-fit-all approach is effective. It would provide valuable insight if subgroup analysis can be followed to understand if other specific groups of older adults may have different preference for the intervention design.

The qualitative study of this project highlighted three key actors that can influence the decision-making process, which apart from the older adults themselves (the targeted group for this project), the service providers, elderly centre staff, and lay referral network (family members, and peers) were also found to have influenced whether the older adults would take up an eye examination service to some extent. The current study focused mainly on the service user perspective. The proposed strategies were based on the qualitative evidence and DCE collected from the older adults. Future research should consider widening the target group by understanding how different people perceive the factors that influence the older adults from using such service. This includes older adults from the general population who are not a

member of the elderly centre. Previous research has been conducted on diabetic retinopathy screening and found that the perceptions of the perceived barriers to service uptake varied among the service user, service provider and the family members (Kumar et al., 2023). By studying the perspectives of different actors, a clearer picture of how social factors may play a role in influencing the decision-making process of the older adults can be better understood. This will also have an implication on how strategy could be designed and implemented at different time point of the decision-making process to further empower the older adults to engage in preventive eye examination regularly.

The predicted uptake was based on a hypothetical scenario that eye examination was recommended every one to two years and that the elderly centre programme was provided at the elderly centre. There are two noticeable implications. First, future study should be determined the best preventive eye examination interval that would be best suitable for the Hong Kong population. It was unclear if the recommended frequency of eye examination interval would influence the decision to use preventive eye examination and therefore the preference for the intervention used to improve such service uptake. Second, elderly centre programme has greater potential to be exploited to act as a hub for older adults for information sources, linking to useful resources. Future input from these interested stakeholders should be followed to ensure the implication of these intervention strategies can be successful.

8.5 Future directions

The findings from this project have provided some insights into the research questions posed, while also highlighting several unanswered questions that warrant further exploration. The focus of this thesis has been on enhancing both the social environment and physical environment to provide older adults with easier access to services. However, there are other aspects that require further investigation, such as service provider factors, behavioural maintenance, and reaching a wider general population of older adults. The following are three key research questions for future research investigation and discussion:

Suggested research question 1: How do eyecare professionals communicate eye care-related information to patients and how does this influence the subsequent eye care utilisation behaviour?

Both the qualitative study and the DCE study, along with evidence from other studies conducted in Hong Kong, have collected data reflecting the role of healthcare professionals in influencing preventive eye care behaviour. In addition to investigating service users' perceptions of optometrists, it is crucial to examine the communication that takes place during consultations, as this may provide important information for nudging people towards using preventive eye care services to maintain their eyesight through routine monitoring.

Research on the role of health communication is more common in other healthcare services (Mohd Salim et al., 2023), but there have been a few studies focusing on eye disease-specific healthcare using focus groups (Wang et al., 2023) and others investigating health communication in referral pathways across different eyecare levels (Harvey et al., 2022). However, no studies have been conducted to investigate health communication in preventive eye care.

In addition to qualitative studies using interviews and focus groups, other approaches to investigating communication in a more natural way could yield more meaningful evidence to facilitate useful discussion around this topic. This may require innovative research approaches, but it is essential to carefully consider the ethics involved in filling this gap. Understanding whether further intervention should be implemented at the service provider level or both sides will be crucial for future researchers seeking to improve preventive eye care behaviour for older adults.

Suggested research question 2: Why do some people regularly engage in preventive eye examination and what factors cause them to maintain or stop such behaviour?

The current study primarily focuses on understanding the reasons for individuals with low motivation to use eye examinations. However, it is essential to also explore the factors influencing older adults who regularly engage in preventive eye care behaviour. This would provide a basis for comparison and further investigate whether these factors exist among non-regular vision care users and determine the underlying reasons behind such discrepancies. To address this research gap, a clear operationalized definition of "regular" eye examination utilisation is crucial.

International authorities recommend that individuals aged 65 or above should get their eyes checked every one to two years. However, surveys have reported varying eye care utilisation frequencies, including yearly, biennial, or within the range of 1 to 2 years. Standardizing the

conceptualization of "regular eye examination utilisation behaviour" will facilitate more effective evidence synthesis in the future.

To better understand regular vision care users and factors influencing behaviour maintenance, a longitudinal qualitative study should be considered. By interviewing older adults at different time points, researchers can identify any factors that may or may not be relevant to behaviour maintenance and contribute to a more comprehensive understanding of preventive eye examination service utilisation behaviours.

Suggested research question 3a – 3c: a) Is there a difference in preventive eye examination uptake rate between elderly centre members and non-elderly centre general older adult population? b) What are the factors influencing the behaviour of the general older adult population? c) How can the general older adult population be encouraged to use preventive eye examination?

The current project focused on exploring reasons for not using preventive eye examination regularly. The participants recruited were from the elderly centre population. Future study should widen the population group by including the general older adult population to understand how this specific group of older adults decide to use preventive eye examination or not. Although the results from the DCE findings suggest that the older adults from the elderly centre could be given the same intervention strategy to encourage their uptake of preventive eye examination, the concept of a "one-size-fits-all" approach for preventative vision care strategies should be reevaluated in a wider population group. Our research focused exclusively on members of elderly centres; however, it is necessary to determine if these factors are also significant for the broader older adult population. For instance, our study highlighted the significance of social environment in encouraging eye examination uptake and its impact on perceived need and self-efficacy for service utilisation. Other factors may influence the behaviour of the general older adult population. Understanding these factors better could have considerable policy implications, such as whether a population-based preventative vision care programme is feasible and how to implement it effectively.

To answer this question, future DCE study can consider conducting subgroup analysis to compare the differences in preference between elderly centre members and general older adult population. The findings will have implication on how to best allocation community resources to benefit older adults with different backgrounds.

8.6 Conclusion

An ageing population presents significant challenges to maintaining the health and well-being of older individuals. Preventive eye care, often overshadowed by other preventive services, has gained increasing attention from health authorities as an important component of comprehensive healthcare. To address this issue, this study provides actionable insights for service providers, community social workers, and older adults themselves, highlighting the potential benefits of collaborative efforts to enhance preventive eye examination uptake.

The process of modifying behaviour related to preventive eye examinations is complex and multifaceted, requiring sustained efforts over an extended period. The findings of this study serve as a foundation for future research, providing a framework for developing innovative and engaging strategies that can promote regular uptake of preventive eye examinations among older adults. Taking a holistic perspective, this research was the first to integrate behavioural science frameworks into a comprehensive analysis of intervention options, leveraging the principles of Behavioral Change Wheel (BCW) and the COM-B model to inform discrete choice experiment design.

This study offers evidence for the utility of behavioural science in addressing non-uptake behaviour related to preventive eye examinations. By demonstrating the feasibility of this approach, we provide a proof of concept for future research, highlighting the importance of considering behavioural science principles when developing interventions aimed at promoting healthy behaviours among older adults.

Appendices

Appendix A: Supplementary materials for Chapter 4

Below is a list of the supplementary materials mentioned in **Chapter 4** systematic review. The materials are presented the order in which they were mentioned. Subheading were used signpost the section in which the materials were being referred.

Appendix A1 PRISMA Reporting checklist

Section and Topic	Item #	Checklist item
TITLE		
Title	1	Identify the report as a systematic review.
ABSTRACT		
Abstract	2	See the PRISMA 2020 for Abstracts checklist.
INTRODUCTION		
Rationale	3	Describe the rationale for the review in the context of existing knowledge.
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.
METHODS		
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.
Study risk of	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used,

Section and Topic	Item #	Checklist item
bias assessment		how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.
RESULTS		
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.
Study characteristics	17	Cite each included study and present its characteristics.
Risk of bias in studies	18	Present assessments of risk of bias for each included study.
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.

Section and Topic	Item #	Checklist item
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.
	20c	Present results of all investigations of possible causes of heterogeneity among study results.
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.
DISCUSSION		
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.
	23b	Discuss any limitations of the evidence included in the review.
	23c	Discuss any limitations of the review processes used.
	23d	Discuss implications of the results for practice, policy, and future research.
OTHER INFORMATION		
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.
	24c	Describe and explain any amendments to information provided at registration or in the protocol.
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.
Competing interests	26	Declare any competing interests of review authors.
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.

Appendix A2 Full search strategy

The number of recorded for each database was based on the search conducted on 1 June 2023.

Database	Search strategy	Records (N = 3108)
PubMed	((("general" AND "health check") OR "health check?" OR "health check" OR "preventive health check?" OR "medical checkup?" OR "medical check?" OR "comprehensive health check?") AND ("uptake" OR attend* OR participat* OR utili?ation OR adher* OR appointment?)) AND ("intervention" OR "strategy" OR "strategies" OR "method?" OR "technique?")	449
PsychINFO	((("general" AND "health check") OR "health check?" OR "health check" OR "preventive health check?" OR "medical checkup?" OR "medical check?" OR "comprehensive health check?") AND ("uptake" OR attend* OR participat* OR utili?ation OR adher* OR appointment?)) AND (("intervention" OR "strategy" OR "strategies" OR "method?" OR "technique?"))	210
EMBASE	((('general' AND 'health check') OR 'health check?' OR 'health check' OR 'preventive health check?' OR 'medical checkup?' OR 'medical check?' OR 'comprehensive health check?') AND ('uptake' OR attend* OR participat* OR utili?ation OR adher* OR appointment?) AND ('intervention' OR 'strategy' OR 'strategies' OR 'method?' OR 'technique?'))	1546
Web of Science	((("general" AND "health check") OR "health check?" OR "health check" OR "preventive health check?" OR "medical checkup?" OR "medical check?" OR "comprehensive health check?") AND ("uptake" OR attend* OR participat* OR utili?ation OR adher* OR appointment?)) AND (("intervention" OR "strategy" OR "strategies" OR "method?" OR "technique?"))	903

Appendix A3 Screening selection criteria coding scheme

The following coding scheme was used in Excel to label the reason for exclusion.

Code	Exclusion criteria
A	Not about general health check/ or disease-specific screening
B	Not include older people population aged 50 or above
C	The intervention was not designed to improve the uptake or utilisation of general health check
D	The outcome measure was not the actual uptake or utilisation (i.e. intention/ willingness to use)
E	Study did not include a control/comparison group
F	Not written in English
G	Not published as an empirical research article
H	Have no record available
I	Have no access to the paper

Appendix A4 Identified BCTs with illustrative quotations

Table A4.1 Identified BCTs with illustrative quotations

Behaviour Change Techniques	Illustrative quotations
Goals and planning	
<p>1.4 Action planning</p> <p>Prompt details planning of performance of the behaviour (i.e. health check attendance) (must include at least one of context, frequency, duration and intensity)</p>	<p><i>“...by adding a tear-off slip with space for patients to record the date, time and location of their NHS HC ...”</i></p> <p>Sallis et al. (2016)</p>
Social support	
<p>3.1 Social support (unspecified)</p> <p>Advise on, arrange or provide social support or non-contingent praise or reward for performance of the behaviour. It includes encouragement and counselling, but only when it is directed at the behaviour.</p>	<p><i>“Using geographic information systems (GIS), we identified the clinics providing general health check-up services that were the nearest to participants' addresses, and printed them on the reminder letter. The printed clinic information was meant to serve as the “default option” for participants, one which would require minimum information-seeking burden—because it would enable them to not have to search for an appropriate clinic, among the many present, in the long online list of available clinics.”</i></p> <p>Shimoda et al (2022)</p> <p><i>“Can I book you in for an appointment?”</i></p> <p>Gidlow et al. (2019) additional file</p> <p><i>“ The intervention was a prompt to clinical staff, ‘Patient due NHS Health Check’, which appeared on the screen when the file was opened [...] If the member of staff moved the cursor over the prompt, then they were given the instruction, ‘Please offer the patient an appointment for their free NHS Health Check’.”</i></p> <p>Gold et al (2021)</p>
<p>3.2 Social support (practical)</p> <p>Advise on, arrange, or provide practical help (from friends, relatives, colleagues, 'buddies' or staff) for performance of the behaviour (health check attendance)</p>	
Shaping knowledge	
<p>4.1 Instruction on how to perform the behaviour</p> <p>Advise or agree on how to perform the behaviour (includes 'skills training')</p>	<p><i>“... The letter included behaviour instruction asking patients to call and book an appointment”, design to instruct the individual as to what action they needed to take...”</i></p> <p>Sallis, Sherlock, et al. (2019)</p> <p><i>“Using geographic information systems (GIS), we identified the clinics providing general health check-up services that were the nearest to participants' addresses, and printed</i></p>

Behaviour Change Techniques	Illustrative quotations
	<p><i>them on the reminder letter. The printed clinic information was meant to serve as the “default option” for participants, one which would require minimum information-seeking burden—because it would enable them to not have to search for an appropriate clinic, among the many present, in the long online list of available clinics. This perspective is also supported by the literature, which suggest that planning support such as the location and time an individual should conduct screening behaviour is effective at promoting participation.”</i></p> <p>Shimoda et al (2022)</p>
Natural consequences	
<p>5.1 Information about health consequences</p> <p>Provide information (e.g. written, verbal, visual) about health consequences of performing the behaviour</p>	<p><i>“NHS Health Check aim to prevent 1,600 people from heart attacks and stroke per year... reduce your risk of developing Dementia... could prevent you from developing type 2 diabetes”</i></p> <p>Gold et al. (2019)</p>
<p>5.3 Information about social and environmental consequences</p> <p>Provide information (e.g. written, verbal, visual) about social and environmental consequences of performing the behaviour</p>	<p><i>“...explaining that the NHHSC can help to prevent the development of serious health conditions which take up lots of NHS resource...”</i></p> <p>Sallis, Gold, et al. (2019)</p>
<p>5.5 Anticipated regret</p> <p>Induce or raise awareness of expectations of future regret about performance of the unwanted behaviour</p>	<p><i>“It was also decided to add items assessing anticipated regret because a previous QBE study⁴⁵ found that, among participants who returned completed questionnaires, those who completed a TPB with anticipated regret questionnaire had a significantly higher cervical cancer screening attendance rate ... than those who received a TPB-only questionnaire ...”</i></p> <p>McDermott et al. (2016)</p>
Comparison of behaviour	
<p>6.2 Social comparison</p> <p>Draw attention to others’ performance to allow comparison with the person’s own performance</p>	<p><i>“Make the most of life. Book your NHS Health Check. 6 million people have already attended”</i></p> <p>Gold et al. (2019)</p> <p><i>“similarity was emphasised – ‘thousands of people like you have attended their health check’”</i></p> <p>Sallis, Sherlock, et al. (2019)</p>
<p>6.3 Information about others’ approval</p> <p>Provide information about what other people think about the behaviour. The information clarifies whether others will like, approve or disapprove of what the person is doing or will do</p>	<p><i>“Many people find it beneficial”</i></p> <p>Gold et al. (2019)</p>

Behaviour Change Techniques	Illustrative quotations
Association	
<p>7.1 Prompts/ cues</p> <p>Introduce or define environmental or social stimulus with the purpose of prompting or cueing the behaviour. The prompt or cue would normally occur at the time or place of performance</p>	<p><i>“adding a tear-off slip With an instruction to stick it to their fridge, the letter intended to address the intention-behaviour gap... through planning prompts.”</i></p> <p>Sallis et al. (2016)</p>
Comparison of outcomes	
<p>9.1. Credible sources</p> <p>Present verbal or visual communication from a credible source in favour of or against the behaviour (e.g. from the general practitioner)</p>	<p><i>“...the letter detailing ‘excuses’ for not attending an NHSHC alongside a reply from the GP to counter this excuse.”</i></p> <p>Sallis, Gold, et al. (2019)</p>
<p>9.3 Comparative imagining of future outcomes</p> <p>Prompt or advise the imagining and comparing of future outcomes of changed versus unchanged behaviour</p>	<p><i>“the loss-framed leaflet...had traffic-light coloured faces with appropriate emotional expressions to reinforce the personalised consequence of the NHS Health Check: ‘Not attending: You might be at risk of stroke, If you don’t know, you can’t do anything about it, ‘Ignoring: You can’t ignore diabetes. Don’t ignore your NHS Health Check’, and ‘Attending Your NHS Health Check could help prevent dementia, type 2 diabetes and more’</i></p> <p>Gold et al. (2019)</p>
Reward and threat	
<p>10.1 Material incentive (behaviour)</p> <p>Inform that money, vouchers or other valued objects will be delivered if and only if there has been effort and/or progress in performing the behaviour (include ‘Positive reinforcement’)</p>	<p><i>“The covering letter in this trial arm offered the £5 retail voucher as an incentive to return the questionnaire.”</i></p> <p>McDermott et al. (2016)</p>
Identity	
<p>13.2 Framing/ reframing</p> <p>Suggest the deliberate adoption of a perspective or new perspective on behaviour (e.g. its purpose) in order to change cognitions or emotions about performing the behaviour (include ‘cognitive structuring’)</p>	<p><i>“The second argument explains that family history plays only a small role in the cause of heart attacks and that looking after your body is also important; this aimed to overcome the belief that family history dictates their future health outcomes.”</i></p> <p>Sallis, Gold, et al. (2019)</p>
<p>13.3 Incompatible belief</p> <p>Draw attention to discrepancies between current or past behaviour and self-image, in order to create discomfort (include ‘cognitive dissonance’).</p>	<p><i>“In terms of the QBE, cognitive dissonance can arise when completing a questionnaire leads individuals to realise that their current or past actions are incompatible with their beliefs about how they should act.”</i></p> <p>McDermott et al. (2016)</p>
Self-belief	

Behaviour Change Techniques	Illustrative quotations
<p>15.1 Verbal persuasion about capability</p> <p>Tell the person that they can successfully perform the wanted behaviour, arguing against self-doubts and asserting that they can and will succeed.</p>	<p><i>“Although you feel fine, you could get diabetes, heart disease, kidney disease or dementia. Did you know they can be prevented, even if they run in your family? Doing nothing could lead to complications. Getting check could help you and help the NHS...”</i></p> <p>Gold et al. (2019)</p> <p><i>“Even if you’re feeling well, you will receive useful personalised advice on how to look after yourself and make simple changes that will help you feel better. Using your NHS Health Check to stay healthy helps you and the NHS.”</i></p> <p>Gold et al. (2019)</p>

Note. All the definitions were extracted from Michie et al. (2014) design guide

Appendix A5 The intervention functions of the identified BCTs.

Table A5.1 Linking BCTs to the identified intervention functions in BCW

Intervention function	Most used BCTs	Less frequently used BCTs
Education Increase knowledge or understanding	5.1 Information about health consequences 5.3 Information about social and environmental consequences 7.1 Prompt/ Cue	6.3 Information about others' approval
Persuasion Use communication to induce positive or negative feeling to stimulate action	5.1 Information about health consequence 5.3 Information about social and environmental consequences 9.1 Credible source	6.2 Social comparison 6.3 Information about others' approval 13.2 Framing/ reframing 15.1 Verbal persuasion about capability
Coercion Create an expectation of punishment or cost		5.5 Anticipated regret 13.3 Incompatible beliefs
Incentivization Create an expectation of reward		10.1 Material incentive (behaviour)
Training Impart skills	4.1 Instruction on how to perform the behaviour	
Environment restructuring Change the physical or social context	7.1 prompt/ cues	
Enablement Increase means or reduce barriers to increase capability (beyond education or training) or opportunity (beyond environmental restructuring)	1.4 Action planning 3.1 Social Support (unspecified)	5.5 Anticipated regret 9.3 Comparative imagining of future outcomes 13.2 Framing/ reframing 13.3 Incompatible beliefs 15.1 Verbal persuasion about capability

Note. All the definitions are extracted from Michie et al. (2014) designing guide.

Appendix A6 Risk of bias summary for each study

Table A6.1 Risk of bias summary for Gidlow et al (2019)

Bias	Author judgement	Support for judgement (illustrative quotation)	Comment
Random sequence generation (selection bias)	unclear risk	<p>A three-arm randomised controlled trial (RCT) was conducted across nine general practices in Stoke-on-Trent and Staffordshire, with individual patient randomisation.</p> <p>Within practices, eligible patients were identified through EMIS searches and randomly allocated to the three trial arms: standard letter (SL), telephone (TP), risk-personalised letter (PL).</p>	<p>The author mentioned it was a "individual patient randomisation" although the exact methods to achieve the random sequence generation was not explicitly stated.</p> <p>Author reported statistically difference in three variables (age, deprivation and urban-rural residence) among the three randomised group. However as there was no mention on the exact methods to achieve individual patient randomisation. The observed differences was addressed using an adjusted logit model.</p>
Allocation concealment (selection bias)	low risk	<p>To allow practices to follow trial procedures, EMIS provided practices with a detailed workflow/specification document. This provided instructions on searches, queries and read codes necessary to identify the eligible cohort as 'trial participants,' for random allocation,</p> <p>[Content provided under "ethnics approval and consent to participate] Separate informed consent was not necessary for individuals invited for a Health Check as: 1. These individuals would have received a Health Check invitation by letter or telephone invitation within the study period regardless; 2. The study involved practices inviting patients for an NHS Health Check using one of the two methods that they already employed (i.e., letter or telephone call);</p>	<p>Under the subsection, it was mentioned that no individual consent was made - this implied that the subjects would not be explicitly informed about the research aim and therefore they wouldn't know they were being allocated to different invitation letter. The subjects' preference for a specific invitation method was not avoided and therefore the risk of selection bias was minimal in this regard.</p> <p>As for the personnel who delivered the intervention, they did not know the allocation group prior to recruitment as the allocation was completed in a software system using "searches, queries and codes".</p>
Blinding of participants	high risk	Practice staff, predominantly reception/administrative staff or the Practice Nurse or Health Care Assistant,	The personnel that delivered the telephone invitation would have known the assigned intervention. It was impossible to

and personnel (performance bias)		made telephone calls to invite patients (Table 1). To standardise the type of information relayed and provide prompts to likely questions, a guide / script was provided (Additional file 1). This was developed with input from practice staff. Specific training in how to conduct telephone invitations was not necessary as all participating general practices had experience of using telephone calls for NHS Health Check invitations (one of the eligibility criteria).	blind the personnel as they would have to send out the letter/ make the telephone invitation before the non-attender criteria was met. For telephone call arm, although instructions were provided to those who delivered the call, it could not be assumed that the risk were minimal. In contrast, for the risk-personalised letter, it was sent out to participants and the personnel did not have contact with the recipients. Therefore, the risk of performance bias for the risk-personalised letter trial arm was minimal.
Blinding of outcome assessment (detection bias)	low risk	The primary outcome was attendance at an NHS Health Check (binary measure).	No explicit mention of how the attendance records were extracted . However, it is likely the record was extracted electronically as the EMIS software system was used. The attendance rate was determined by a set of pre-defined criteria. For telephone trials, classified as non-attender was after three calls was made; and for letter trial arms three letters were sent. There were differences in how these subjects were approached and the differences between trial arms could not be avoided due to the nature of the design. However, since this attendance rate was an objective outcome measure, the potential risk of detection bias was minimal.
incomplete outcome data (attrition bias)	high risk	<p>Third, the EMIS template (designed for this study) coded telephone calls as 'failed to respond' rather than recording each call made. This reduced the reliability of data regarding the number of telephone calls made per patient and prevented meaningful analysis of non-responders (i.e., those who did not respond to the call).</p> <p>Ethnicity is re- ported descriptively, but was not included in regression analysis because: data were missing for 914 patients (19.8%); inconsistent coding across practices and small numbers of patients in non-White British ethnic categories necessitated a dichotomous</p>	<p>Outcome data was lost for various reasons at practice and individual levels.</p> <p>First, the author discussed about the ways outcome were being classified for the telephone calls. As the nature of the telephone call involved responding to the phone call, there was an extra step for the personnel to take before confirming the attendance of the subjects. However, the potential misclassification was not the non-response, it would not have much impact on the outcome measurement i.e. attendance. Therefore, this would have low risk of attrition bias.</p>

		variable; the dichotomised variable was not a predictor of uptake.	<p>Data was also lost from excluding general practices that did not follow the protocol to meet the requirement. Because some of the telephone was invalid, the subjects could not be reached. There was a total of 1415 subjects being excluded from the study of 6244 eligible subjects (around 23%). The characteristics between the excluded subjects and the included subjects were not explored. It was not possible to comment on the impact of attrition bias due to incomplete outcome data given there was no evidence available to confirm whether systematic differences existed between these two groups.</p> <p>Secondly, other misclassification error which led to missing data was reported for Ethnicity variable. Given this, the variable was not included in the analysis and only available in descriptive analysis.</p>
Selective reporting (reporting bias)	low risk		No selective reporting bias was observed.

Table A6.2 Risk of bias summary for Gold et al (2019)

Bias	Author judgement	Support for judgement (illustrative quotation)	Comment
Random sequence generation (selection bias)	low risk	In each of Lewisham and Northeast Lincolnshire, patients were pseudo-randomised into three groups.	Although pseudo-randomisation adopted a deterministic algorithm to generate a random number, it is good enough to allow randomisation into group.
Allocation concealment (selection bias)	low risk	<p>These two local authorities both have a centralised invitation procedure (although letters were signed from the patient's GP, they were issued centrally, rather than by GP surgeries), which was important for ease of implementation of the trial.</p> <p>Invitations for the practices in Lewisham were sent by Quality Medical Solutions (QMS) and invitations for the practices in North East Lincolnshire were sent by the local authority administrator (although in both areas the letters were from the patient's GP).</p> <p>Both GPs and patients were blinded to intervention assignment.</p> <p>A double-blind three-armed randomized controlled trial was conducted.</p>	The GP and patients did not aware they were in a trial and therefore they did not know which intervention were being assigned. The issue of invitation letter was not through any of the outcome assessor and personnel.

Blinding of participants and personnel (performance bias)	low risk	A double-blind three-armed randomized controlled trial was conducted. Patients in Lewisham and Northeast Lincolnshire were pseudo-randomised (see "Procedure and randomisation" for details) to receive either the current national leaflet, the new loss-framed leaflet, or the new gain-framed leaflet.	The author reported that the GP and patients did not aware they were in a trial. However, the intervention leaflets were noticeably difference from the control leaflet. Although the included subjects were individual who had not have a health check more than five years, it could not be assumed that they would not notice they were given a different leaflet. However, considered the author reported that both GP and patients were not aware they were taking part in an RCT, the bias resulted from this was minimal.
Blinding of outcome assessment (detection bias)	low risk	The outcome measure was attendance at an NHS Health Check by November 2018 at active practices (in Lewisham, the outcome measure was attendance within 6 months of receiving the invitation, if that was sooner than the end of the trial). The outcome measure was attendance at the NHS Health Check, as recorded by individual practices. In addition, the GP practices provided anonymised data on age, sex, ethnicity, and previous health check invitation and attendance.	Both GP and patients were not aware they were being studied. The attendance was recorded in the QMS system. The influence of outcome assessor was kept to a minimal, if not none as it was a record saved in the system.
incomplete outcome data (attrition bias)	high risk	<p>The data from Northeast Lincolnshire contained an error where all 341 patients in one of the practices were allocated to the control condition, so the data from these patients was removed before analysis.</p> <p>In Lewisham, 452 patients in the control group for May were sent both the control leaflet and a second invitation with one of the intervention leaflets, so these patients were removed from the trial and adjustments were made to the trial groups in June, in order to have an even number of patients in each arm</p>	The missing data mechanism was due to error in allocation and sending the actual intervention. The outcome being missed out were related to the outcome measure (attendance rate). The proportion of the missing outcome data caused by this error was not considered small. The risk of attribution bias was likely to be high.

Selective reporting (reporting bias)	low risk		No selective reported was observed.
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Table A6.3 Risk of bias summary for Gold et al (2021)

Bias	Author judgement	Support for judgement (illustrative quotation)	Comment
Random sequence generation (selection bias)	low risk	<p>The randomisation was a pseudo- randomised process based on the ages of the participants. The participants with quinquennial ages (ending in 0 or 5) were stratified and systematically split. The reason for this was that letter invitations are sent to people in Southwark when they reach one of these milestones, so these were the patients who were likely to have already received a letter invitation in 2015 and most likely to respond to a prompt. The practices were also divided into two areas and stratified based on this, in order to account for differing levels of deprivation.</p> <p>Of these, 252 (3.22%) were not randomised into a condition for the trial and were excluded from the analysis at this stage, owing to technical issues in the practices when the randomisation was rolled out.</p> <p>The baseline demographics of the intervention and control group showed no statistically significant differences for sex and ethnicity, but there was a relationship between age and the intervention, $\chi^2(6, n = 7564) = 17.983, P < 0.01$ (see Table 2 for the complete set of tests). Inspecting the distributions further, it seems that there is an overrepresentation of the 50–54years category in the control group</p>	Allocation algorithm was provided in the supplementary file, uploaded online.

		(20.57% of that condition) compared with the intervention group (17.51%), which may explain this result.	
Allocation concealment (selection bias)	high risk	Fully random allocation was not possible within the restrictions of the IT system, so the researchers devised an allocation sequence to assign patients to groups that would be as free from bias as possible (see Supplementary File 1 for details).	Researcher had the knowledge of group allocation though effort was made to reduce the bias.

Blinding of participants and personnel (performance bias)	high risk	The new template for the prompts were developed for EMIS Web and installed by the clinical commissioning group (CCG) in the participating practices. The data that were extracted from the clinical system contained no patient identifiable information. Once data had been extracted, the same algorithm that was used to determine the groups for the prompts was used to create the groups for analysis.	There was a high chance that the personnel (GP) were aware of the different prompts being provided to them.
Blinding of outcome assessment (detection bias)	low risk	The primary outcome was attendance at an NHC. Data on attendance of the NHC were stored on EMIS software and were extracted by Southwark CCG. Data were automatically extracted from patient records, meaning there was no outcome assessor as such, and blinding was not necessary.	
incomplete outcome data (attrition bias)	high risk	The data used in this analysis comprise 7816 individuals who were registered in a participating practice and eligible for an NHC between the dates of 2 May 2015 and 17 July 2015, the pre-specified start and end dates of the trial. Of these, 252 (3.22%) were not randomised into a condition for the trial and were excluded from the analysis at this stage, owing to technical issues in the practices when the randomisation was rolled out. Two practices did not offer any health checks; it is not known why.	Missing outcome data was observed, with the author unable to further explore the reason behind.
Selective reporting (reporting bias)	low risk	The unadjusted model (Model 1, Table 3) showed that people in the intervention group had higher odds of attending an NHC (odds ratio [OR]=1.70; 95% confidence intervals [CI] = 1.46 to 1.99, P<0.001)	All the unadjusted and adjusted model were reported accordingly.

Table A6.4 Risk of bias summary for McDermott et al (2016)

Bias	Author judgement	Support for judgement (illustrative quotation)	Comment
Random sequence generation (selection bias)	low risk	<p>We therefore developed an alternative method of recruitment and randomisation that could be implemented through visits to general practices. The trial was delivered through the use of these two different recruitment and randomisation procedures, which will be referred to as the 'automated' and 'in-practice' recruitment methods, respectively.</p> <p>Each month, the trial statistician drew up randomisation lists, stratified by general practice. As all patients within a practice were assigned simultaneously, participants were allocated to intervention arms in a ratio of 1 : 1 : 1 by means of a computer-generated randomisation list stratified by general practice and month using permuted blocks of three.</p> <p>[automated] For general practices assigned to the automated method for recruitment and allocation, randomisation was performed automatically using a randomisation procedure programmed into QMS Health Check Focus software, used to manage the Health Check programme. Randomisation lists were generated using a bespoke algorithm embedded within the QMS software. Simple randomisation, stratified by practice and month, was employed.</p>	<p>Modification was introduced to the system - there were two type of randomisation procedures.</p> <p>For in-practice methods, blocked design was used to ensure allocation concealment, 'permuted blocks of three' was used. For automated methods, simple randomisation was used with stratification.</p>
Allocation concealment (selection bias)	low risk	<p>The randomisation list was applied to the approved PNL by the trial researcher, who assigned the trial arm in the existing order of the approved PNL. Practice staff responsible for preparing the approved PNL never had access to the randomisation list for the practice. This process was considered to provide adequate concealment of the allocation procedure.</p>	

		Participants were automatically assigned a study identification number and group allocation when the PNL was electronically approved by the general practice.	
Blinding of participants and personnel (performance bias)	high risk	Participants' GPs provided consent to their participation in the trial and so participants were not overtly aware that there were other trial arms. However, participants in the QBE questionnaire and QBE questionnaire and incentive groups received a postal intervention and thus could not be blinded to their trial arm allocation	Although the risk was not high for the study team, the subjects in the trials were not blinded, hence it was downgraded to high risk.
Blinding of outcome assessment (detection bias)	low risk	No data were collected directly from patients. Data were extracted from electronic health records into a spreadsheet and were then transferred to a database for statistical analysis. The primary outcome was uptake of an NHS health check within 182 days (6 months) of receiving the standard invitation letter. Members of the study team were blind to participants' details during trial arm allocation and were blind to group allocation during extraction of participant data and outcomes from general practice records.	All the data was extracted and that there was no variables that required patients to provide.
incomplete outcome data (attrition bias)	low risk		
Selective reporting (reporting bias)	low risk		

Table A6.5 Risk of bias summary for Sallis et al (2016)

Bias	Author judgement	Support for judgement (illustrative quotation)	Comment
Random sequence generation (selection bias)	high risk	<p>The study was a quasi-randomised controlled trial with one intervention arm.</p> <p>...one of the four practices was generated from patient records accessed by the Medway NHS HC manager. These were extracted into a database and ordered alphabetically. The IT systems in place for sending out the letters meant that it was not possible to truly randomly allocate the participants to the control or intervention letters. Instead, the local NHS HC manager allocated participants to control and intervention groups by surname divided at the midpoint within their practice lists. In order to minimise bias those with surnames in the first half of the list received the control letters at two practices and intervention letters at the other two primary care practices; and vice versa.</p>	<p>NHS HC manger would know the specific rule applied to generate the group list, although attempts were made to minimise the risk. Later on, the summary result revealed that there was no significant differences between the two arms in terms of gender, age, deprivation quintile.</p>

Allocation concealment (selection bias)	low risk	<p>the local NHS HC manager allocated participants to control and intervention groups by surname divided at the midpoint within their practice lists. In order to minimise bias those with surnames in the first half of the list received the control letters at two practices and intervention letters at the other two primary care practices; and vice versa. Practice staff were unaware which intervention group participants were allocated.</p> <p>Individual consent for participation was not sought as researchers only had access to anonymised data, no individual level data are presented, and because informed consent would likely have influenced individuals' behaviour therefore affecting the ecological validity of the study and extrapolation of its findings. To protect confidentiality, anonymised, aggregate data can be obtained by contacting the authors.</p>	<p>The allocation was performed by the NHS HC manager, but the general practice staff were not aware. The risk of selection bias was low. As for the subjects, they were not aware as the researcher did not have to obtain their informed consent and therefore did not know they were in a trial.</p>
Blinding of participants and personnel (performance bias)	low risk	<p>Individual consent for participation was not sought as researchers only had access to anonymised data, no individual level data are presented, and because informed consent would likely have influenced individuals' behaviour therefore affecting the ecological validity of the study and extrapolation of its findings. To protect confidentiality, anonymised, aggregate data can be obtained by contacting the authors.</p>	

		Practice staff were unaware which intervention group participants were allocated.	
Blinding of outcome assessment (detection bias)	unclear risk	The primary outcome was attendance at an NHS HC (binary measure).	No mention of the way outcome was assessed it was difficult to judge whether there would be other factors influencing this, it was not known how the outcome was recorded.
incomplete outcome data (attrition bias)	low risk		No missing data was reported, excepted one subject did not provide deprivation data. But this data was not directly related to the outcome measure.
Selective reporting (reporting bias)	low risk		

Table A6.6 Risk of bias summary for Sallis, Gold et al (2019)

Bias	Author judgement	Support for judgement (illustrative quotation)	Comment
Random sequence generation (selection bias)	low risk	At the beginning of every month, a list of adults due for an NHSHC at each of the GP practices was generated, using specialized healthcare software. Patients on this list were randomly assigned to receive one of three different NHSHC invitation letters. Randomization was conducted monthly at each GP practice individually, by a researcher working with Northamptonshire's R&D service, using a computerized random number generator (Microsoft Excel's random function).	
Allocation concealment (selection bias)	low risk	<p>During the randomization process, the letters were referred to as 'Letter A', 'Letter B' and 'Letter C', and the researcher doing the randomization did not know to which conditions these referred or, therefore, to which condition participants were being assigned.</p> <p>We did not collect informed consent from participants because that would not have been practicable (we collected completely anonymized data from 6000 patients) and because that would have defeated the purpose of the trial (it is not possible to ask patients whether they want to receive a letter when investigating the effect of a letter on changing behaviour)</p>	
Blinding of participants and personnel (performance bias)	low risk	Patients were blinded to the intervention; they did not know that other patients in the practice might have been sent a different invitation letter from them, nor did health check providers know what invitation any individual patient had been sent.	
Blinding of outcome assessment (detection bias)	low risk	The outcome measure was attendance at the NHSHC recorded by individual practices. Data extraction was carried out 12 weeks after the end of the period when the letters were sent out. In addition, the GP practices provided anonymized age, sex and ethnicity data.	

incomplete outcome data (attrition bias)	high risk	<p>Ethnicity was not modelled in the analysis because levels of missing data systematically differed on the main outcome: 48.44% of individuals who did not take up the health check did not have any ethnicity data recorded about them, in contrast to the 97.57% of individuals who did attend a health check. In order to test whether the efficacy of the two interventions differed, a logistic regression model was estimated that excluded data from the control arm.</p> <p>In this study, data on ethnicity were often missing and ethnicity was not included in the data analysis because non-attendees were less likely to have had ethnicity data recorded than attendees.</p>	Ethnicity data was missed out for 48.44%, it was found that these were mostly from the non-attendees.
Selective reporting (reporting bias)	low risk		

Table A6.7 Risk of bias summary for Sallis, Sherlock et al (2019)

Bias	Author judgement	Support for judgement (illustrative quotation)	Comment
Random sequence generation (selection bias)	low risk	<p>Primary Care Support Service (PCSS) extracted the patient data and sent it to individual practices to ap- prove. Patient records were then allocated to combinations of SMS interventions (pre-notification and reminder, pre-notification only, reminder only or no SMS) using simple randomisation, whereby each patient had an equal probability of being in any of the four conditions. This was done by iPlato using Mersenne Twister, which is a pseudo-random number generator, an algorithm for generating a sequence of numbers whose properties approximate the properties of sequences of random numbers [31].</p> <p>There were two significant differences in the allocation of invitees across trial arms according to these demographic factors (see Table 2). There was a larger proportion of men in the control letter trial arm (57.3%) ($p = 0.012$). There was also a slightly different distribution by ethnic group between the trial arms that were sent the SMS pre-notification or not ($p = 0.035$).</p>	

		There were also differences in demo- graphics across the intervention groups, but when demo- graphics were introduced into the model they did not make much difference to the main effects. The reason for practice variation is also not explored.	
Allocation concealment (selection bias)	low risk	The employees at iPlato and QMS who conducted the randomisation were aware of the interventions being performed in each condition. QMS then allocated each patient to a letter (control, open-ended, time-limited, social norm) based on the number that was generated. The employees at iPlato and QMS who conducted the randomisation were aware of the interventions being performed in each condition. Staff in the general practices were unaware of allocation and patients were not aware of conditions other than their own.	
Blinding of participants and personnel (performance bias)	low risk	Staff in the general practices were unaware of allocation and patients were not aware of conditions other than their own.	
Blinding of outcome assessment (detection bias)	low risk	The primary outcome measure was attendance at an NHS HC, recorded as a completed NHS HC by a Read code in patients' electronic records, and extracted at the end of the study. Both transferred the data after randomisation to the researchers, who merged it using a unique identifier.	
incomplete outcome data (attrition bias)	high risk	Patients without mobile phone numbers recorded in the database were included in the randomisation but subsequently excluded from analysis. However, the number of exclusions was relatively small compared to the total number of participants in the trial and they were randomly distributed across the intervention combinations, so they are not expected to have a large effect on the results.	Data was missing and excluded for those who had no valid mobile phone number as it was excluded after randomisation, there was a possible risk that bias was introduced and influenced the effect size.
Selective reporting (reporting bias)	low risk		

Table A6.8 Risk of bias summary for Shimoda et al (2022)

Bias	Author judgement	Support for judgement (illustrative quotation)	Comment
Random sequence generation (selection bias)	low risk	<p>The Insurance Association provided the researchers with a list of dependents eligible for the present study for randomization. Simple randomization with a 1:1 allocation was performed by an external collaborator using a computer-generated randomization sequence.</p> <p>There were no apparent differences in any of the socio-demographic variables between the groups (Table 1).</p>	
Allocation concealment (selection bias)	Low risk	<p>Simple randomization with a 1:1 allocation was performed by an external collaborator using a computer-generated randomization sequence. We chose this method because it preserves the complete unpredictability of assignment; although it is argued that simple randomization can yield highly disparate sample sizes, the chance of pronounced imbalance becomes negligible in trials with sample sizes greater than 200 (Schulz and Grimes, 2002).</p> <p>The participants had no access to the list of random numbers and were masked for the randomization sequence, resulting in them being unaware that they were participants in the present study.</p>	

Blinding of participants and personnel (performance bias)	high risk	The participants had no access to the list of random numbers and were masked for the randomization sequence, resulting in them being unaware that they were participants in the present study.	Only the subject were masked. It was a single-blinded RTC, although the information about the masking of service provider (personnel) was not mentioned in the actual paper publication. However, in the protocol uploaded as supplementary file mentioned that it was originally planned to be a "double-blinded RCT" which stated, "The participants and service providers of the general health check-up will have no access to the list of random numbers and will be masked for the randomization sequence."
Blinding of outcome assessment (detection bias)	low risk	The main outcome measure was participation in the general health check-up provided by the Insurance Association within 1 month of receiving a postal reminder. Data on general health check-up attendance were collected as part of the ordinal record-keeping process of the clinics designated by the Insurance Association; then, after delivering the general health check-up, each clinic sent a written notification to the Insurance Association. Afterwards, this information was transferred to the data for this study, which served to determine the number of participants.	It was "part of the original record-keeping process of the clinics", there was no outcome accessor involved in the record keeping.
incomplete outcome data (attrition bias)	low risk		

Selective reporting (reporting bias)	low risk		
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Appendix B: Supplementary materials for Chapter 5

Below is a list of the supplementary materials mentioned in **Chapter 5 Qualitative study**.

Appendix B1 Revised interview guide

Below is the revised interview guide used in the qualitative study (Chapter 5). The revised version included B. warm up question. This question was included to initiate the discussion around the use of preventive service which can help respondent to engage in discussion around preventive eye examination service utilisation.

Study One Research Question:

What are the barriers to initial use and sustained use of routine optometric care for healthcare voucher recipients in Hong Kong?

A. Interview procedure

1. Greet interviewee + confirm eligibility
2. Seek a) informed consent (sign documents); b) permission to record the interview
3. Interview commences
4. Interview ends
5. Collect Demographic details
6. Giving a voucher to interviewee as a token of appreciation

B. Warm up question – to understand if the interviewee has ever used preventive care or not

1. Have you ever received any vaccination? Ever undergo any preventive services, e.g. colorectal cancer screening?

C. Interview topic guide

1. Could you share with me **if you have ever use** optometric care or not?
[Probe: **Yes** – when is the first time you have used it? If you have used it after the first time, and why or why not? How regular do you use the service, or not and why? How do you feel about it?
No – why not? If they have once thought about utilizing the service, and why or why not?]
2. Could you share with me your **thoughts/opinions/ views** towards routine optometric care? [Probe: last experience/ service expectation/ service delivery]
3. What do you **expect** from an optometric care? [Probe: tests to be received from an eye examination/ explore what are their understanding about optometric care]
4. Think back to when you **last utilize** an eyecare service, what led you to use it?
[Probe: why or why not?]
5. Why did you **stop attending (never attend)** routine optometric care? [if no reason: probe, what happened since last optometric care visit?]

6. **Under what circumstances** would you go for an eye examination?
7. **What influence your decision** to use routine optometric care or not? [Probe: Could you walk me through the steps you take to utilize optometric care service?]
8. How would you be **motivated to use** routine optometric care? [Probe: what is lacking, what is currently available to you?]
9. (should be asked last) In general, it is recommended that individual aged 65 + to attend an annual eye examination. **How possible is it for you to follow this recommendation?** [Probe: to encourage more input from the respondent, e.g. please explain more/ explain with an example/ What are your thoughts on this recommendation?]

[Summary] Do you have anything you wish to add/ elaborate more on?

(The End)

Appendix B2 Illustrative quotations

Sub-themes	Illustrative quotations
<u>Theme 1: previous health service utilisation as a reference for judging primary eye care</u>	
1. Symptom-driven and external-cued health seeking habit	<p><i>Interviewee: “I’ve undergone health check before. I have to take medication for high cholesterol and joint pain. I have regular medical consultation at the hospital. The doctors provide good follow up service. My legs also suffered from inflammation, which also require follow up consultation at the hospital”</i></p> <p>(INT_013, Female)</p> <p><i>Interviewer: “You shared about your previous experience with flu vaccination. What are the differences between getting your jab and getting an eye examination? Interviewee:” Well, I don’t see anything wrong with my eyes. But for flu jab...I always need to visit the doctor because I always catch a cold and feel unwell. I used to catch a cold before, and a medical consultation costs a lot, around HKD 400. Another time I got gastroenteritis, I had to pay HKD\$480.</i></p> <p>(INT_039, Female)</p>
2. Greater reliance on the public health sector	<p><i>Interviewee: [the government] have special offer for the older adults. They did a great job at providing healthcare to us. For example, if your knee (pointing at the knee) is in pain occasionally, they will refer to the hospital; for traditional Chinese practitioners, they will have acupuncture treatment. The facility are diverse.”</i></p> <p>(INT_021, Female)</p>
3. Healthcare expenditure as a financial burden	<p><i>Interviewee: It already costs a lot for visiting a private doctor, the check-up requires at least thousands of dollars. It costs at least ten-thousand dollars for surgery. What could you do? (giggle helplessly). For people like us in the low socioeconomic status, anything that requires money would need to be carefully considered.”</i></p> <p>(INT_020, Female)</p>

Interviewer: "You shared about your previous experience with flu vaccination. What are the differences between getting your jab and getting an eye examination?"
Interviewee: "Well, I don't see anything wrong with my eyes. But for flu jab...I always need to visit the doctor because I always catch a cold and feel unwell. I used to catch a cold before, and a medical consultation costs a lot, around HKD 400. Another time I got gastroenteritis, I had to pay HKD\$480."

(INT_039, Female)

Theme 2: perceiving limited primary eye care service needs

1. Symptom-driven primary eye care needs

a. *Depends on the interruption of symptoms on daily activities and anticipated consequences on vision*

Interviewer: "You told me that you have undergone cataract surgery on your [left] eye... how about your right eye, have you considered receiving a cataract surgery?"

Interviewee: "Not really..."

Interviewer: "Why is that?"

Interviewee: "Because I am very old now, it only matters to me if I could see, right? I can see these words (12pt font size on a A4 paper), and I am satisfied with that..."

(INT_012, Male)

Interviewer: "What are the chances for you to get your eye checked during the asymptomatic stage?"

Interviewee: "no not really..."

Interviewer: "Why is that?"

Interviewee: "Because I think it's not that needed, unless it's an emergency. My eyes are fine now, so I don't really consider that. But maybe in ten years' time when I noticed some abnormal symptoms such as seeing black lines that can't get rid of, then I might consider go and see a doctor. Otherwise, I won't consider."

(INT_013, Female)

b. *Coping strategies reduce perceived needs for vision care*

Interviewer: "Can you share with me the reasons for not using any eye examination after your last one?"

Interviewee: "My eyesight is quite good. For example, I could see far away clearly...the bus number on the bus when I

waited at the bus stop. So, I don't go to get my eyes checked purposively. I will put on my reading glasses if I need to read under a dim environment. But when I am in a bright environment, like now [during the interview], I can see these words clearly. I read more concentratedly for smaller words, such as the one presented here (font size 12 on an A4 sheet paper)."

(INT_021, Female)

Interviewer: "Can you share with me the reasons for not considering undergoing an eye check?"

Interviewee: "I see fine! Up till now, I can see well. See, I have this pair of glass (showing the interviewer the glasses she owns) for [reading]. I see clearly with these glasses. [I have] two glasses; one for reading..."

(INT_053, Female)

Interviewer: "Do you ever encounter any difficulties in your daily lives (with your current vision)?"

Interviewee: "You can judge if there are any impact...first you need a torch light (on the phone). Second, you need a magnifying glass. The impact [of the current vision] on us is present. But the thing is, these solve the problem (caused by blurriness in vision). There is nothing more we could do. You don't have to do more than that yet because the problem isn't that severe. But at times, when the words are written so tiny, that causes difficulties in reading [...] But what if we couldn't see the whole article? You need to think of a solution. There is no easy way. You could take a picture (on the phone) and magnified the screen content to the maximum. I think this solve the problem."

(INT_043, Male)

2. Social influences on primary eye care needs appraisal

a. *Vision deterioration is perceived as part of the normal ageing process*

Interviewer: "How is your current vision, compared to your working days?"

Interviewee: "Other than blurriness, I noticed nothing, so I don't need to deal with it. I think it's normal to experience

blurriness as we age. There is no way [the vision] is going to get any better. I have read about this in some magazines, saying that deterioration in functionality is common. So, I don't think there is a need yet. I would go [to see a doctor] if there is something wrong with me".

(INT_028, Female)

Interviewer: "What are your thoughts on undergoing an eye examination, with no symptoms of blurry vision? What are your thoughts on this?"

Interviewee: "I just give up on myself, and because I don't think there is anything wrong with me..."

Interviewer: "What are the chances of you receiving an eye examination in the coming two years?"

Interviewee: "Well... very difficult to tell. As I grow older, I often think about giving up... think about being old mean I could pass away at any time... so why bother [receiving eye care]? Why not leaving the healthcare resource to the younger generation?"

(INT_053, Female)

Interviewer: "You've talked about the reasons for not considering having another eye check after cataract surgery. Amongst all of these experiences, which one is the most influential one?"

Interviewee: "Although they sent me a letter for follow-up... I was going to undergo the cataract surgery on the other eye...but I didn't eventually... I mean I am quite old (in my 90s), any unpredictable things could happen, right? We are all in our 80s and 90s. It's acceptable to only have one eye that sees fine. This is my thought"

(INT_012, Male)

Interviewee: "Presbyopia...it's no good, you need to wear glasses. I would prescribe one if I was still working...I've been working in the Mainland China for more than a decade, then I retired in 1995 when I moved to Hong Kong. To be honest, I needed to save up and wanted to keep it simple."

(INT_012, Male)

b. *Downwards social comparison*

Interviewer: "Although you have never had an eye examination before, have you ever considered one?"

Interviewee: "But...first of all, I don't know how to get it checked. I think it's good to receive an eye check as an elder, but I can see clearly and I believe I don't have cataract. People said that you will see black stuff if you have cataract in your vision. I see very clearly; do you understand what I mean? Everything is so clear..."

(INT_009, Female)

c. *Absence of doctors' recommendation reduced perceived need for primary eye care*

Interviewer: "You had your cataract surgery at the private sector. Ever since you have received the cataract surgery, do you think you would need another routine eye examination? Have you ever undergone any?"

Interviewee: "No...no. Because [the doctor] told me I am fine during the follow-up [cataract] consultation. Since he told me I am fine, then I am fine, hence I didn't go (for another eye examination)..."

(INT_040, Female)

Interviewee: "I visit my doctor for regular follow-up every three months because I am a patient with chronic illnesses. During the consultation, I don't remember the doctor brought up any conversations about my eyes"

Interviewer: "Never mentioned about the eyes?"

Interviewee: "No. The doctor never proactively asked 'how do you feel about your eyes?'. Just never mention about it. I felt like, if you never mention it... that means that it is not important, isn't it? [The doctor] usually ask 'did you measure your blood pressure?', 'have you taken your diabetes medications?' ... [the doctor] never ask 'how's is your vision?'"

(INT_037, Female)

3. *Limited understanding of the significance of primary eye care*

Interviewer: "Can you share with me why do you think you need to get vaccinated?"

Interviewee: "Because of the campaign...to prevent infected with severe seasonal influenza therefore I receive the vaccination."

(INT_021, Female)

Interviewer: "What are the biggest difference between vaccination services and eyecare services?"

Interviewee: "...maybe is the campaign and information...seasonal vaccinations have been widely campaigned. There is nothing about eye care services that tell people to go use it."

(INT_021, Female)

4. Competing with other healthcare needs

Interviewer: "At your age, amongst all the healthcare needs, how important is routine eye examination to you, in terms of health priority?"

Interviewee: "Oh, it won't be my first priority. At our age, we come across many healthcare information regarding colorectal, liver, kidney, which are all important. [...] However, in term of our eyes, to be honest...we can live without it. You just need to adapt to it... at most, you would be a little clumsy. However, if you are not well, that really means your body is failing, which is not ideal. If I were to choose between not able to function well or being blind, I would rather be functioning well, right? It is all about the priority."

(INT_029, Female)

Theme 3: perceived low self-efficacy on routine eye examination utilisation

1. Concerns over service fees for routine eye examinations

Interviewer: "What made you go for [the simple] eye check nine months ago?"

Interviewee: "free-of-charge."

Interviewer: "How did you come across the programme?"

Interviewee: "It was organised by the elderly centre."

(INT_040, Female)

Interviewer: "Can you give me some examples why do you think you don't need to go [for an eye examination]?"

Interviewee: "I think I'm fine, hence no need to use such service. For importantly, you have to pay when you get the test. I don't have any financial income, so I won't pay for the service. To be honest, I have to save as much as possible."

(INT_007, Male)

2. Limited information on service availability

Interviewer: "What roles does the centre, or being a member of elderly centre plays, in terms of influencing the use of healthcare services?"

Interviewee: "quite good".

Interviewer: "In what way?"

Interviewee: "We don't know a lot of things; so, we would ask [the staff] and they can explain that to us. For example, if you asked them about anything about healthcare, they could acquire useful information for you."

(INT_051, Female)

Interviewee: "You can't obtain much information yourself. We rely on elderly centre to obtain the information for us, then we could know more about it."

(INT_015, Female)

Interviewee: "Most of the educational talk... I had a feeling that they are just selling the product. I have been to some [educational talks] myself, about different healthcare needs and about the elderly. Sometimes I registered for the talk, only to know towards the end it was all about selling the product."

(INT_029, Female)

Interviewer: "You talked about the elderly centre having educational talk... (haven't finished asking the question)"

Interviewee: "They didn't ask you for an eye check. They only talked about the eye problem, using some short video clips."

(INT_013, Female)

Interviewer: "How would you prefer to receive useful information, in terms of trusted information sources?"

Interviewee: "Those by the government, or maybe those provided by your university. For those private services, especially those

asked you to get your annual health check, even if it promoted as a free-of-charge services, I would never go. If the programme is organised by the government I may consider. But those by private service, I think they will cost us more... so I won't use the service."

(INT_039, Female)

3. Limited social support

Interviewee: "We, as elders ourselves, have different gatherings. During the gatherings, we shared a lot of information. We talked about our needs, also where we could access the services. So, if I know, I could pass on the information. Sometimes if I don't know something myself, I can learn from others. We help each other out."

(INT_007, Male)

Interviewer: "Would you consider [getting an eye check] in the future?"

Interviewee: "Sometimes...I think about what if I couldn't see in the future? If I got the chance to get the eyes checked, it would be good... but I have no idea how I can access these services. I never consider that. I have no children, no one ever told me about this. I know nothing..."

(INT_009, Female)

Interviewer: "...where can you seek help to obtain service information?"

Interviewee: "I don't have the opportunities to meet any people. I usually come to [the elderly centre], otherwise I stay at home".

(INT_009, Female)

Interviewer: "What are your thoughts about needing to go for eye examination at least every two years?"

Interviewee: "I believe it would be beneficial to receive one if we have the ability to do it, right? However, some may not be convenient, or have no money. Especially, when you undergo a dilation, you couldn't see clearly for at least half an hour. You would be alright if you could stay and wait till the vision restore normal. However, if that's not the case, you wouldn't be able to leave the venue without

someone's accompany. I invited my friend to come with me to my previous eye check because I needed her to assist me to cross the road [...] when we left, I couldn't see clearly, not even the words. So, my friend came with me [...] because I needed to take the [transportation] back home. Because of these conditions, sometimes it is not easy to do so (to go for an eye examination)."

(INT_032, Female)

4. Low health literacy

Interviewee: "I see myself as an educated individual, equipped with the literacy to understand the information. I can guide my own decision making. However, I know some elders who have little literacy to understand, they are uneducated. They don't know which department to seek help. So, it is very important that the social worker, or having someone to organise meetings to get the elders involved. In this way, [the elders] can get involved and understand more about [the health information]."

(INT_007, Male)

Interviewee: "when I get my optical prescription, I will usually ask them questions [related to my vision]. So, I can know about my health. If I know my friends have any symptoms, I will also ask the optometrist if I have those symptoms as well... I talked to them to learn."

(INT_054, Male)

Interviewer: "Can you share with me what procedures they have performed?"

Interviewee: "They... they checked your glass prescription... something like that?"

Interviewer: "Do you remember if they performed fundus photography?"

Interviewee: "I don't know... they never tell you about this. They only told me to get this checked, that's it."

(INT_031, Female)

Appendix C: Supplementary materials for Chapter 6

Below is a list of the supplementary materials mentioned in **Chapter 6 Intervention development**. The materials are presented the order in which they were mentioned. Subheading were used signpost the section in which the materials were being referred.

Appendix C1 Preliminary intervention strategy

The proposed intervention will be implemented under a **community optometrist network** which consists of three key stakeholders: optometrist (service provider), elderly centre (community), and the elders (service users). The proposed **community-engagement programme** below describes a system that can be used to encourage the initial and continue use of preventive vision care for the community-dwelling elders. The listed items (1 - 4) are not separated activities. The following activities are intended to carry out regularly, either as an annual health promotion activity, or as regular activities incorporated into the daily operation of the elderly centre activities.

“**Elderly**” mentioned in this proposal refers to those **aged 65 years or above**.

1. **Establish a community optometrist network** (*social opportunity, physical opportunity*)

Previous study has found that elders seem to have misleading understanding towards optometrists (misunderstanding about their competency/ mistrust towards service charge by them), so intervention designed to encourage service uptake should involve actors that are trusted by the elders – the neighbourhood elderly centre (NEC) is such an example. Establishing a community optometrist network allows intervention to be carried out in conjunction with the elderly centre on a regular basis (e.g. annually).

Under the community optometrist network, optometrist will be responsible for:

- 1.1. Organising **health promotion** campaign activities (e.g. annually) with the elderly centre
- 1.2. Information **dissemination** (e.g. blog post, leaflet)
- 1.3. Establishing a **booking system** with the elderly centre (allowing different forms: sign up with centre staff/ booking online/ by phone); reminder
- 1.4. When needed (e.g. high demand of inquiries from elders), **consultation** may be provided to the centre-in-charge
- 1.5. **Service provision**
 - 1.5.1. Set a more affordable service price for the participating elders, around \$400 for each comprehensive eye examination; if there are subsidy from the NGOs then the elders may be able to pay less
 - 1.5.2. May provide discount code for buying glasses/ other treatment options (the discount code cannot be applied to the eye examination fee according to the code of practice section 5.4)
 - 1.5.3. Mobile service provided at the elderly centre (can only perform simple vision screening, unless the NEC has the equipment)

1.5.4. In-person, a more preferable option for comprehensive eye examination (e.g. ask the elders to go to an optometric clinic/DHC?)

1.5.5. Consideration of establishing a system whereby it facilitates triage of patients to secondary care (e.g. those who have enrolled to the programme can enjoy a quicker waiting time to see an ophthalmologist) – the aim is to increase the incentive to join the programme

2. **Empowering the elderly centre staff and elders** (*reflective motivation, psychology capability, social opportunity*)

NECs have a potential in encouraging elders' use of preventive eye care. Empowering the centre staff allows them to act as a bridge between service provider (optometrist) and service users (elders). Make use of other social influences (e.g. peers carers/ family members) can also further empower elders to make decision to use preventive vision care.

2.1. **Empowering centre-in-charge to communicate with community optometrists to**

organise (annual) health promotion activities that are aligned with the interest of the elderly centre/ elders.

2.2. **Encouraging the elderly centre staffs to cue elders to use the service**, e.g. putting VA chart Amsler grid, at the centre during health promotion month; to make them aware of the need to go for a comprehensive eye examination or; provide staff training for the centre staff to educate them about preventive vision care and its significance on elderly health wellbeing.

2.3. Elderly centre staff to encouraging elders to access the service by providing service-related information of the collaborated community optometrists (e.g. service location, price for examination, price range for optical aids); referring to an official webpage (if any) ideally to avoid competing of interest, the centre staff may only be able to provide information about the specific optometrist who came to give out the talk, other more general useful link can be disseminated for elders who asked for information.

2.4. Optometrist and elderly centre can work together and put together **a decision aid to empower elders to make a healthcare use decision** (this could be provided as an information pack and delivered in the health education activities)

2.5. To **broadcast health promotion video clips** at the elderly centre

2.6. Form a **group of peer ambassadors**

2.6.1.(limited quota, e.g. 2-3 young old volunteers from the NGOs, or that specific centre)

2.6.2.**to promote preventive vision care** in the annual health activities; peer sharing of past service experience

2.6.3.**provide social support to other elders** – e.g. accompany elders to the optometric clinics and back to the community (to reduce the inconvenience caused by blurry vision), or as a potential information source

2.6.4.the ambassador volunteers will **receive training before engaging in social support activities** (e.g. optometrist provides vision-related education)

2.6.5.they can also encourage the elderly to give out the leaflets/ information pack to their carers/ family members, so the carers/ family members can also be aware of the service and the importance of preventive vision care.

3. **Health promotion activities** (*psychological capability, reflective motivation*)

Optometrist and elderly centre should work together and organize annual health promotion campaign at the elderly centre. The key difference of these health promotion activities from the normal health educational talk (which usually are limited to vision-related information and its relevant health consequences), is content included should extend beyond vision.

3.1. Health promotion activities **format**:

3.1.1.(in-person/online/hybrid) **health educational talk**

3.1.2.**interactive**: workshop, games (virtual glasses, games)

3.1.3.**peer-sharing** of successful experience

3.1.4.**physical copy**: leaflet/ brochure/ pamphlet/ printed publication

3.1.5.**e-version**: blog posts/ elderly centre monthly magazine (publication) – depends on the centre's usual operation. Once may not have the section for health education, but only be able to advertise for any activities for the members to register.

3.2. **Content** to include:

3.2.1.**Persuading vision care is equally important** as the general health condition

3.2.2.**Educating vision-related health consequences** – *vision related consequences*

3.2.3. **Educating the social, environmental and emotion consequences** as a result of poor vision

e.g. risk of fall/ physical injuries/ poor vision and its impact on social life (grocery shopping/ babysitting grandchildren/ leisure activities with peers)

3.2.4. **Educating the CEE procedures** and their functions (increase elders' familiarity to the service)

3.2.5. **Educating the elders about the optometrists' role and job duties** (to increase the elders' understanding of optometrist, e.g. knowing that optometrist is not only capable of prescribing glasses but also performing comprehensive eye examination; aim to increase their willingness to use the service provided by an optometrist)

3.3. To attract more audience to attend the health promotion event, small gift can be prepared and gifted to the attendee after the event:

3.3.1. VA chart / Amsler grid

3.3.2. Artificial tears

3.3.3. Glasses cloth

3.3.4. Food (usual ones that centre would prepare)

4. **Health communication between optometrists and elders** (*reflective motivation*)

Communication at the examination with the optometrist offers opportunity to encourage future appointment attendance. Apart from the currently existing practices. i.e. optometrist to explain the examination results and suggest the next appointment on a report, the following can be considered.

4.1. When suggesting the next appointment time, optometrists will inform the elder that an **opt-in appointment has been scheduled for them**. They are welcome to change the date and time.

4.1.1. Providing reminders before the schedule appointment as well (e.g. telephone, SMS reminders/ appointment letter)

4.1.2. Or the elder will be informed that an **opt-in discount code** will be available for use to spend on their treatment option (e.g. purchases of glasses, if needed) if the elder comes to the next scheduled appointment.

4.1.3. If the elders have come to the next appointment, the report will include a sentence **praising their effort** and **encourage they continue to attend** the next scheduled appointment as recommended by the optometrist.

Appendix C2 Modified intervention strategy for older adults

Below shows the modified intervention strategy sent to the IAA members. The strategy was translated into Chinese. Modification was made to highlight the key point for the IAA members to consider. This information was sent to the IAA members two days before the discussion.

有關眼睛健康社區參與計劃設計的意見分享訪談

研究目的：

65 歲或以上的長者定期進行全面眼科檢查（每一或兩年）有助提早發現眼疾，對提早治理有很大的幫助。研究發現，本港的長者受不同因素影響導致他們甚少使用或持續使用預防眼睛健康服務。根據以往的研究結果，我們設計了一個社區參與計劃，目的是希望長者能持續的使用由視光師所提供的預防眼睛健康服務，最終目的是希望長者能保持良好的視力。

我們在此誠意邀請您參與一個訪談（約 45 分鐘），目的是想瞭解您對於此計劃設計上的意見與改善（如有）。以下是計劃提案的詳細內容。

【下一頁】

【以下内容請保密，謝謝】

眼睛健康社區參與計劃提案

本計劃是由四個部分所組成，並有三方的參與：視光師、長者及長者鄰舍中心。

- 1) 建立社區視光師網路
- 2) 增加長者/長者中心職員對於做出使用預防眼睛健康服務決定的信心
- 3) 舉行預防眼睛健康相關的教育宣傳活動
- 4) 改善視光師與長者之間的健康資訊的溝通與資訊交換

1. 建立社區視光師網路

- 1.1. 視光師與長者中心合作，**提供眼睛健康相關的教育宣傳活動**
- 1.2. 視光師提供的全面眼科檢查一般收費大約為港幣 400 元。中心有可能可以與視光師商議以較低的價錢為長者提供全面眼科檢查。
- 1.3. 如有需要，可為鄰舍長者中心負責人提供更多有關眼睛健康方面的諮詢
- 1.4. **提供驗眼服務方式**
 - 1.4.1. 如視光師訪問中心，只能提供有限的檢查服務
 - 1.4.2. 長者到訪視光中心的話，則能享受全面的眼科檢查

2. 增加長者/長者中心職員對於做出使用預防眼睛服務決定的信心

- 2.1. 長者中心職員
 - 2.1.1. 視光師教育中心職員**使用簡易的工具來替有需要的長者檢查視力**，如發現問題可建議長者預約全面眼科檢查
 - 2.1.2. 與視光師為長者**設計簡易選擇指南**，有助長者做出使用預防眼睛健康服務的決定。指南可以在中心里領取。
 - 2.1.3. 為長者提供全面眼科檢查服務的相關資料，例如服務地點，價格等等
 - 2.1.4. 在長者中心里**定期播放眼睛健康宣傳片**
- 2.2. 長者眼睛義工大使
 - 2.2.1. 在長者義工投入服務前，視光師會為他們提供眼睛健康的知識或其他所需知識與訓練
 - 2.2.2. 他們會在活動裡**分享過往驗眼經驗**
 - 2.2.3. 全面眼科檢查可能會需要放瞳，而導致視覺在檢查後可能會有 3-4 小時變得模糊，對強光敏感等等。**眼睛義工大使的作用是陪伴長者到訪視光診所，結束後一起返回社區**，以減低他們因視力模糊而發生意外所產生的擔憂（例如絆倒受傷）。

3. 舉行預防眼睛健康相關的教育宣傳活動

3.1. 可考慮的活動形式

- 3.1.1. 教育講座
- 3.1.2. 教育活動工作坊
- 3.1.3. 派發/提供眼睛健康資訊：小冊子、中心網誌或月刊

3.2. 教育內容

- 3.2.1. 主要目的是要令長者明白眼睛健康和其他的身體狀況同樣重要
- 3.2.2. 提供眼睛健康相關的知識
- 3.2.3. 了解視力不佳對於日常生活的影響（例如買送，照顧孫子孫女，參加日常朋友的聚會）
- 3.2.4. 了解全面眼科檢查及其功能（增加長者對於服務的認知）
- 3.2.5. 了解視光師的職責與能力

3.3. 提供驗眼服務資訊

- 3.3.1. 網頁資訊
- 3.3.2. 服務地點、服務價格
- 3.3.3. 提醒可使用醫療券付費

- 3.4. 為吸引更多長者參與推廣活動，活動結束後會有小禮物贈予參加者（例如人工淚水、眼鏡布、格仔紙/視力表）

4. 改善視光師與長者之間的健康資訊的溝通與資訊交換

- 4.1. 檢查結束後，已為長者安排下一次預約時間（可自行通知更改日期/時間）
- 4.2. 如果按時出席下次預約的檢查，該長者可享受折扣碼用於購買產品（眼鏡，眼藥水）
- 4.3. 如果按時出席下次預約的檢查，在下次的報告里附上表揚他們努力的句子，並鼓勵他們繼續按視光師的建議出席下一次預約的檢查。

Appendix C3 Detailed mapping results on intervention functions with APEASE criteria

Sub-themes	COM-B	Suggested intervention functions	APEASE
Previous health service utilisation as a reference for judging primary eye care			
1. Symptom-driven and externally cued health seeking behaviour	Reflective motivation	Education	Yes
		Persuasion	Yes
	Social opportunity	Environmental restructuring	Not relevant
		Modelling	Not relevant
		Enablement	Not relevant
2. Greater reliance on the public health sector	Reflective motivation	Education	Yes
		Incentivisation	Yes
	Physical opportunity	Training	Not relevant
		Restriction	Not practical
		Environmental restructuring	Not practical
		Enablement	Not practical
	Social opportunity	Restriction	Not relevant
		Environmental restructuring	Not practical
		Modelling	Not relevant
		Enablement	Not practical
3. Health care expenditure as financial burden	Physical opportunity	Training	Not relevant
		Restriction	Not relevant
		Environmental restructuring	Not relevant
		Enablement	Not relevant
Perceiving limited primary eye care service needs			
4. Symptom-driven preventive eye care needs	Reflective motivation	Education	Yes
		Persuasion	Yes
	Automatic motivation	Environmental restructuring	Yes

Sub-themes	COM-B	Suggested intervention functions	APEASE
	Psychological capability	Education	Yes
		Enablement	Yes
5. Social influences on preventive eye care need perception	Social opportunity	Environmental restructuring	Yes
		Modelling	Yes
		Enablement	Yes
	Reflective motivation	Education	Yes
		Persuasion	Yes
6. Limited understanding of the significance of preventive eye care	Psychological capability	Education	Yes
		Training	Yes
		Enablement	Yes
	Reflective motivation	Education	Yes
		Persuasion	Yes
7. Competing with other healthcare needs	Reflective motivation	Education	Yes
		Persuasion	Yes
		Incentivisation	already exist
Perceived low self-efficacy on routine eye examination utilisation			
8. Concern over service fee for preventive eye care	Psychological capability	Education	Yes
		Training	Yes
		Enablement	Yes
	Social opportunity	Modelling	not relevant
		Enablement	Yes
	Physical opportunity	Enablement	Yes
	Reflective motivation	Education	Yes
		Incentivisation	Yes
9. Limited information on service availability	Psychological capability	Education	Yes
		Training	Yes

Sub-themes	COM-B	Suggested intervention functions	APEASE
		Enablement	Yes
10. Limited social support	Social opportunity	Environmental restructuring	Yes
		Enablement	Yes
11. Limited health literacy	Psychological capability	Education	Yes
		Training	Yes
	Social opportunity	Environmental restructuring	Yes
		Enablement	Yes
Service expectations			
12. Perceived qualities of a good preventive eye care provider: patient-centred service and competence	Social opportunity	Enablement	Yes
	Reflective motivation	Education	Yes
		Persuasion	Yes
13. Acceptable service fee	Physical opportunity	Environmental restructuring	Yes
		Enablement	Yes
	Reflective motivation	Education	Yes
		Persuasion	Yes
		Incentivisation	Yes
14. Accessible location	Reflective motivation	Education	Yes
	Physical opportunity	Environmental restructuring	Yes
		Enablement	Yes

Restriction and Coercion were excluded as these two intervention functions were not relevant in the content of improving preventive eye examination.

Appendix C4 Detailed revised intervention strategy summary

Detailed revised intervention summary

1. Community optometrist network

The community optometrist network consists of a pool of optometrists who are interested in providing primary eye care services to the community-dwelling older adults, especially those who are a member of an elderly centre. The community optometry network is the key element of this intervention programme. Having such a network may reduce barriers to increase capability (knowledge) and opportunity (providing services at a more affordable price) for the older adults to use preventive eye examination.

	Strategy (<i>Behaviour change technique(s), if any</i>)	Description	COM-B	TDF	Intervention function
1.1	Service provision mode				
1.1.1	Provide eye examination in the form of mobile services at the elderly centre (12.1, <i>Restructuring physical environment</i>)	This addresses the service expectation of the older adults (accessible location), with an aim to improve physical opportunity to use the service. Older adults are more familiar with the elderly centre.	Physical opportunity	Environmental context and resources	Environmental restructuring
1.1.2	In-person at the optometric clinic (normal practice)				
1.2	Health communication				
	When disseminating information to the elders/ communicating with the elders, the information provided by an optometrist should be delivered in a way that allows elders with low health literacy to understand easily and accurately; provide assistance when needed	This is important for older adults to understand their condition and make a decision to attend the regular preventive eye examination. Elders trust information provided by the healthcare provider. So, the opportunity to meet with the elderly must be exploited effectively so they understand why	Social opportunity Psychological capability	Social influences Memory, attention and decision process	Environmental restructuring Enablement Education

	Strategy (<i>Behaviour change technique(s), if any</i>)	Description	COM-B	TDF	Intervention function
	(3.1, <i>Social support (unspecified)</i> ; 5.1, <i>Information about health consequences</i>)	they have to use and continue to use the service in the future.			
1.3	Service components				
1.3.1.	Set the examination fee at a more affordable level	Reducing the examination fee address the concern on the financial barriers to access to the service, it would influence the reflective motivation to use the service as the belief of their capability to use the service increases. It also provides an incentive for the older adults to use the service if the service is more affordable.	Reflective motivation Physical opportunity	Beliefs about capability Environmental context and resources	Enablement Incentivization
1.3.2.	Providing a set of more affordable spectacles for the elderly to choose (if needed to purchase any spectacles) (5.3, <i>Information about social and environmental consequences</i>)	This addresses the barriers related to concerns on service fee for eye examination, especially after receiving the service where glass prescription is required. Similar to the description above, it aims to increase the belief of having the ability to pay for the service the elderly needed. This enables elders to choose the service within their own affordability.	Reflective motivation Physical opportunity	Beliefs about capability Environmental context and resources	Enablement Incentivization
1.3.3.	Provide a clear and transparent price list for the elderly (5.3, <i>Information about social and environmental consequences</i>)	By providing a transparent price list will allow the elders to know how much the service costs and having the information they needed to decide how they would like to spend the money. Increasing the knowledge about the price for the service item would increase their reflective motivation to use the service.	Psychological capability Reflective motivation	Knowledge Memory, attention and decision process	Enablement

	Strategy (<i>Behaviour change technique(s), if any</i>)	Description	COM-B	TDF	Intervention function
				Belief about capability (to pay for service)	
1.4	Deliver health promotion activities at the elderly centre				
	<i>A range of strategies could be considered when delivering health promotion activities at the elderly centre. This includes how information can be delivered, what content should be delivered. This also involve other actors such as peer volunteers and elderly centre staff</i>	<p>The optometrists will be responsible for delivering activities to the member of elderly centre to empower them with the information.</p> <p>The detailed strategies description, refer to “<i>Empowerment in the elderly’s lay referral network</i>” and “<i>Empowerment in the older adults</i>” in the later part of this appendix.</p>			

2. Empowerment in the elderly's lay referral network

Empowering people around older adults increases the chance to spread/ provide useful knowledge and information within the social network. This also increases the chance for people within the lay referral network to provide any support (e.g. informational/ practical) to the older adults when needed. Make use of the benefit of social influence on need appraisal and the dissemination of useful and appropriate information, below describes the strategies that can be implemented to improve psychological capability, reflective motivation of the elders. The key idea is to increase social support for the older adults and create an enabling environment around the older adults to reduce the barrier to increase capability and opportunity and eventually the motivation to use preventive eye examination.

	Strategy (<i>Behaviour change technique(s), if any</i>)	Description	COM-B	TDF	Intervention function
2.1	Empower the elderly centre staff via staff training				
2.1.1.	Educating the elderly centre staff about the importance of regular uptake of preventive eye examination and train them to use relevant tools to check eyesight e.g. VA chart and Amsler grid. It aims to increase the confidence of the centre staff to provide relevant information to the elders (3.1, <i>social support (unspecified)</i> ; 5.1, <i>Information about health consequence</i>)	Centre staff is a trustworthy source of information. Educating this group of people could increase the chance to provide useful information to the older adults when being asked – a way to reduce the barriers to increase psychology capability as older adults may have little health literacy to understand the information.	Psychological capability Social opportunity	Knowledge Social influences	Enablement
2.1.2.	Introducing centre staff to the community optometrist network and their job nature; letting them know the healthcare professional the older adults should seek help from when they want to have their eyes checked (4.1, <i>Instruction on how to perform a behaviour</i> ; 5.1, <i>Information about health consequences</i>)	Not only the staff would need to know the knowledge about eye examination and eye health, but they would also equip with the information about the service provider.			
2.1.3.	Educate the staff about where and how to search for available services, to facilitate service access when the	This strategy focuses on training the staff how to access the information, again, this aims to			

	Strategy (<i>Behaviour change technique(s), if any</i>)	Description	COM-B	TDF	Intervention function
	elderly come and ask for help (e.g. website with a list of community optometrists) (3.1, <i>Social support (unspecified)</i> ; 4.1, <i>Instruction on how to perform a behaviour</i>)	creating an environment where social support is fruitful for the older adult when they seek for help.			
2.2.	Empower the peers (peer volunteer/ peer ambassador)				
2.2.1.	Encourage peer volunteer to participate in a training programme. Before taking part in these health promotion activities, they will have sufficient knowledge about the significance of regular eye examination, information on service availability, so that they can act a source of information within the lay referral network (3.1, <i>Social support (unspecified)</i>); 4.1, <i>Instruction on how to perform behaviour</i>)	The peer volunteer will help to educate the older adults. Involving peer volunteers could increase the chance of spreading useful information to the older adults in their daily life (during daily gathering). Social comparison also is used by the elders to judge need, with the social influences from their peers, the involvement of peer volunteers in this programme would have influences on their motivation to use the services as elder will see more people around them are using the services.	Psychological capability Social opportunity	Knowledge Social influences	Enablement Environmental restructuring
2.2.2.	Train the peer volunteer to use simple tool to check for eyesight, they can help to demonstrate to other elderly during the health promotion activities (4.1, <i>Instruction on how to perform a behaviour</i> ; 6.1, <i>Demonstration of the behaviour</i>)	Basic training will be provided to peer volunteers, so they are equipped with the correct information to share the skills and knowledge with other older adults during the health promotion activities. This can ensure the social opportunities can be correctly exploited.			

	Strategy (<i>Behaviour change technique(s), if any</i>)	Description	COM-B	TDF	Intervention function
2.2.3.	Provide social support to elders by having peer ambassadors or existing centre volunteer accompanying elderly in need to scheduled appointment (3.2, <i>Social support (practical)</i>)	This strategy is for older adults who need extra support to attend the appointment, reduce concerns/ inconvenience caused by blurry vision after dilation. However, the feasibility and sustainability of implementing this strategy depends on the available peer volunteer, and other logistics issues surrounding the service provider and the elderly centre.	Social opportunity	Social influences	Enablement Environmental restructuring
2.3.	Empower the family members with relevant knowledge and information				
2.3.1.	To provide leaflet to the lay referral network e.g. caregiver and family members, to educate the importance of eye care and inform them about service available to them (where can they access the service) (3.1, <i>Social support (unspecified)</i> ; 5.1, <i>Information about health consequences</i>)	Several ways to disseminate the information to the family members or carers can be considered. The aim is to educate and increase awareness of the lay referral network to increase the chance of them providing support to the older adults when needed, whether that is accessing necessary information or travelling to attend an eye examination appointment.	Psychological capability Social opportunity	Memory, attention and decision process Environmental context and resources	Enablement Modelling
2.3.2.	Encourage carer/ family members of the elder to join the health promotion activities, to learn about the significance of preventive vision care, service provider and service component, and service availability (3.1, <i>Social support (unspecified)</i>)	While the activities at the elderly centre are mainly focused on the elderly centre members, expanding it to their family members to join the activities could increase the social support.		Social influences	
2.3.3.	Encourage carer/ family member who have used the service before to join the peer sharing session to share	This strategy can be included as part of the health promotion activities. This strategy aim to make use of the social influence to encourage			

	Strategy (<i>Behaviour change technique(s), if any</i>)	Description	COM-B	TDF	Intervention function
	about their experience (3.1, <i>Social support (unspecified)</i>)	the older adults to use preventive eye examination by providing an example to the older adults and their referral network on how the others are doing to safeguard their eyesight.			

3. Empowerment in the older adults

Older adults are the target service users. It would depend on them whether they access the available service. Therefore, it is important to empower the older adults with knowledge and skills to increase their motivation to use preventive eye examination. Below lists out the strategies that could be used to empower the older adults. Some of the strategies would require the help from the elderly centre and the service provider.

	Strategy (<i>Behaviour change technique(s), if any</i>)	Description	COM-B	TDF	Intervention function
3.1.	Empower the older adults to be mindful of their vision care needs				
3.1.1.	Encourage the elderly centre to display leaflet in the elderly centre to make the elderly aware of/ remind about their vision and eye care needs; and display VA chart as a cue to make them be aware of the needs for an eye examination if they could see clearly. (3.2, <i>Social support (practical)</i> ; 12.5, <i>Adding objects to the environment</i>)	Introducing cues in the environment increase the chance of an elderly to think about their vision and leading them to have more motivation to use the service. Although this was perceived less effective to increase motivation by the older adults, it is a conventional way to disseminate information. The older adults can also seek help from the centre staff as the cues and prompts are displayed within the elderly centre environment.	Social opportunity	Social influences	Environmental restructuring

	Strategy (<i>Behaviour change technique(s), if any</i>)	Description	COM-B	TDF	Intervention function
3.1.1.1.	When designing the leaflet, the content should be easily understood by the older adults.	This can reduce the barrier due to limited health literacy and to increase their knowledge and awareness about preventive eye examination.	Psychological capability	Memory, attention and decision process	Enablement
3.1.2.	Encourage the elderly to attend health promotion activities with the following content and delivery mode:	A series of strategies can be implemented in the content of the health promotion activities.			
3.1.2.1.	Educational talk that involves educating the elders about the health consequences of using/not using regular eye examination; educating the impact of vision deterioration on daily activities). (5.1, <i>Information about health consequences</i> ; 5.3, <i>Information about social and environmental consequences</i>)	This is normal to invite optometrist (or other healthcare professional) to deliver healthcare talks. This strategy focuses on the content of the educational talk by including health consequences along with the common age-related eye diseases.	Psychological capability	Knowledge	Education
3.1.2.2.	Using visual stimulation glasses to show the elders what it feels like to have narrow vision field – this intends to persuade the elders of the importance of regular use of preventive eye examination (5.1, <i>Information about health consequences</i> ; 5.2, <i>Salience of consequences</i>)	As part of the health promotion activities, the use of visual stimulation glasses helps the older adults to experience the consequence of poorer eyesight (especially for those who perceived no needs as they don't have any symptoms yet). This is a way to persuade the importance of using preventive eye examination to detect any abnormalities.	Reflective motivation	Belief about consequences	Persuasion

	Strategy (<i>Behaviour change technique(s), if any</i>)	Description	COM-B	TDF	Intervention function
3.1.2.3.	<p>Through the educational talk and peer sharing (peers, carer/ family member, content should focus on educating the social, environmental and emotional consequences/ benefit of having good vision – e.g. the risk of fall, injuries, and impact on their daily activities, e.g. grocery shopping, babysitting grandchildren and other leisure activities with peers.</p> <p><i>(5.1, Information about health consequences; 5.3, Information about social and environmental consequences; 5.6, Information about emotional consequences; 6.3, Information about others' approval)</i></p>	Organising peer sharing session intends to use the social influences in change the need perception to use eye examination and their motivation to such service.	<p>Psychological capability</p> <p>Social opportunity</p> <p>Reflective motivation</p>	<p>Knowledge</p> <p>Social influences</p> <p>Belief about consequences</p>	<p>Education</p> <p>Persuasion</p> <p>Enablement</p> <p>Modelling</p>
3.1.2.4.	<p>The health promotion activities will involve training the elders to use VA chart and Amsler grid to self-check their vision, learning when they should seek help</p> <p><i>(6.1, Demonstration of the behaviour)</i></p>	<p>Apart from educating, persuasion intervention functions, training needs to be considered to allow the elders to know how to use the tool to check their eyesight.</p> <p>This strategy would allow elders with lower health literacy to make aware of their need to use the service by having to assess their eyesight briefly using tool without having to rely on written information. This strategy will reduce the barrier to increase psychological capability caused by limited/low health literacy.</p>	<p>Psychological capability</p> <p>Reflective motivation</p>	<p>Knowledge</p> <p>Memory, attention and decision-making process</p> <p>Belief about consequences</p>	Training
3.2.	Empowering the older adults to access the service				

	Strategy (<i>Behaviour change technique(s), if any</i>)	Description	COM-B	TDF	Intervention function
3.2.1.	Strategy to implement during health promotion activities	Apart from knowledge, we need to improve the elders' confidence to use the service. There are several strategies that can be considered in the health promotion activities			
3.2.1.1.	To educate the elderly about the key service provider and service component (what they do, how long the examination will last, what is involved in the examination service); through educational talk or playing video clips (3.1, <i>Social support (unspecified)</i> ; 6.1, <i>Demonstration of the behaviour</i>)	Having this information may better help the elderly to assess their own ability to use the services. Creating positive impression of the examination procedures, increasing the intention to use the service after they know what happened after getting examined by an optometrist.	Psychological capability Reflective motivation	Knowledge Beliefs about capability	Education
3.2.1.2.	Peer sharing of the positive experience using the service by the other peers/ family member/ carers (3.1, <i>Social support (unspecified)</i>); 6.3, <i>Information about others' approval</i>)	Through peer sharing (in different forms, e.g. talk, or through use of video), the eye examination service will be less novel to the older adults. They may be more encouraged to use the service if they knew the service has been used by their peers and with positive experience.	Reflective motivation Social Opportunity	Beliefs about consequences Social influences	Modelling
3.2.1.3.	Showing video of what will be done in the examination and what will you know after getting your eye checked – to improve their understanding of the service components (6.1, <i>Demonstration of the behaviour</i>)	By providing the information in video clip, the older adults do not have to imagine the eye examination scenario themselves. This help to create an expectation that is aligned with the real situation. Also, reducing the sense of unfamiliarity with the service may reduce the	Psychological capability Reflection motivation	Knowledge Beliefs about consequences	Education

	Strategy (<i>Behaviour change technique(s), if any</i>)	Description	COM-B	TDF	Intervention function
		negative impression of the examination procedures.			
3.2.1.4.	To educate the elderly about the normal price range for an eye examination; and their eligible subsidy methods for paying for the service (e.g. elderly healthcare voucher) (5.3, <i>Information about social and environmental consequences</i>)	Having the correct knowledge about service fee and reminded about their eligible ways to reduce financial barrier could help improve reflective motivation by being more certain about their capability and opportunity to choose the eye examination service.	Psychological capability Reflective motivation	Knowledge Belief about capability	Education
3.2.1.5.	Reminding them about that the elderly healthcare voucher can be used to cover the examination fee (5.3, <i>Information about social and environmental consequences</i>)	Reminding the voucher can be used to cover the service fee will increase the elders' belief about using the service, it also reminds the existing available financial incentive which may not be aware by the older adults.	Reflective motivation	Belief about capability	Incentivisation
3.2.1.6.	To educate the elderly where they can access the service (e.g. direct them to a website with a list of community optometrist) (6.1, <i>Demonstration of the behaviour</i>)	Similar to the above component, having the right information, the older adults will be more likely to make better judgement on where and how to access the service. This is to enable the older adults to search for the information they need.	Psychological capability	Knowledge	Education
3.2.1.7.	To provide elderly-friendly instructions for them to follow when needed to access to service (leaflet, via video demonstration) (6.1, <i>Demonstration of the behaviour</i>)		Reflective motivation	Memory, attention and decision process Belief about capability	Training Enablement

	Strategy (<i>Behaviour change technique(s), if any</i>)	Description	COM-B	TDF	Intervention function
3.2.1.8.	Encourage elders who needed more help and provide training to them and learn how to obtain these information (6.1, <i>Demonstration of the behaviour</i> ; 4.1, <i>Instruction on how to perform the behaviour</i> ; 8.1, <i>Behavioural practice and rehearsal</i>)				
3.3	For next appointment				
3.3.1.	Offer an opt-in appointment for the older adults to attend the next appointment as advised by the optometrist. The opt-in appointment detail will be provided as an appointment slip format, detailing the time, date and location for the next appointment. (1.4, <i>Action planning</i> , 7.1, <i>Prompts/ cues</i>)	Having an opt-in appointment system increase the chance for elderly to use the service by 1) not relying on them to make an appointment, 2) the reinforcing the perceived need by an authorized figure (e.g. optometrist). Together this could increase the motivation to attend future appointment.	Reflective motivation (eventually become automatic)	Intention	Enablement Environmental restructuring
3.3.2.	To provide reminder before the next appointment (either phone, SMS, or by appointment letter), with all the appointment details (1.4, <i>Action planning</i> ; 3.1, <i>Social support (unspecified)</i> ; 7.1, <i>Prompts/ cues</i>)	This ensures the elderly remember to attend the appointment, some may forget. This addresses the psychological capability more specifically about the ability to “retain information”. The appointment letter would first improve their reflective motivation as it includes less decision to make. An appointment has already been scheduled, and the appointment letter act as a cue to go to have an eye examination (the cue is so similar to those they are used to, e.g. appointment letter issued by the doctor,	Psychological capability	Memory, attention and decision processes	Enablement

	Strategy (<i>Behaviour change technique(s), if any</i>)	Description	COM-B	TDF	Intervention function
		something the older adults are already familiar with).			

Appendix D: Supplementary materials for Chapter 7

Below is a list of the supplementary materials mentioned in **Chapter 7** Discrete Choice Experiment. The materials are presented the order in which they were mentioned. Subheading were used signpost the section in which the materials were being referred.

Appendix D1 1st draft of the DCE choice sets

Below presents the DCE choice sets included in the 1st draft of the DCE questionnaire. This version includes one rationality test (Choice 0) and 12 formal DCE choice sets (Choice 1 to Choice 12).

Please compare the programme and choose the one which you prefer most that would encourage you to go for a comprehensive eye examination. If you think neither programme will improve uptake of comprehensive eye examination, you can choose Neither.

Choice 0	Programme A	Programme B	Neither
Programme target	Elderly only	Elderly + carer	
Empowerment activities content	Comprehensive information	Comprehensive information + empowerment activities	
Specific training for centre staff	No	Yes	
Eyesight ambassador participation	No	Yes	
Providing information at the centre	No	Yes	
Service fee range	No	Yes	
Service location	Mobile service provides at elderly centre	Mobile service provides at elderly centre	
Appointment booking	You book your next appointment	The service provider has booked your next appointment	
Appointment reminder	No	Yes	

Please select your answer:

☐
☐
☐

[If chosen opt-out, ask]

What are the reason(s) for choosing opt-out?

[This is warm-up question #1] – think aloud

Please compare the programme and choose the one which you prefer most that would encourage you to go for a comprehensive eye examination. If you think neither programme will improve uptake of comprehensive eye examination, you can choose Neither.

Choice 1	Programme A	Programme B	Neither
Programme target	Elderly + carer	Elderly only	
Empowerment activities	Comprehensive information	Comprehensive information + empowerment activities	
Specific training for elderly centre staff	No	Yes	
Eyesight ambassador involvement	No	Yes	
Providing information at the centre	No	Yes	
Service fee range	No	Yes	
Service location	Mobile service provides at elderly centre	Optometric clinics in the community	
Appointment booking	You book your next appointment	The service provider has booked your next appointment	
Appointment reminder	No	Yes	
Please select your answer:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

[If chosen opt-out, ask]

What are the reason(s) for choosing opt-out?

[This is warm-up question #2] – think aloud

Please compare the programme and choose the one which you prefer most that would encourage you to go for a comprehensive eye examination. If you think neither programme will improve uptake of comprehensive eye examination, you can choose Neither.

Choice 2	Programme A	Programme B	Neither
Programme target	Elderly only	Elderly + carer	
Empowerment activities	Comprehensive information + empowerment activities	Comprehensive information	
Specific training for elderly centre staff	No	Yes	
Eyesight ambassador involvement	Yes	No	
Providing information at the centre	Yes	No	
Service fee range	Yes	No	
Service location	Mobile service provides at elderly centre	Optometric clinics in the community	
Appointment booking	You book your next appointment	The service provider has booked your next appointment	
Appointment reminder	No	Yes	
Please select your answer:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

[If chosen opt-out, ask]

What are the reason(s) for choosing opt-out?

Please compare the programme and choose the one which you prefer most that would encourage you to go for a comprehensive eye examination. If you think neither programme will improve uptake of comprehensive eye examination, you can choose Neither.

Choice 3	Programme A	Programme B	Neither
Programme target	Elderly + carer	Elderly only	
Empowerment activities	Comprehensive information + empowerment activities	Comprehensive information	
Specific training for elderly centre staff	Yes	No	
Eyesight ambassador involvement	No	Yes	
Providing information at the centre	Yes	No	
Service fee range	Yes	No	
Service location	Optometric clinics in the community	Mobile service provides at elderly centre	
Appointment booking	You book your next appointment	The service provider has booked your next appointment	
Appointment reminder	No	Yes	
Please select your answer:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

[If chosen opt-out, ask]

What are the reason(s) for choosing opt-out?

Please compare the programme and choose the one which you prefer most that would encourage you to go for a comprehensive eye examination. If you think neither programme will improve uptake of comprehensive eye examination, you can choose Neither.

Choice 4	Programme A	Programme B	Neither
Programme target	Elderly only	Elderly + carer	
Empowerment activities	Comprehensive information	Comprehensive information + empowerment activities	
Specific training for elderly centre staff	Yes	No	
Eyesight ambassador involvement	Yes	No	
Providing information at the centre	No	Yes	
Service fee range	Yes	No	
Service location	Optometric clinics in the community	Mobile service provides at elderly centre	
Appointment booking	The service provider has booked your next appointment	You book your next appointment	
Appointment reminder	No	Yes	
Please select your answer:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

[If chosen opt-out, ask]

What are the reason(s) for choosing opt-out?

Please compare the programme and choose the one which you prefer most that would encourage you to go for a comprehensive eye examination. If you think neither programme will improve uptake of comprehensive eye examination, you can choose Neither.

Choice 5	Programme A	Programme B	Neither
Programme target	Elderly + carer	Elderly only	
Empowerment activities	Comprehensive information + empowerment activities	Comprehensive information	
Specific training for elderly centre staff	No	Yes	
Eyesight ambassador involvement	Yes	No	
Providing information at the centre	Yes	No	
Service fee range	No	Yes	
Service location	Optometric clinics in the community	Mobile service provides at elderly centre	
Appointment booking	The service provider has booked your next appointment	You book your next appointment	
Appointment reminder	Yes	No	
Please select your answer:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

[If chosen opt-out, ask]

What are the reason(s) for choosing opt-out?

Please compare the programme and choose the one which you prefer most that would encourage you to go for a comprehensive eye examination. If you think neither programme will improve uptake of comprehensive eye examination, you can choose Neither.

Choice 6	Programme A	Programme B	Neither
Programme target	Elderly + carer	Elderly only	
Empowerment activities	Comprehensive information	Comprehensive information + empowerment activities	
Specific training for elderly centre staff	Yes	No	
Eyesight ambassador involvement	No	Yes	
Providing information at the centre	Yes	No	
Service fee range	Yes	No	
Service location	Mobile service provides at elderly centre	Optometric clinics in the community	
Appointment booking	The service provider has booked your next appointment	You book your next appointment	
Appointment reminder	Yes	No	
Please select your answer:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

[If chosen opt-out, ask]

What are the reason(s) for choosing opt-out?

Please compare the programme and choose the one which you prefer most that would encourage you to go for a comprehensive eye examination. If you think neither programme will improve uptake of comprehensive eye examination, you can choose Neither.

Choice 7	Programme A	Programme B	Neither
Programme target	Elderly + carer	Elderly only	
Empowerment activities	Comprehensive information	Comprehensive information + empowerment activities	
Specific training for elderly centre staff	No	Yes	
Eyesight ambassador involvement	Yes	No	
Providing information at the centre	No	Yes	
Service fee range	Yes	No	
Service location	Optometric clinics in the community	Mobile service provides at elderly centre	
Appointment booking	You book your next appointment	The service provider has booked your next appointment	
Appointment reminder	Yes	No	
Please select your answer:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

[If chosen opt-out, ask]

What are the reason(s) for choosing opt-out?

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Please compare the programme and choose the one which you prefer most that would encourage you to go for a comprehensive eye examination. If you think neither programme will improve uptake of comprehensive eye examination, you can choose Neither.

Choice 8	Programme A	Programme B	Neither
Programme target	Elderly only	Elderly + carer	
Empowerment activities	Comprehensive information	Comprehensive information + empowerment activities	
Specific training for elderly centre staff	No	Yes	
Eyesight ambassador involvement	No	Yes	
Providing information at the centre	Yes	No	
Service fee range	No	Yes	
Service location	Optometric clinics in the community	Mobile service provides at elderly centre	
Appointment booking	The service provider has booked your next appointment	You book your next appointment	
Appointment reminder	No	Yes	
Please select your answer:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

[If chosen opt-out, ask]

What are the reason(s) for choosing opt-out?

Please compare the programme and choose the one which you prefer most that would encourage you to go for a comprehensive eye examination. If you think neither programme will improve uptake of comprehensive eye examination, you can choose Neither.

Choice 9	Programme A	Programme B	Neither
Programme target	Elderly only	Elderly + carer	
Empowerment activities	Comprehensive information + empowerment activities	Comprehensive information	
Specific training for elderly centre staff	No	Yes	
Eyesight ambassador involvement	No	Yes	
Providing information at the centre	No	Yes	
Service fee range	Yes	No	
Service location	Mobile service provides at elderly centre	Optometric clinics in the community	
Appointment booking	The service provider has booked your next appointment	You book your next appointment	
Appointment reminder	Yes	No	
Please select your answer:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

[If chosen opt-out, ask]

What are the reason(s) for choosing opt-out?

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Please compare the programme and choose the one which you prefer most that would encourage you to go for a comprehensive eye examination. If you think neither programme will improve uptake of comprehensive eye examination, you can choose Neither.

Choice 10	Programme A	Programme B	Neither
Programme target	Elderly only	Elderly + carer	
Empowerment activities	Comprehensive information + empowerment activities	Comprehensive information	
Specific training for elderly centre staff	Yes	No	
Eyesight ambassador involvement	No	Yes	
Providing information at the centre	No	Yes	
Service fee range	No	Yes	
Service location	Optometric clinics in the community	Mobile service provides at elderly centre	
Appointment booking	You book your next appointment	The service provider has booked your next appointment	
Appointment reminder	Yes	No	
Please select your answer:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

[If chosen opt-out, ask]

What are the reason(s) for choosing opt-out?

Please compare the programme and choose the one which you prefer most that would encourage you to go for a comprehensive eye examination. If you think neither programme will improve uptake of comprehensive eye examination, you can choose Neither.

Choice 11	Programme A	Programme B	Neither
Programme target	Elderly + carer	Elderly only	
Empowerment activities	Comprehensive information + empowerment activities	Comprehensive information	
Specific training for elderly centre staff	Yes	No	
Eyesight ambassador involvement	Yes	No	
Providing information at the centre	No	Yes	
Service fee range	No	Yes	
Service location	Mobile service provides at elderly centre	Optometric clinics in the community	
Appointment booking	The service provider has booked your next appointment	You book your next appointment	
Appointment reminder	No	Yes	
Please select your answer:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

[If chosen opt-out, ask]

What are the reason(s) for choosing opt-out?

Please compare the programme and choose the one which you prefer most that would encourage you to go for a comprehensive eye examination. If you think neither programme will improve uptake of comprehensive eye examination, you can choose Neither.

Choice 12	Programme A	Programme B	Neither
Programme target	Elderly only	Elderly + carer	
Empowerment activities	Comprehensive information	Comprehensive information + empowerment activities	
Specific training for elderly centre staff	Yes	No	
Eyesight ambassador involvement	Yes	No	
Providing information at the centre	Yes	No	
Service fee range	No	Yes	
Service location	Mobile service provides at elderly centre	Optometric clinics in the community	
Appointment booking	You book your next appointment	The service provider has booked your next appointment	
Appointment reminder	Yes	No	
Please select your answer:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

[If chosen opt-out, ask]

What are the reason(s) for choosing opt-out?

Appendix D2 Steps to construct the 2nd draft of the DCE design

The DCE design was a pairwise, unforced design (include a neither alternative). The initial coding scheme assigned for the five attribute is shown in **Table D2.1** in Appendix D2.

A subset was constructed based on Plan code 91, which directed to five columns (column 1,6,7,8,9) of Master Plan 2 (**Table D2.2**). Each column represents an attribute. “Service Location” was assigned to row one (column number 1), which is the attribute that required collapsing from a 4-level to a 2-level. The result after recoding is shown in **Table D2.3**.

To construct the choice set which consisted of two forced alternatives, a shift design was used. The attribute with a coding of 0 were coded to 1 and vice versa. **Table D2.4** shows the coding for all eight choice sets.

Table D2.1 The initial coding levels of attributes and level for DCE (version 2)

Attributes	Levels	
Service location	Optometric clinics in the community	Mobile service provides at the elderly centre
Specified fee range	No, not stated	Yes, stated
Appointment booking	You make the next appointment	The service provider has scheduled your next appointment
Appointment reminder	No	Yes
How well are you informed about eye care needs and service	Without supportive environment	With supportive environment
Coding level	0	1

Table D2.2 Master Plan 2 from Catalogue

	Column number				
	1	6	7	8	9
Choice 1	0	0	0	0	0
Choice 2	0	1	1	1	1
Choice 3	1	0	0	1	1
Choice 4	1	1	1	0	0
Choice 5	2	0	1	0	1
Choice 6	2	1	0	1	0
Choice 7	3	0	1	1	0
Choice 8	3	1	0	0	1

Table D2.3 The updated coding used to populate the experimental design for DCE questionnaire (version 2)

	Column number				
	1	6	7	8	9
Choice 1	0	0	0	0	0
Choice 2	0	1	1	1	1
Choice 3	1	0	0	1	1
Choice 4	1	1	1	0	0
Choice 5	<u>0</u>	0	1	0	1
Choice 6	<u>0</u>	1	0	1	0
Choice 7	<u>1</u>	0	1	1	0
Choice 8	<u>1</u>	1	0	0	1

Bolded underlined number indicates the number have been recoded after collapsed from a 4-level attribute into a 2-level attribute.

Table D2.4 Coding used to construct a pairwise DCE design

Alternative A	1A	2A	3A	4A	5A	6A	7A	8A
SL	0	0	1	1	0	0	1	1
SF	0	1	0	1	0	1	0	1
AB	0	1	0	1	1	0	1	0
AR	0	1	1	0	0	1	1	0
SE	0	1	1	0	1	0	0	1
Alternative B	1B	2B	3B	4B	5B	6B	7B	8B
SL	1	1	0	0	1	1	0	0
SF	1	0	1	0	1	0	1	0
AB	1	0	1	0	0	1	0	1
AR	1	0	0	1	1	0	0	1
SE	1	0	0	1	0	1	1	0

1A refers to the programme A of question 1, and 1B refers to programme B of question 1. The same logic can be used to identify the combinations for other questions.

SL = Service location; SF = Specified fee range; AB = Appointment booking; AR = Appointment reminder; SE = How well are you informed about eye care needs and service

After the preliminary 2nd draft of the DCE questionnaire was constructed, the coded plan was inspected for any potential unrealistic combination or dominant choice set. Dominant choice set was a choice set included five attribute levels that were considered more superior than the others. Those attribute levels assigned with a coding level of 1 were considered more superior. Following the coding scheme shown in **Table D2.1** have resulted in one dominant choice set. To avoid this, the coding level for service fee range was changed, so that 0 = service fee range stated and 1 = service fee range not stated. The new coding levels used to populate the choice tasks in the final DCE questionnaire are shown in **Table D2.5**. No plausible combination was identified. The property of minimal overlap was not violated and therefore could generate more information about the preference of the older adults for the strategies to improve the regular uptake of eye examination

Table D2.5 An updated coding levels of attributes and level used in final DCE design (version 2)

Attributes	Levels	
Service location	Optometric clinics in the community	Mobile service provides at the elderly centre
Specified fee range	<i>Yes, specified</i>	<i>No, not specified</i>
Appointment booking	You make the next appointment	The service provider has scheduled your next appointment
Appointment reminder	No	Yes
How well are you informed about eye care needs and service	Without supportive environment	With supportive environment
Coding level	0	1

Property checking for 2nd draft of the DCE design

Below is the plan retrieved from Master Plan 2 based on Plan Code 91 (**Table D2.6**). In excel, the frequency of each coding appeared was counted. **Table D2.7** shows that all the level are balanced (the frequency of each coding is the same with each attribute). The correlation was also checked, orthogonality was not violated (**Table D2.8**).

Table D2.6 Plan code 91 from Master plan 2 (Hahn et al., 1966)

Attribute	A1	A2	A3	A4	A5
Column no from master plan 2	1	6	7	8	9
Choice 1	0	0	0	0	0
Choice 2	0	1	1	1	1
Choice 3	1	0	0	1	1
Choice 4	1	1	1	0	0
Choice 5	0	0	1	0	1
Choice 6	0	1	0	1	0
Choice 7	1	0	1	1	0
Choice 8	1	1	0	0	1

Master Plan 2 from (Hahn et al., 1966)

Table D2.7 DCE design v2 level balanced property checking

coding	A1	A2	A3	A4	A5
0	4	4	4	4	4
1	4	4	4	4	4

Table D2.8 DCE design v2 orthogonality property checking

	A1	A2	A3	A4	A5
A1	1				
A2	0	1			
A3	0	0	1		
A4	0	0	0	1	
A5	0	0	0	0	1

A = attributes

Appendix D3 Chinese version of the finalised DCE questionnaire (v2)

Below is the Chinese version of the DCE questionnaire (version 2) used in formal data collection.

有關使用定期視光服務的知識和過往服務使用記錄，以及長者中心使用記錄

請訪問者依據受訪者的答案填寫 Q1.1 – Q1.11

有關使用定期視光服務的知識和過往使用記錄

Q1.1. 你是否知道長者應多久進行一次全面眼睛檢查？

0. ☐ 不知道
1. ☐ 知道，請說明

Q1.2. 你是否知道哪裡可以做眼睛檢查嗎？

1. ☐ 不知道 (*Go to Q1.3*)
2. ☐ 知道 (*Go to Q1.2a*)

Q1.2.a 請問可以做眼睛檢查的地方是什麼呢？（答案可多於一個）

- | | |
|---|--------------------------------------|
| 1. <input type="checkbox"/> 公立醫院/診所普通科 | 5. <input type="checkbox"/> 眼科視光診所中心 |
| 2. <input type="checkbox"/> 私家醫院/診所普通科 | 6. <input type="checkbox"/> 眼鏡舖 |
| 3. <input type="checkbox"/> 公立醫院/診所眼科專科 | 7. <input type="checkbox"/> 不清楚 |
| 4. <input type="checkbox"/> 私家醫院/診所眼科專科 | |

Q1.3. 你認為定期進行全面眼科視光檢查重要嗎？

0. ☐ 不重要
1. ☐ 重要

Q1.4. 你認為是不是當眼睛出現症狀時才需要檢查眼睛呢？

0. ☐ 不是
1. ☐ 是
2. ☐ 不肯定/不知道

Q1.5. 請問你過去 24 個月有冇去眼科醫生或者視光師驗眼呢？

0. ☐ 沒有 (*Go to Q1.7*)
1. ☐ 有 (*Go to Q1.6*)

Q1.6. 如有，

Q1.6.a 你去驗眼的原因是什麼？

1. ☐ 眼科醫生定期跟進（已知眼疾）
2. ☐ 眼科醫生一次性跟進（非定期跟進，例如眼睛感染、受傷、不適或視力問題被轉介）
3. ☐ 因慢性疾病，由醫護人員轉介接受眼睛檢查，例如糖尿眼篩查
4. ☐ 常規（定期）眼科視光檢查
5. ☐ 其他，請列明

Q1.6.b. 請問你在什麼地方進行驗眼？

1. ☐ 私家眼鏡店
2. ☐ 私家診所或醫院
3. ☐ 非政府機構
4. ☐ 其他，請列明.....

Q1.6.c. 驗眼內容包括什麼？如果受訪者回答視力檢查，驗糖尿眼或者配眼鏡等單一項目，不屬於全面眼科檢查

1. ☐ 基本視力測試
2. ☐ 眼睛健康檢查（例如影眼底相）
3. ☐ 配眼鏡
4. ☐ 其他，請列明.....

Q1.6.d. 如何付款服務費用？ (then answer Q1.8)

1. ☐ 自己墊付
2. ☐ 長者醫療券
3. ☐ 其他，請列明.....

Q1.7. 如果沒有進行全面眼睛檢查，主要原因是什麼？

1. ☐ 費用問題
2. ☐ 怕麻煩
3. ☐ 現階段視力沒問題
4. ☐ 不怕視力受影響
5. ☐ 驗眼只是例行公事（不重要）
6. ☐ 不知道需要驗眼檢查
7. ☐ 有人叫驗眼檢查
8. ☐ 已經有眼科醫生跟進*（定期在專科門診或政府醫院複診請同時記錄跟進內）
.....
9. ☐ 其他，請列明.....

長者中心使用記錄

Q1.8. 你經常使用這個中心嗎？

- 0. ☐ 不是
- 1. ☐ 是

Q1.9. 你是否記得成為這間長者中心會員有多長時間？

- 1. ☐ 記得
年:
月:
- 2. ☐ 不記得/不確定

Q1.10. 你曾參加過任何在長者中心舉辦的活動嗎？

- 0. ☐ 沒有
- 1. ☐ 有

Q1.11. 你是否為長者中心義工員？

- 0. ☐ 不是
- 1. ☐ 是

Part 2: DCE 問卷

訪問者需知：

- 解釋問卷方式、背景和特徵級別。
- 記得檢查受訪者是否明白解釋；需要釐清對方對於特徵級別的理解。

關於本次問卷調查

- 定期（綜合）眼科視光檢查（眼睛檢查）對可能避免的視力損失起著重要的預防作用。我們設計了一系列的方案促進長者使用綜定期眼科視光檢查，而不同的方案會有不同的特徵。
- 你將會回答 8 個選擇題，所有選擇題都基於假設情景。
- 這些問題的設計只是為了收集您對方案設計特點的偏好並不會直接改變目前服務提供的方式。
- 如果您在介紹環節有任何問題，請隨時告訴我。

情景解釋

有關定期眼科視光檢查

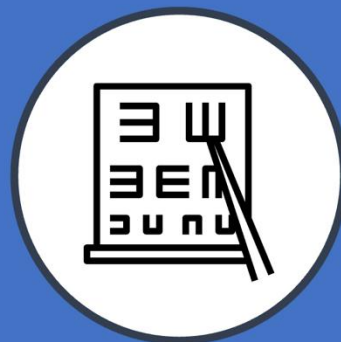
- 定期眼科視光檢查是由第一部分視光師提供，這種視光師通常在私家工作。
- 檢查範圍除了包括檢查視力、屈光度數檢查，還有眼睛功能、眼睛健康和檢查隱性眼疾（例如白內障、青光眼、糖尿眼等等）。視光師會根據檢查結果提供適當的建議。
- 一般建議 65 歲或以上的長者每隔一至兩年進行一次全面眼睛檢查。
- 所需支付的驗眼檢查費用（只限驗眼）會因不同的服務提供者而異。
- 醫療券可以用於由已參加醫療券計劃的第一部分視光師提供的全面眼科視光檢查、驗配眼鏡的服務。
- 每名合資格的長者每兩年的視光服務醫療券上限為港幣\$2000
[訪問員：根據最新醫療券政策，視光服務醫療券配額不可與配偶共用(更新：2023 年 7 月)]
- 社區裡有不同的視光診所可以為你提供驗眼服務。

由第一部分註冊視光師主理驗眼服務。檢查範圍包括：

- 詳細問診：
了解你的背景(生活習慣、視力需求、個人身體健康狀況、眼睛病史和藥物過敏、家庭病歷等), 驗眼目的和需要
- 視力及屈光度數檢查
- 雙眼視覺和立體感檢查
- 眼內壓量度
- 色覺檢查
- 雙眼內外健康檢查
- 數碼視網膜攝影
- 拍攝眼底影像
- 診斷、處方及建議

**視光師會因應個別情況而決定當天是否需要作利用放瞳藥水作放瞳眼底及度數檢查。*

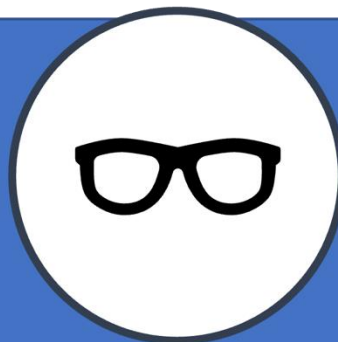
視力評估



檢查
眼睛功能
眼部健康



(如有需要)
驗配眼鏡



請考慮以下情景：

假設現在長者中心向你介紹一個新計劃旨在鼓勵長者定期使用眼睛檢查，從而保持長者的視力健康。一般建議 65 歲或以上的長者每隔一至兩年進行一次眼睛檢查。請你試想像下以下的方案，哪一個方案會鼓勵到你去使用定期眼睛檢查呢？

每個方案都有五個特徵，你需要考慮這五個特徵後再做選擇。現在我會解釋每個特徵與對應特徵的級別。

訪問者需知：

- 請向長者解釋特徵和級別。
- 每解釋完一個特徵後記得檢查受訪者對於特徵、級別理解正確。如需要，請對方說明他們對特徵（或級別）的理解。需要時請澄清/改正理解。
- 然後請完成：1) rating 問卷， 2) ranking 問卷。請他們說出他們對於該選擇的原因。如發現對於特徵理解不同，請問清楚和解釋。
 - 用詞不一樣？
 - 對於特徵理解困難？
 - 描述特徵時提起其他因素？
 - **注意**：rating 和 ranking 的結果會**互相矛盾**嗎？如有，請問清楚，並記下理由。

特徵與級別

Remember to mark down the response/ questions from the elders.

特徵	解釋	級別
1. 驗眼地點	<p>假設無論在哪個驗眼地點，服務質素都是一樣的情況下，驗眼服務可以在</p> <ul style="list-style-type: none"> ● <u>長者中心進行</u>，服務提供者會提供流動車服務，他們會來到中心幫你驗眼； ● 或是你去<u>社區的視光診所</u>驗眼 	<ul style="list-style-type: none"> ● 在社區視光診所 ● 長者中心提供流動車服務
2. 指定服務收費範圍	<p>假設無論在哪個驗眼地點，服務質素都是一樣的情況下，服務提供者是否會提供一個有指定收費範圍的服務。</p> <p>若<u>有提供</u>，則表示在您使用該服務之前，服務提供者會提供一個有指定的收費範圍的眼睛檢查服務和眼鏡（如需要）。例如視光師會提供一定價格範圍的眼鏡讓你選擇。如果需要，您亦可以選擇其他鏡框和鏡片。否則服務收費範圍是不會改變。</p> <p>如<u>無提供</u>，則表示在您使用該服務之前，服務提供者並不會向你提供一個有指定服務收費範圍的驗眼服務和眼鏡（如需要）。這意味著當您使用該服務時，您需要根據服務提供者設定的價格支付服務費用，即眼睛檢查和配眼鏡（如果需要），而該價格可能因不同服務提供者而有不同。</p> <p>備註 1：您可以使用長者醫療券支付驗眼相關服務費用。</p> <p>備註 2：<u>服務質素</u>一樣是指服務都會由政府認可的第一部分的驗光師提供。他們受過眼科視光檢查訓練，並能根據檢查結果向你提供適當的建議（例如配眼鏡或需要轉介做更加深入的檢查）。</p>	<ul style="list-style-type: none"> ● <u>沒有提供</u> ● <u>有提供</u>
3. 預約方式	指下次預約驗眼的方法。任何預約方式你都可以根據你的需要取消或改期。	<ul style="list-style-type: none"> ● 服務提供者已為你<u>“排期”</u> ● <u>自己聯繫</u>服務提供者
4. 預約提醒	指服務提供者會不會向你提供預約提醒（提醒可以以任何方式提供，例如 WhatsApp、微信、電話）	<ul style="list-style-type: none"> ● 沒有提醒 ● 有提醒
5. 提供資訊支援	這是指是否有提供充足的資訊幫助你充分了解到驗眼的需求和驗眼相關的資訊。例如通過長者中心發放資訊；發放資訊的途徑可以有擺放小冊子或以活動形式進行、或會有受過培訓的職員或義工在你詢問時為你提供相關資訊等等。	<ul style="list-style-type: none"> ● <u>沒有</u>資訊支援 ● <u>有</u>資訊支援

【對於特徵的理解】

特徵	備註
驗眼地點	
指定服務收費範圍	
預約方式	
預約提醒	
提供資訊支援	

【你覺得特徵#1-5 是鼓勵你去定期驗眼的重要因素嗎？】

order	特徵	Rating		備註
	驗眼地點	重要	不重要	
	指定服務收費範圍	重要	不重要	
	預約方式	重要	不重要	
	預約提醒	重要	不重要	
	提供資訊支援	重要	不重要	

【排序】

*檢查 Ranking 結果與 Rating 結果是否互相矛盾 - 例如覺得 A 不重要，但排 A 在第一、第二位。

order	特徵	Ranking					備註*
	驗眼地點	1	2	3	4	5	
	指定服務收費範圍	1	2	3	4	5	
	預約方式	1	2	3	4	5	
	預約提醒	1	2	3	4	5	
	提供資訊支援	1	2	3	4	5	

問題：哪個方案更有可能鼓勵你去做定期驗眼檢查？

- 每一個選擇題內都會有兩個不同的方案（請訪問員用例題解釋問卷形式）
- 每個方案都由五個特徵組成，而特徵內的級別會有不同。
- 你需要比較兩個方案，然後指出一個更有可能鼓勵你使用定期眼睛檢查的一個方案。如果比較完兩個方案後，你認為沒有一個方案會鼓勵你去使用定期眼睛檢查的話，你可以選擇「兩者都不會」。

情景：

假設現在長者中心向你介紹一個新計劃旨在鼓勵長者定期使用眼睛檢查，從而保持長者的視力健康。一般建議 65 歲或以上的長者每隔一至兩年進行一次眼睛檢查。請你試想像下，假設你現在考慮使用眼睛檢查服務，下列哪個方案會鼓勵你使用該服務呢？

訪問者需知：

請確保受訪者了解：

- 問題呈現的方式只是為了收集您對方案設計特點的偏好並不會直接改變目前服務提供的方式。
- 你將會回答 8 個選擇題，所有選擇題都基於假設情景。
- 問題沒有對錯之分；他/她們的意見最重要。
- 請視每道選擇題為新的一題，不用理會前一題的答案。

如果受訪者不懂怎麼做選擇，你可以建議：

- 你需要
 - a. 先看看方案一的內容，然後看看方案二的。
 - b. 然後比較方案一和方案二
 - c. 最後，選擇一個你認為能鼓勵你去做定期驗眼檢查的方案

建議排除/建議退出情況和處理方法：

- 如受訪者還是未能理解如何做比較，建議排除/退出
 - 若受訪者在解釋完後還是沒能明白如何完成 DCE 選擇題，請和長者中心的職員溝通，請他們和長者解釋退出原因。
 - 如果長者堅持完成問卷，請訪問員在問答本上記錄清楚。
- 在問題 0（理性題）中未能解釋為何選擇“較差”的方案 – 要寫下原因
 - 不一定要排除，可以再看看問題 1 的回答
 - 如果還是沒有比較、或不懂比較 – 寫下原因；詢問受訪者是否想繼續作答。不想的話可以退出；或者繼續回答（但訪問員要記下原因）

例子

假設你現在考慮使用眼睛檢查服務。
請比較方案一和方案二，然後指出你哪個方案更可能令你去定期驗眼。
或者如果你覺得兩者都不會鼓勵你驗眼，你可以選“兩者都不會”。

	問題	Example	
	方案一	方案二	
驗眼地點	在社區視光診所	長者中心提供流動車服務	
指定服務收費範圍	沒有	有	
預約方式	自己聯繫服務提供者	服務提供者已幫你排期	
預約提醒	有	沒有	
提供資訊支援	有	沒有	
你會選擇哪個方案？	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

例題中，假設這個人選擇了“方案二”，並有以上列出的特徵。與方案一比較下，這個人在五個特徵中做了取捨。雖然沒有預約提醒、沒有提供資訊支援，但這個人認為有其他以上列出的特徵是值得的（在長者中心驗眼，有指定服務收費範圍的服務，並已幫你下次驗眼時間排期了）。

For interviewer:

- 對於問題呈現的方式有沒有問題？

問題 0 = 理性題

問題 1 + 問題 2 = 熱身題, use think-aloud techniques

記得提醒受訪者：

- 答案沒有對錯之分；你的意見是最重要。
- 視每題為全新的一題；不用理會之前的題目。
- 記得做比較（方案一，方案二）

[FULL CHOICE SETS]

假設你現在考慮使用眼睛檢查服務。
請比較方案一和方案二，然後指出你哪個方案更可能令你去定期驗眼。
或者如果你覺得兩者都不會鼓勵你驗眼，你可以選“兩者都不會”。

問題		0	
方案一		方案二	兩者都不會
驗眼地點	在長者中心提供流動車服務	長者中心提供流動車服務	
指定服務收費範圍	沒有	有	
預約方式	自己聯繫服務提供者	服務提供者已幫你排期	
預約提醒	沒有	有	
提供資訊支援	沒有	有	
你會選擇哪個方案？	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

如果受訪者選擇“兩者都不會”，請紀錄原因：

.....

.....

.....

假設你現在考慮使用眼睛檢查服務。
請比較方案一和方案二，然後指出你哪個方案更可能令你去定期驗眼。
或者如果你覺得兩者都不會鼓勵你驗眼，你可以選“兩者都不會”。

問題		1	
方案一		方案二	兩者都不會
驗眼地點	在社區視光診所	長者中心提供流動車服務	
指定服務收費範圍	有	沒有	
預約方式	自己聯繫服務提供者	服務提供者已幫你排期	
預約提醒	沒有	有	
提供資訊支援	沒有	有	
你會選擇哪個方案？	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

如果受訪者選擇“兩者都不會”，請紀錄原因：

.....

.....

.....

假設你現在考慮使用眼睛檢查服務。
請比較方案一和方案二，然後指出你哪個方案更可能令你去定期驗眼。
或者如果你覺得兩者都不會鼓勵你驗眼，你可以選“兩者都不會”。

問題		2	
	方案一	方案二	兩者都不會
驗眼地點	在社區視光診所	長者中心提供流動車服務	
指定服務收費範圍	沒有	有	
預約方式	服務提供者已幫你排期	自己聯繫服務提供者	
預約提醒	有	沒有	
提供資訊支援	有	沒有	
你會選擇哪個方案？	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

如果受訪者選擇“兩者都不會”，請紀錄原因：

.....

.....

.....

假設你現在考慮使用眼睛檢查服務。
請比較方案一和方案二，然後指出你哪個方案更可能令你去定期驗眼。
或者如果你覺得兩者都不會鼓勵你驗眼，你可以選“兩者都不會”。

問題		3	
	方案一	方案二	兩者都不 會
驗眼地點	長者中心提供流動車服務	在社區視光診所	
指定服務收費範圍	有	沒有	
預約方式	自己聯繫服務提供者	服務提供者已幫你排期	
預約提醒	有	沒有	
提供資訊支援	有	沒有	
你會選擇哪個方案？	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

如果受訪者選擇“兩者都不會”，請紀錄原因：

.....

.....

.....

假設你現在考慮使用眼睛檢查服務。
 請比較方案一和方案二，然後指出你哪個方案更可能令你去定期驗眼。
 或者如果你覺得兩者都不會鼓勵你驗眼，你可以選“兩者都不會”。

問題		4	
	方案一	方案二	兩者都不 會
驗眼地點	長者中心提供流動車服務	在社區視光診所	
指定服務收費範圍	沒有	有	
預約方式	服務提供者已幫你排期	自己聯繫服務提供者	
預約提醒	沒有	有	
提供資訊支援	沒有	有	
你會選擇哪個方案？	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

如果受訪者選擇“兩者都不會”，請紀錄原因：

.....

.....

.....

假設你現在考慮使用眼睛檢查服務。
請比較方案一和方案二，然後指出你哪個方案更可能令你去定期驗眼。
或者如果你覺得兩者都不會鼓勵你驗眼，你可以選“兩者都不會”。

問題		5	
方案一		方案二	兩者都不 會
驗眼地點	在社區視光診所	長者中心提供流動車服務	
指定服務收費範圍	有	沒有	
預約方式	服務提供者已幫你排期	自己聯繫服務提供者	
預約提醒	沒有	有	
提供資訊支援	有	沒有	
你會選擇哪個方案？	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

如果受訪者選擇“兩者都不會”，請紀錄原因：

.....

.....

.....

假設你現在考慮使用眼睛檢查服務。
請比較方案一和方案二，然後指出你哪個方案更可能令你去定期驗眼。
或者如果你覺得兩者都不會鼓勵你驗眼，你可以選“兩者都不會”。

問題		6	
方案一		方案二	兩者都不會
驗眼地點	在社區視光診所	長者中心提供流動車服務	
指定服務收費範圍	沒有	有	
預約方式	自己聯繫服務提供者	服務提供者已幫你排期	
預約提醒	有	沒有	
提供資訊支援	沒有	有	
你會選擇哪個方案？	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

如果受訪者選擇“兩者都不會”，請紀錄原因：

.....

.....

.....

假設你現在考慮使用眼睛檢查服務。
請比較方案一和方案二，然後指出你哪個方案更可能令你去定期驗眼。
或者如果你覺得兩者都不會鼓勵你驗眼，你可以選“兩者都不會”。

問題		7	
方案一		方案二	兩者都不 會
驗眼地點	長者中心提供流動車服務	在社區視光診所	
指定服務收費範圍	有	沒有	
預約方式	服務提供者已幫你排期	自己聯繫服務提供者	
預約提醒	有	沒有	
提供資訊支援	沒有	有	
你會選擇哪個方案？	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

If respondent chose “neither” option, please note the reasons:

.....

.....

.....

假設你現在考慮使用眼睛檢查服務。
請比較方案一和方案二，然後指出你哪個方案更可能令你去定期驗眼。
或者如果你覺得兩者都不會鼓勵你驗眼，你可以選“兩者都不會”。

問題		8	
	方案一	方案二	兩者都不 會
驗眼地點	長者中心提供流動車服務	在社區視光診所	
指定服務收費範圍	沒有	有	
預約方式	自己聯繫服務提供者	服務提供者已幫你排期	
預約提醒	沒有	有	
提供資訊支援	有	沒有	
你會選擇哪個方案？	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

如果受訪者選擇“兩者都不會”，請紀錄原因：

.....

.....

.....

****如果受訪者 8 題全部都回答了“兩者都不會”，請問原因****

.....

.....

.....

Debrief questions

訪問員需知：請受訪者回答 Q2.1 – Q2.3，並記錄答案

Q2.1. 你覺得回答剛才 8 條問題困難嗎？

非常容易 1	幾容易 2	不困難也不容易 3	有些困難* 4	非常困難啊* 5
-----------	----------	--------------	------------	-------------

****如果受訪者回答 4 或 5，請詢問其原因 - 為何覺得有些困難或非常困難？**

.....

.....

.....

Q2.2. 這些問題需要你比較後做出選擇。當你選擇方案一或方案二時，你有沒有比較方案一和方案二？

0. ☐ 沒有 (請問受訪者他如何做出選擇？)

.....

.....

.....

1. ☐ 有

Q2.3. 當你選擇方案一或方案二時，你有沒有考慮其他因素後再做出選擇？

0. ☐ 沒有

1. ☐ 有，請列明.....

[訪問者在訪問完成後填寫]

請在完成問卷後評估受訪者的回答問題的能力與能力，

Q2.4. 您認為受訪者在訪問過程中對問題的理解和執行程度如何？

- 1. ☐ 易於理解和執行選擇題
- 2. ☐ 有些問題，但似乎最後還是明白（請記錄理由）
- 3. ☐ *懷疑受訪者是否理解選擇題（請記錄理由）

備註：

.....

.....

.....

Q2.5. 在努力和專心方面，以下哪項陳述最能描述受訪者執行任務的情況？

- 1. ☐ 集中精神並付出大量努力
- 2. ☐ 集中精力，並付出一些努力（請記錄理由）
- 3. ☐ *沒有專心致志地投入其中（請記錄理由）

備註：

.....

.....

.....

Part 3: 基本人口、自我報告健康相關的問題；以及獲得全面眼科檢查服務資訊的途徑

Q3.1. 年齡: _____ [如果受訪者拒絕回答，請記錄年齡範圍]

65 – 69 1	70-74 2	75 – 79 3	80 – 84 4	≥ 85 5
--------------	------------	--------------	--------------	-----------

Q3.2. 性別

0. ☐ 女
1. ☐ 男

Q3.3. 請問你最高的教育程度是什麼？

1. ☐ 未受教育／學前教育
2. ☐ 小學
3. ☐ 中學（初中/高中）
4. ☐ 專上教育（文憑/證書/副學位課程/學位課程）
5. ☐ 不回答 / 拒絕回答

Q3.4. 你的婚姻狀況是什麼？

1. ☐ 單身（從未結婚/喪偶/離婚/分居）
2. ☐ 已婚
3. ☐ 不回答

Q3.5. 請問你平均一個月嘅個人收入係幾多(包括所有收入來源: 自己嘅收入, 子女俾嘅零用, 政府補貼)？

1. ☐ < 2,000
2. ☐ 2,000 – 4,999
3. ☐ 5,000 – 9,999
4. ☐ 10,000 – 14,999
5. ☐ 15,000 – 19,999
6. ☐ 20,000 +
7. ☐ 沒有收入
8. ☐ 不知道
9. ☐ 拒絕回答 / 不想回答

Q3.6. 你現時有否領取綜援（CSSA）？

0. ☐ 沒有
1. ☐ 有

Q3.7. 你的收入來源有哪些？

收入來源	沒有	有	備註
a. *高齡津貼 (生果金)			
b. (\$1,570) 由 2023 年 2 月 1 日起；70 歲以上	0	1	
c. *^長者生活津貼 (\$4,060)			
d. (福建/廣東計劃下的長者生活津貼^) 65 歲以上	0	1	
e. 傷殘津貼 (高額 \$4010/普通 \$2,005)	0	1	
f. 家人經濟幫助 (e.g. 子女俾嘅零用)	0	1	
g. 積蓄/ 退休金/長俸	0	1	
h. 工作收入	0	1	
i. 不回答	0	1	
j. 其他，請列明	0	1	

*只能選其一

^由 2022 年 9 月 1 日起，普通長者生活津貼及高齡長者生活津貼合併為「長者生活津貼」。

Q3.8. 居住情況

1. ☐ 獨居
2. ☐ 與配偶同住
3. ☐ 只與子女同住
4. ☐ 與配偶同住,並與子女同住
5. ☐ 其他，請列明.....
6. ☐ 不回答/拒絕回答

自我報告的身體健康狀況

Q3.9. 你的醫生有說過你曾患有以下那種慢性疾病？

慢性疾病	從沒有	有，以前	有，現在	不知道	備註
a. 高血壓	0	1	2	3	
b. 膽固醇過高	0	1	2	3	
c. 糖尿病	0	1	2	3	
d. 心臟病	0	1	2	3	
e. 哮喘	0	1	2	3	
f. 癌病	0	1	2	3	
g. 中風	0	1	2	3	
h. 其他，請列明	0	1	2	3	

自我報告/自我感知的眼睛健康狀況

Q3.10. 如果按對同齡人士和你健康狀況比較，你認為你自己的健康狀況是？

1 = 好許多，5 = 差許多

好許多	較好	差不多	較差	差許多	不知道
1	2	3	4	5	6

Q3.11. 你有沒有帶任何眼鏡、隱形眼鏡或者其他視力矯正的工具，例如放大鏡？

0. ☐ 沒有

1. ☐ 有

Q3.12. 以現時的情況做評估，如果雙眼並用（如你需要佩戴眼鏡或隱形眼鏡，則根據已佩戴的情況作答），你認為你的視力屬於？

極佳	良好	一般	差	極差	完全失明
1	2	3	4	5	6

Q3.13. 你患有以下那種屈光不正？

	沒有	有	不知道	備註
a. 近視	0	1	2	
b. 遠視	0	1	2	
c. 散光	0	1	2	
d. 老花	0	1	2	

Q3.14. 你的醫生有說過你患有以下哪種眼睛疾病嗎？

眼睛疾病	從沒有	有，以前	有，現在	不知道	備註
a. 青光眼	0	1	2	3	
b. 老年黃斑病變	0	1	2	3	
c. 糖尿病視網膜病變	0	1	2	3	
d. 白內障*	0	1	2	3	
e. 青光眼	0	1	2	3	
f. 其他 (請列明)	0	1	2	3	

*如果已經做了白內障手術並已經 *close file*，圈“有，以前”

有關獲取全面眼科檢查服務資訊的途徑

Q3.15. 你認為在日常生活中對於全面眼睛檢查的資訊是否足夠？

- 0. ☐ 不足夠
- 1. ☐ 足夠

Q3.16. 你從什麼途徑得知有關全面眼睛檢查的資訊？（答案可多於一個）

- 1. ☐ 家人或親戚
- 2. ☐ 朋友/同輩
- 3. ☐ 鄰居
- 4. ☐ 長者鄰舍中心
- 5. ☐ 廣告或傳媒
- 6. ☐ 政府單張/宣傳
- 7. ☐ 醫護人員，例如醫生、視光師
- 8. ☐ 其他，請列明.....
- 9. ☐ 從未接觸過任何有關全面眼睛檢查的相關資訊

Appendix D4 English Version of the finalised DCE questionnaire (v2)

Below is the English version of the DCE questionnaire (version 2).

Part 1: Knowledge, attitude towards need for an eye examination, previous use of eye examination and elderly centre utilisation

For interviewer: Please ask the following question and complete Q1.1 – Q1.11

Knowledge, attitude and utilisation of eye examination

Q1.1 Do you know how frequently an elder should get an eye examination?

- 0. ☐ No
- 1. ☐ Yes, please specify

Q12. Do you know where you can get an eye check?

- 1. ☐ No (Go to Q1.3)
- 2. ☐ Yes (Go to Q1.2a)

Q1.2.a. Where can you get an comprehensive eye examination? (allow multiple answers)

- 1. ☐ General public clinic / Hospital
- 2. ☐ General private clinic / Hospital
- 3. ☐ Public ophthalmic clinics / hospital
- 4. ☐ Private ophthalmic clinic / hospital
- 5. ☐ Optometric clinic/ centre

Q1.3. Do you think it is important to have regular comprehensive eye examination?

- 0. ☐ No
- 1. ☐ Yes

Q1.4. Do you think eye examination is only necessary when there are any eye symptoms?

- 0. ☐ No
- 1. ☐ Yes
- 2. ☐ Don't know

Q1.5. Have you ever used eye examination in the past 24 months?

- 0. ☐ No (Go to Q1.7)
- 1. ☐ Yes (Go to Q1.6)

Q1.6. If yes,

Q1.6.a. why did you get the eye examination?

- 1. ☐ Regular follow up by an ophthalmologist (for known/ diagnosed eye diseases)

2. ☐ One-off check up with ophthalmologists (not regular check-up, e.g. eye infection, injuries, discomfort or other visual issues that were referred
3. ☐ Being referred by other specialist due to chronic illness (e.g. diabetic retinopathy screening)
4. ☐ Routine, regular eye examination
5. ☐ Others, please specify

Q1.6.b. Where did you get the eye examination?

1. ☐ Private optical store
2. ☐ Private clinic or hospital
3. ☐ Non-governmental organisation
4. ☐ Others, please specify

Q1.6.c. What service did you use?

1. ☐ Visual acuity
2. ☐ Ocular health examination (fundus examination)
3. ☐ Spectacle prescription
4. ☐ Others, please specify

Q1.6.d. How did you pay for the service (then answer Q1.8)

1. ☐ Out-of-pocket
2. ☐ Elderly healthcare voucher
3. ☐ Others, please specify

Q1.7. If no, what is the main reason for not getting an eye examination?

1. ☐ Cost
2. ☐ Troublesome
3. ☐ Currently no eye problem
4. ☐ Not scared of losing vision
5. ☐ Expected eye examination as routine (not important)
6. ☐ Did not know required eye examination
7. ☐ Not being told of the need to have eye examination
8. ☐ Already follow up by an ophthalmologist (e.g. SOPCS, HA hospital),
please specify the content of the follow- up
9. ☐ Others, please specify

Being an elderly centre member

Q1.8. Do you have membership at different elderly centres?

0. ☐ No
1. ☐ Yes, please specify the total number of elderly centre

Q1.9. Do you remember how long have you been a member of this centre?

1. ☐ Remember
Year:
Month:
2. ☐ I Don't remember

Q1.10. Have you ever participated in any activities organised by the elderly centre?

0. ☐ No
1. ☐ Yes

Q1.11. Are you a volunteer at the elderly centre yourself? (any elderly centre)

0. ☐ No
1. ☐ Yes

Part 2: DCE questionnaire

For interviewer:

- Please introduce the background of the survey, explain the scenario, attributes and level.
- Make sure to check the respondent's understanding and clarify when needed.

About this questionnaire

- Regular use of comprehensive eye examinations plays an important role in preventing avoidable vision loss. We have designed a series of strategies aimed to improve the uptake of eye examination by the older adults, with different strategies having different characteristics.
- You will be asked to make **8 choices**, all based on hypothetical scenarios.
- These questions are about your preference for the characteristics of the programme designed to encourage you to use the eye examination service to preserve your eyesight.
- Your answers will NOT imply future change in the way service is provided to you currently.
- If you have any question during the introductory session, please let me know.

Scenario

About comprehensive eye examination

- Regular comprehensive eye examination is provided by Part I Optometrist in Hong Kong. These optometrists usually work in the private sector.
- Comprehensive eye examination includes assessment of not only visual acuity and refractive status, but also visual functions, and ocular health to detect any early sign of eye diseases (e.g. cataract, diabetic retinopathy, glaucoma). Based on the results, the optometrist will provide appropriate advice, treatment, and follow-up options.
- Elders are recommended to get their eye checked every one to two years.
- The price you pay for a comprehensive eye examination varies between clinics.
- You can use the elderly healthcare voucher to cover the service fee provided by the Part I Optometrist who has enrolled in the voucher scheme.
- The biennial quota for optometric services for each eligible elder is capped at HKD 2000. [**Note for interviewer:** the quota for optometric service cannot be shared with spouse under the shared account]
- There are many clinics in the community that provide comprehensive eye examination.

List of examination components in a comprehensive eye examination

1. Case history taking
2. Vision acuity and refraction assessment
3. Binocular vision assessment
4. Intra-ocular pressure measurement
5. Colour vision assessment
6. Internal and external ocular health assessment
7. Fundus examination
8. Explanation of results and professional advice on follow-up options

** The optometrist will base on individual circumstances, whether there is a need to dilate the eye to evaluate the fundus and your vision.*

Vision assessment



Assessment on:
Visual function
Ocular health



Eyeglasses prescription
(if needed)



Please consider the following scenario:

Imagine the elderly centre introduce a new programme to the elders. This programme collaborates with optometrists will an aim to improve the use of comprehensive eye examination of the older adults to preserve their eyesight. Individual aged 65 years or above should get an eye examination at least every one to two years. Imagine that you now decide to get an eye examination. Which package would encourage you to use the service?

There are 5 characteristics you will need to consider before choosing your preferred programme. I will explain each characteristic to you now.

For interviewer:

- Please **explain** the attributes and levels.
- Make sure to **check the respondent's understanding and clarify** the description when needed. Note down their responses regarding the attribute understanding and questions raised.
- After that, asked the respondents to **completing the rating and ranking survey** – note down their responses. Make sure to also check their understanding based on their think-aloud account. If needed, please clarify the attributes descriptions again.
- Check
 - how the respondent interpret the description/ understand the attributes (e.g. did they use different wordings?), ask for their interpretation
 - do they have difficulties understanding/ following the explanation?
 - Were there other factors they mentioned when describing the characteristics?

Attributes and levels

Remember to mark down the response/ questions from the elders.

Characteristics	Descriptions	Levels
Service location	Assuming the service quality are the same regardless of the service location, you can either receive the eye examination at the elderly centre via mobile service. Or, you can visit the optometric clinics in the community.	<ul style="list-style-type: none"> • Optometric clinics in the community • Mobile service provides at the elderly centre
Service fee range	<p>Assuming the service quality are the same regardless of the service location, whether the service provider will state the service fee range.</p> <p>If it is stated, it means that before you use the service, the service provider will state the fee range for the eye examination and glasses (if required). There will be a range of affordable glasses for you to choose from. You may upgrade the frame and lenses if you want. Otherwise, the service fee range will not change.</p> <p>If not stated, you will not know the service fee range in advance. It means that when you use the service, you will have to pay for the service, i.e. eye examination and glasses (if needed), based on the price set by the service provider, which can vary by different service providers.</p> <p>Note 1: you can use the elderly healthcare voucher to pay for the optometric services</p> <p>Note 2: <u>Service quality</u> refers that service will be provided by Part I Optometrists who are well-trained to provide eye examination and that they can all provide you with appropriate clinical advice/decision according to examination results.</p>	<ul style="list-style-type: none"> • No, not stated • Yes, stated

Appointment booking	This describes how the next eye examination appointment is reserved.	<ul style="list-style-type: none"> • You make the next appointment • The service provider has scheduled your next appointment
Appointment reminder	This is whether you will receive any reminder to attend the scheduled appointment	<ul style="list-style-type: none"> • No • Yes
How well you are informed about the eyecare need and service	Whether there will be a supportive environment to inform you well about the need for an eye examination. For example, your centre staff, volunteers will be well-trained to provide you with the necessary eyecare information (knowledge). The centre will also disseminate information about the eye health and the service whether that is via the form of leaflet or educational activities.	<ul style="list-style-type: none"> • Without supportive environment • With supportive environment

Understanding of the service attributes:

Attributes	Remarks
1) Service location	
2) Service fee range	
3) Appointment booking	
4) Appointment reminder	
5) How well you are informed about the service	

Rating

order	Attributes	Rating		Remarks
	1) Service location	Important	Unimportant	
	2) Service fee range	Important	Unimportant	
	3) Appointment booking	Important	Unimportant	
	4) Appointment reminder	Important	Unimportant	
	5) How well you are informed about the service	Important	Unimportant	

Ranking

order	Attributes	Ranking					Remarks
	1) Service location	1	2	3	4	5	
	2) Service fee range	1	2	3	4	5	
	3) Appointment booking	1	2	3	4	5	
	4) Appointment reminder	1	2	3	4	5	
	5) How well you are informed about the service	1	2	3	4	5	

Question: Which service programme would you prefer?

- You will be given two packages each time (show the questionnaire format to the respondent to help them understand the format)
- The five attributes will be combined into a package.
- You will be asked to compare both packages before selecting the one which you believe would encourage you to use an eye examination. If you think neither package would encourage you, you can choose “neither” option.

Scenario:

Imagine there is a new programme introduced to the elders with an aim to improve the use of comprehensive eye examination to preserve their eyesight. Individual aged 65 years or above should get an eye examination at least every one to two years. Imagine that you now decide to get an eye examination. Which package would encourage you to use the service?

For interviewer:

Before asking the respondents to answer the DCE choice sets, please remind them that:

- The questions are designed to elicit their preference
- All choice sets are based on hypothetical scenarios
- There is no right or wrong answer, your opinions are what matter.
- Should treat each choice set as separate question

If the respondents **don't know how to compare**, you can suggest them:

- You need to
 - a. **Look at** Package A and then Package B
 - b. **Compare** all the attributes in Package A and Package B
 - c. **Select** the one you think would **encourage you** to use an eye examination

Exclusion criteria:

- Interviewer needs to determine whether the elders can understand how to complete the DCE questionnaire
- **If they couldn't understand how to complete, need to communicate with elderly centre staff to kindly ask the respondent to withdraw from the survey study**

Example question

Please compare the two packages. Which package would encourage you to use eye examination regularly? If you think neither package would encourage you, you can choose “neither” option.

	Question	Example	
	Package A	Package B	Neither
Service location	Optometric clinic in the community	Mobile service provides at the elderly centre	
Service fee range	No	Yes	
Appointment booking	You make the next appointment	The service provider has scheduled your next appointment	
Appointment reminder	Yes	No	
How well are you informed about the service	With supportive environment	Without supportive environment	
Which you would you prefer?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

In this example, this person has chosen “Programme B”. This person prefers to have all the listed attributes. Comparing Programme B to Programme A, this person is willing to trade having no reminder and having no supportive environment to informed about the service, for having the rest of the attribute (mobile service, stated service fee range, appointment booking).

For interviewer:

- Ask the respondent: Do you have any questions on the question format?

Question 0 = rationality test

Question 1 + Question 2 = warm-up questions, use think-aloud techniques

For pilot – use think aloud techniques for all questions.

Remind the respondents:

- there is no right or wrong answer, your opinions are what matter.
- Also please treat each choice set as separate one.
- Make sure to **compare both packages** before making a decision

[FULL CHOICE SETS]

Please compare the two packages. Which package would encourage you to use eye examination regularly? If you think neither package would encourage you, you can choose “neither” option.

Question		0	
	Package A	Package B	Neither
Service location	Mobile service provides at the elderly centre	Mobile service provides at the elderly centre	
Service fee range	No	Yes	
Appointment booking	You make the next appointment	The service provider has scheduled your next appointment	
Appointment reminder	No	Yes	
How well are you informed about the service	Without supportive environment	With supportive environment	
Which you would you prefer?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

If respondent chose “neither” option, please note the reasons:

.....

.....

.....

Please compare the two packages. Which package would encourage you to use eye examination regularly? If you think neither package would encourage you, you can choose “neither” option.

Question		1	
	Package A	Package B	Neither
Service location	Optometric clinic in the community	Mobile service provides at the elderly centre	
Service fee range	Yes	No	
Appointment booking	You make the next appointment	The service provider has scheduled your next appointment	
Appointment reminder	No	Yes	
How well are you informed about the service	Without supportive environment	With supportive environment	
Which you would you prefer?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

If respondent chose “neither” option, please note the reasons:

.....

.....

.....

Please compare the two packages. Which package would encourage you to use eye examination regularly? If you think neither package would encourage you, you can choose “neither” option.

Question		2	
Package A		Package B	Neither
Service location	Optometric clinic in the community	Mobile service provides at the elderly centre	
Service fee range	No	Yes	
Appointment booking	The service provider has scheduled your next appointment	You make the next appointment	
Appointment reminder	Yes	No	
How well are you informed about the service	With supportive environment	Without supportive environment	
Which you would you prefer?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

If respondent chose “neither” option, please note the reasons:

.....

.....

.....

Please compare the two packages. Which package would encourage you to use eye examination regularly? If you think neither package would encourage you, you can choose “neither” option.

Question		3	
Package A		Package B	Neither
Service location	Mobile service provides at the elderly centre	Optometric clinic in the community	
Service fee range	Yes	No	
Appointment booking	You make the next appointment	The service provider has scheduled your next appointment	
Appointment reminder	Yes	No	
How well are you informed about the service	With supportive environment	Without supportive environment	
Which you would you prefer?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

If respondent chose “neither” option, please note the reasons:

.....

.....

.....

Please compare the two packages. Which package would encourage you to use eye examination regularly? If you think neither package would encourage you, you can choose “neither” option.

Question		4	
	Package A	Package B	Neither
Service location	Mobile service provides at the elderly centre	Optometric clinic in the community	
Service fee range	No	Yes	
Appointment booking	The service provider has scheduled your next appointment	You make the next appointment	
Appointment reminder	No	Yes	
How well are you informed about the service	Without supportive environment	With supportive environment	
Which you would you prefer?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

If respondent chose “neither” option, please note the reasons:

.....

.....

.....

Please compare the two packages. Which package would encourage you to use eye examination regularly? If you think neither package would encourage you, you can choose “neither” option.

Question		5	
Package A		Package B	Neither
Service location	Optometric clinic in the community	Mobile service provides at the elderly centre	
Service fee range	Yes	No	
Appointment booking	The service provider has scheduled your next appointment	You make the next appointment	
Appointment reminder	No	Yes	
How well are you informed about the service	With supportive environment	Without supportive environment	
Which you would you prefer?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

If respondent chose “neither” option, please note the reasons:

.....

.....

.....

Please compare the two packages. Which package would encourage you to use eye examination regularly? If you think neither package would encourage you, you can choose “neither” option.

Question		6	
Package A		Package B	Neither
Service location	Optometric clinic in the community	Mobile service provides at the elderly centre	
Service fee range	No	Yes	
Appointment booking	You make the next appointment	The service provider has scheduled your next appointment	
Appointment reminder	Yes	No	
How well are you informed about the service	Without supportive environment	With supportive environment	
Which you would you prefer?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

If respondent chose “neither” option, please note the reasons:

.....

.....

.....

Please compare the two packages. Which package would encourage you to use eye examination regularly? If you think neither package would encourage you, you can choose “neither” option.

Question		7	
	Package A	Package B	Neither
Service location	Mobile service provides at the elderly centre	Optometric clinic in the community	
Service fee range	Yes	No	
Appointment booking	The service provider has scheduled your next appointment	You make the next appointment	
Appointment reminder	Yes	No	
How well are you informed about the service	Without supportive environment	With supportive environment	
Which you would you prefer?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

If respondent chose “neither” option, please note the reasons:

.....

.....

.....

Please compare the two packages. Which package would encourage you to use eye examination regularly? If you think neither package would encourage you, you can choose “neither” option.

Question		8	
	Package A	Package B	Neither
Service location	Mobile service provides at the elderly centre	Optometric clinic in the community	
Service fee range	No	Yes	
Appointment booking	You make the next appointment	The service provider has scheduled your next appointment	
Appointment reminder	No	Yes	
How well are you informed about the service	With supportive environment	Without supportive environment	
Which you would you prefer?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

If respondent chose “neither” option, please note the reasons:

.....

.....

.....

Debrief questions

For interviewer: please ask the respondents the following questions and complete Q2.1 – Q2.3

Q2.1. How do you find these questions, were they difficult to answer?

Very easy 1	Fairly easy 2	Neither difficult nor easy 3	Quite difficult* 4	Very difficult* 5
----------------	------------------	------------------------------------	-----------------------	----------------------

***For subject who rated 4 – 5, please also asked what made it quite difficult/ very difficult.*

.....

.....

.....

Q2.2. The questions require you to compare Programme A and Programme B. Did you actually compare Programme A and Programme B?

0. ☐ No (ask how they make the decision of which package to choose)

.....

.....

.....

1. ☐ Yes

Q2.3. In choosing between programme A and programme B, did you consider other factors?

0. ☐ No
1. ☐ Yes, please specify

[For Interviewer to fill in]

Q2.4. How well do you think the respondent understood and carried out the tasks during the interview?

1. Understood and performed task easily
2. Some problems but seemed to understand in the end
3. Doubtful whether the respondent understood the task

Q2.5. In terms of effort and concentration, which of the following statement best describes the way the respondent undertook the tasks?

1. **Concentrated** well and put a great deal of effort into completing choice sets
2. **Concentrated fairly hard** and put some effort
3. **Didn't concentrate** and put little effort into it

**Part 3: demographic, self-reported health status and knowledge, attitude towards
comprehensive eye examination services**

Q3.1. What is your age: _____ [if refuse to answer, ask for age group]

65 – 69	70-74	75 – 79	80 – 84	≥ 85
1	2	3	4	5

Q3.2. What is your sex?

0. ☐ Female
1. ☐ Male

Q3.3. What is your highest educational attainment?

1. ☐ No-schooling/ pre-primary
2. ☐ Primary
3. ☐ Secondary (lower/ upper)
4. ☐ Post-secondary (diploma, certificate, sub-degree, degree)
5. ☐ Refuse to answer

Q3.4. What is your marital status?

1. ☐ Single (never married/ windowed/ separated)
2. ☐ Married
3. ☐ Prefer not to say

Q3.5. On a typical month What is your monthly income (include all income sources, e.g. own income, financial support from family)?

1. ☐ < 2,000
2. ☐ 2,000 – 4,999
3. ☐ 5,000 – 9,999
4. ☐ 10,000 – 14,999
5. ☐ 15,000 – 19,999
6. ☐ 20,000 +
7. ☐ No income
8. ☐ Don't know
9. ☐ Refuse to answer/ prefer not to say

Q3.6. Are you receiving comprehensive social security assistance (CSSA)?

0. ☐ No
 1. ☐ Yes

Q.3.7. What are the main source of income?

Source of income	No	Yes	Remark
1. Old age allowance (\$1,570)	0	1	
2. Old age living allowance (\$4,060)^	0	1	
3. Disability allowance (higher \$4,010 ; normal \$2,005)	0	1	
4. Financial support from family members/ relatives	0	1	
5. Saving/ pension	0	1	
6. Employment	0	1	
7. Prefer not to say	0	1	
8. Others, please specify	0	1	

^ With effect from 1 September 2022, the Normal OALA and the Higher OALA merge as the “Old Age Living Allowance”

Q3.8. Living arrangement

1. ☐ Living alone
 2. ☐ Living with spouse only
 3. ☐ Living with child(ren) only
 4. ☐ Living with spouse and with child(ren)
 5. ☐ Others, please specify
 6. ☐ Prefer not to say

Self-reported physical health status**Q3.9. Have you ever been diagnosed with the following chronic disease?**

Chronic illnesses	No, never	Yes, before	Yes, current	Don't know	Remarks
a. Hypertension	0	1	2	3	
b. High blood cholesterol	0	1	2	3	
c. Diabetes mellitus	0	1	2	3	
d. Coronary heart diseases	0	1	2	3	
e. Asthma	0	1	2	3	
f. Cancer	0	1	2	3	
g. Stroke	0	1	2	3	
h. Others, please specify	0	1	2	3	

Q3.10. How would you rate your overall health as compared with people of the same age, on a scale of 1 to 5, where 1 = excellent and 5 = poor health?

Excellent	Very Good	Good	Fair	Poor	Don't know
1	2	3	4	5	6

Self-reported/ self-perceived visual health status**Q3.11. Do you wear any glasses, contact lenses or other visual aids (e.g. magnifier)?**

0. ☐ No
1. ☐ Yes

Q3.12. At the present time, how would you rate your eyesight using both eyes (with glasses or contact lenses, if you wear them?)

Excellent	Good	Fair	Poor	Very Poor	Completely Blind
1	2	3	4	5	6

Q3.13. What type(s) of refractive error do you have?

	No	Yes	Don't Know	Remarks
a. Myopia (short-sightedness)	0	1	2	
b. Hyperopia (long-sightedness)	0	1	2	
c. Astigmatism	0	1	2	
d. Presbyopia	0	1	2	

Q3.14. Have you ever been diagnosed with the following eye disease(s)?

Eye disease(s)	No, never	Yes, before	Yes, current	Don't know	Remarks
a. Glaucoma	0	1	2	3	
b. Age-related Macular Degeneration	0	1	2	3	
c. Diabetic Retinopathy	0	1	2	3	
d. Cataract	0	1	2	3	
e. Others (Please state)	0	1	2	3	

Information about comprehensive eye examination services

Q3.15. Do you think there are sufficient information about comprehensive eye examination in your daily life?

0. ☐ No
1. ☐ Yes

Q3.16. From which source do you get comprehensive eye examination-related information? (*allow multiple answers*)

1. ☐ Family members/ relatives
2. ☐ peers/ friends
3. ☐ Neighbourhood
4. ☐ Elderly centres
5. ☐ Advertisement / media (social media, internet)
6. ☐ Government leaflets / campaign
7. ☐ Healthcare professional, e.g. doctors, optometrists
8. ☐ others, please specify
9. ☐ Never come across any information related to eye examination

Appendix D5 Invitation letter used in centre recruitment

Below shows the invitation letter issued via email for centre recruitment. The elderly centre was sent both the Chinese and the English version.

DD/MM/2023

Dear centre-in-charge,

Invitation to a survey on elders' preference for strategies to improve comprehensive eye examination uptake

Thank you for participating in a survey on the use of financial incentives to promote preventive care, conducted by the School of Optometry The Hong Kong Polytechnic University, in year 2021.

Regular use of comprehensive eye examinations plays an important role in preventing avoidable vision loss. Previous study has allowed us to understand the factors related to the lack of use of comprehensive eye examinations by the elderly. Based on the research findings, we have designed a series of strategies aimed to improve the uptake of such services, with different strategies having different characteristics.

We cordially invite your centre to participate in a study entitled "Elders' preference for strategies to improve comprehensive eye examination uptake". **This study aims to use questionnaire survey to understand the elders' preference towards the characteristics of the above strategies.** The results will help develop strategies that are in line with the elder's preferences, which can be used to improve the service uptake and thereby preserve good eyesight of the elderly.

If your centre agrees to participate in this questionnaire survey,

- We would like to invite the elders who participated in the 2021 survey to take part in this study
- A researcher will visit the centre and complete a one-to-one questionnaire survey with the invited elders; each session will last for around 45 minutes
- After completion, the participants will receive a token of appreciation

If the centre is interested in participating, please fill in the acceptance letter and send it back to Ms Ingrid Lau via email by [insert recruitment deadline]. **We will also contact the centre within one week of issuing this invitation letter.** For further enquiries, please do not hesitate to contact Ms Ingrid Lau (tel: xxxx xxxx; email: xxxxxxxx). This research project has been approved by the PolyU Institutional Review Board (reference no.: HSEARS20221212003) and will be conducted under the supervision of Dr Tina Lian Jinxiao. We look forward to the centre's reply. Thank you once again for the centre's support and participation.

Yours Sincerely,

Ms Ingrid Lau Wing Yan
PhD Student
The Hong Kong Polytechnic University
School of Optometry
Public Health Research Group

Dr Tina Lian Jinxiao
Assistant Professor
The Hong Kong Polytechnic University
School of Optometry
Public Health Research Group

2023年xx月xx日

致中心主任：

促進長者使用綜合眼科視光檢查策略偏好的研究 – 問卷調查邀請

您好！首先多謝貴中心曾於 2021 年參與由香港理工大學眼科視光學院進行的一項使用財政誘因促進預防護理的問卷調查。

定期綜合眼科視光檢查對可能避免的視力損失起著重要的預防作用。上述的研究調查讓我們了解長者缺乏使用綜合眼科視光檢查的因素。並由此為依據，推動我們設計了一系列促進長者使用綜合眼科視光檢查的策略，不同的策略會有不同的特徵。

現誠意邀貴中心參加一項名為“促進長者使用綜合眼科視光檢查策略偏好的研究”。這次研究是以問卷的形式，目的是為了解長者對上述策略中的特徵有哪些偏好。研究結果將有助於制定符合長者偏好的策略，藉以可以用來提高長者對該服務的使用率，進而保護長者的視力健康。

如果中心同意參加問卷調查，

- 我們會邀請參加過 2021 年問卷調查的長者再次參加這次研究
- 研究人員將到訪中心與受邀長者進行一次問卷調查，每次需時約 45 分鐘
- 完成問卷調查後，長者將獲得禮券 乙張 作為感謝他們為我們研究付出的時間

如果中心有興趣參加，請填妥參與同意書，並在 2023 年 8 月 1 日前將附件回覆至劉穎欣小姐的電郵。我們亦會在發出此邀請信的一個星期內與中心聯絡。如有任何查詢，歡迎聯絡劉穎欣小姐 (電話: xxxx xxxx; 電郵: xxxx xxxx)。本研究項目已獲香港理工大學研究事務所操守委員會的批准 (參考編號: HSEARS20221212003)並會在連金曉博士指導下進行。

期待中心的回復。再次感謝中心的支持和參與。

劉穎欣 小姐
研究生
香港理工大學
眼科視光學院
公共衛生研究小組

連金曉 博士
助理教授
香港理工大學
眼科視光學院
公共衛生研究小組

Appendix D6 Name list used for individual recruitment

Below is the name list used for individual recruitment.

【問卷調查：促進長者使用綜合眼科視光檢查策略偏好的研究】

中心名稱	
負責人	
所需人數	
訪問日期	如需要安排其他時間，請聯繫 xxx小姐。 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

可預約時間：

*實際預約時段：按照中心安排規劃時段；每個長者預約時段為一小時。

- 最終名單會以以下形式提供給中心作紀錄。

日期	時段*	姓名
xx月xx日	10am - 11am	
xx月xx日	11am - 12pm	
xx月xx日	12pm - 1pm	
xx月xx日	10am - 11am	
xx月xx日	11am - 12am	
xx月xx日	12pm - 1pm	

【受邀長者需知】

關於問卷調查

- 這是一個問卷調查（“促進長者使用綜合眼科視光檢查策略的偏好”）
- 長者需要預留45 – 60 分鐘時間完成問卷調查
- 問卷調查分為以下幾個部分：
 - 1) 訪問者解釋問卷調查目的（長者需要同意參加後才會進下一部分）
 - 2) 長者回答選擇題（長者不用填寫任何題目，需要他們口頭回答就可以）
 - 3) 長者回答基本人口、健康相關的問題
- 問卷完成後，每位長者會有HK\$100 超市禮券作為感謝他們付出的時間。

【表格A】

編號	姓名	性別 (M/F)	同意參加?	如同意 請預約時間 (dd/mm, timeslot)	如不同意，原因是什麼？（如有）
1			<input type="checkbox"/> 同意 <input type="checkbox"/> 不同意		<input type="checkbox"/> 沒人接聽 <input type="checkbox"/> 沒時間 <input type="checkbox"/> 不感興趣
2			<input type="checkbox"/> 同意 <input type="checkbox"/> 不同意		<input type="checkbox"/> 沒人接聽 <input type="checkbox"/> 沒時間 <input type="checkbox"/> 不感興趣
3			<input type="checkbox"/> 同意 <input type="checkbox"/> 不同意		<input type="checkbox"/> 沒人接聽 <input type="checkbox"/> 沒時間 <input type="checkbox"/> 不感興趣
4			<input type="checkbox"/> 同意 <input type="checkbox"/> 不同意		<input type="checkbox"/> 沒人接聽 <input type="checkbox"/> 沒時間 <input type="checkbox"/> 不感興趣
5			<input type="checkbox"/> 同意 <input type="checkbox"/> 不同意		<input type="checkbox"/> 沒人接聽 <input type="checkbox"/> 沒時間 <input type="checkbox"/> 不感興趣
6			<input type="checkbox"/> 同意 <input type="checkbox"/> 不同意		<input type="checkbox"/> 沒人接聽 <input type="checkbox"/> 沒時間 <input type="checkbox"/> 不感興趣
7			<input type="checkbox"/> 同意 <input type="checkbox"/> 不同意		<input type="checkbox"/> 沒人接聽 <input type="checkbox"/> 沒時間 <input type="checkbox"/> 不感興趣
8			<input type="checkbox"/> 同意 <input type="checkbox"/> 不同意		<input type="checkbox"/> 沒人接聽 <input type="checkbox"/> 沒時間 <input type="checkbox"/> 不感興趣
9			<input type="checkbox"/> 同意 <input type="checkbox"/> 不同意		<input type="checkbox"/> 沒人接聽 <input type="checkbox"/> 沒時間 <input type="checkbox"/> 不感興趣
10			<input type="checkbox"/> 同意 <input type="checkbox"/> 不同意		<input type="checkbox"/> 沒人接聽 <input type="checkbox"/> 沒時間 <input type="checkbox"/> 不感興趣
11			<input type="checkbox"/> 同意 <input type="checkbox"/> 不同意		<input type="checkbox"/> 沒人接聽 <input type="checkbox"/> 沒時間 <input type="checkbox"/> 不感興趣

Appendix D7 Restructuring from wide to long format for the eight choice sets

Table D7.1 Restructuring the data from wide to long format

Observation		Wide format					Long format											
Choice	alter	SL	SF	AB	AR	SE	SL_Clinic	SL_Mobile	SL_neither	SF_No	SF_Yes	AB_user	AB_provider	AB_neither	AR_No	AR_Yes	SE_No	SE_Yes
0	1	0	0	0	0	0	1	0	0	0	1	1	0	0	1	0	1	0
0	2	1	1	1	1	1	0	1	0	1	0	0	1	0	0	1	0	1
0	3						0	0	1	1	0	0	0	1	1	0	1	0
1	1	0	1	1	1	1	1	0	0	1	0	0	1	0	0	1	0	1
1	2	1	0	0	0	0	0	1	0	0	1	1	0	0	1	0	1	0
1	3						0	0	1	1	0	0	0	1	1	0	1	0
2	1	1	0	0	1	1	0	1	0	0	1	1	0	0	0	1	0	1
2	2	0	1	1	0	0	1	0	0	1	0	0	1	0	1	0	1	0
2	3						0	0	1	1	0	0	0	1	1	0	1	0
3	1	1	1	1	0	0	0	1	0	1	0	0	1	0	1	0	1	0
3	2	0	0	0	1	1	1	0	0	0	1	1	0	0	0	1	0	1
3	3						0	0	1	1	0	0	0	1	1	0	1	0
4	1	0	0	1	0	1	1	0	0	0	1	0	1	0	1	0	0	1
4	2	1	1	0	1	0	0	1	0	1	0	1	0	0	0	1	1	0
4	3						0	0	1	1	0	0	0	1	1	0	1	0
5	1	0	1	0	1	0	1	0	0	1	0	1	0	0	0	1	1	0
5	2	1	0	1	0	1	0	1	0	0	1	0	1	0	1	0	0	1
5	3						0	0	1	1	0	0	0	1	1	0	1	0
6	1	1	0	1	1	0	0	1	0	0	1	0	1	0	0	1	1	0
6	2	0	1	0	0	1	1	0	0	1	0	1	0	0	1	0	0	1
6	3						0	0	1	1	0	0	0	1	1	0	1	0
7	1	1	1	0	0	1	0	1	0	1	0	1	0	0	1	0	0	1
7	2	0	0	1	1	0	1	0	0	0	1	0	1	0	0	1	1	0
7	3						0	0	1	1	0	0	0	1	1	0	1	0
8	1	1	1	0	0	0	0	1	0	1	0	1	0	0	1	0	1	0
8	2	1	0	1	1	1	0	1	0	0	1	0	1	0	0	1	0	1
8	3						0	0	1	1	0	0	0	1	1	0	1	0

Choice 0 is rationality test.

SL = service location, SF= specified fee range, AB = appointment booking, AR = appointment reminder, SE = how well you are informed about eyecare needs and service.

Appendix D8 Data cleaning – recoding variables

Recoded variables in Part 1 of the questionnaire are as follow.

- Q1.1. asked about the subjective knowledge on the recommended examination interval. For those who answered “Yes”, their answer on the interval was initially designed as an opened question. The answer was regrouped into four groups accordingly: “within a year”, “1 – 2 years”, “more than 2 years”, and “others”.
- Q1.3 asked about the attitude about CEE. The questions on the subjective perception on the significance of regular eye examination were recorded as open-ended questions which were then regrouped accordingly. There were three groups: “lack of social companion”, “perceived limited/ no needs for regular eye examination”, “lack of meaning in life”.
- Q1.6a asked about the reasons for eye examination utilisation in the past 24-month which was set as a structured question, with “other” option. The reasons coded in “other” was reviewed and regrouped to further explore the reasons.
- Q1.6.b asked about “other” option on the location at which eye examination was received. The responses were reviewed and regrouped accordingly.
- Q1.7 asked about the reason for not using eye examination services in the past 24-month, the group coded as “other” was regrouped to explore the reasons, eventually all the “other” options are recoded into four different categories “pandemic”, “unable to make an appointment”, “don’t know where to access the service”, and “ophthalmologist from previous eye examination said “no need”.
- Q.1.9 asked the subjects about their duration of being a member of the elderly centre. Although it was designed as a structure question, which allowed them to state the month and year, it was found some subjects couldn’t remember and therefore provided a range. Three groups were used to regroup the responses: “within 10 years”, “more than 10 years”, and “forgot”.

Responses regarding the debrief questions in Part 2 of the questionnaire were also recoded.

- After completing the eight DCE choice sets, the subjects were asked to share whether they found answering the CE questions difficult (Q2.1). For those that coded “quite difficult”, the responses were reviewed, and group into four groups accordingly: “spent time considering the most preferred scenario”, “questionnaire format, multiple factors

to consider”, “uncertain which scenario would be the best for the subjects”, and “require simultaneous explanation from interview to be able to complete all the questions”.

- Q2.3 asked whether additional factors were considered before they compare two programme. For those responded “yes”, their answers were reviewed six groups were identified, “convenience”, “service provider factors (trust and service quality)”, “self-perceived health status (general health and visual health)”, “involvement of elderly centre (familiarity)”, “individual’s intention to engage in CEE” and “cost-related factors (voucher limit, low service fee).
- After the debrief questions were completed by the subject, the interviewers also filled in question regarding the understandability of the subject. For those who was marked as “Some problems but seemed to understand in the end”, the notes were reviewed and the answered were then grouped in five groups: “questionnaire format, design being hypothetical”, “comparison of alternatives”, “understanding about the scenario of CEE-based”, “understanding of attribute” and “communication difficulties (dialect)”.

Below are the variables recoded in Part 3 of the questionnaire.

- For living arrangement (Q3.8), the subject who answered “others” were regrouped accordingly. The regrouping was guided by the definition of the Governmental report on living arrangement. If the subject is living with his/her son and their son’s family (including daughter-in-law and grandchild(ren), it would be coded either “Living with child(ren) only” or “Living with spouse and child(ren), depending on whether the spouse were also living with them.
- Questions were asked to know about the subjective perception on whether eye examination being sufficient (Question 3.16). The original grouping consisted of three groups “not sufficient”, sufficient” and don’t know/did no notice”. The response to this question were regrouped into two categories “not sufficient” and “sufficient” for easier interpretation of results.

Appendix D9 IIA results based on the final DCE questionnaire (v2)

The IIA test was performed in Stata version 18, using the command *hausman*.

Below is the comparison between a model (b) including Programme B and Neither alternative, and the full model (B) including Programme A, Programme B and Neither alternative.

Table D9.1 IIA results based on the comparison of a model with Programme B and Neither alternative with the full model

	(b) noA	(B) full	(b-B)	SE
acs2	-0.832	-1.021	0.189	0.383
Service location (mobile service)	0.686	0.837	-0.151	0.259
Specified fee range (yes)	1.117	1.135	-0.019	0.258
Appointment booking (service provider)	0.449	0.603	-0.153	0.225
Appointment reminder (yes)	0.663	0.781	-0.118	0.259
Informed about needs and service (supportive environment)	0.560	0.433	0.127	0.225

p > 0.05

asc2 = alternative specific constant for programme B

SE = standard error

Below is the comparison between a model with Programme A and Neither alternative (b), and the full model (B) including Programme A, Programme B and Neither alternative.

Table D9.2 IIA results based on the comparison of a model with Programme A and Neither alternative with the full model

	(b) noB	(B) full	(b-B)	SE
acs1	-1.041	-0.915	-0.126	0.283
Service location (mobile service)	0.975	0.837	0.138	0.235
Specified fee range (yes)	1.141	1.135	0.006	0.229
Appointment booking (service provider)	0.764	0.603	0.162	0.239
Appointment reminder (yes)	0.839	0.781	0.058	0.230
Informed about needs and service (supportive environment)	0.336	0.433	-0.097	0.239

p > 0.05

Asc1 = alternative specific constant for programme A.

SE = standard error

Below is the comparison between a model with Programme A and Programme B (b), and the full model (B) including Programme A, Programme B and Neither alternative.

Table D9.3 IIA results based on the comparison of a model with Programme A and Programme B with the full model

	(b) noN	(B) full	(b-B)	SE
acs1	0.089	-0.915	1.003	.
Service location (mobile service)	0.824	0.837	-0.013	0.037
Specified fee range (yes)	1.110	1.135	-0.026	0.032
Appointment booking (service provider)	0.609	0.603	0.007	0.027
Appointment reminder (yes)	0.775	0.781	-0.007	0.036
Informed about needs and service (supportive environment)	0.431	0.433	-0.002	0.029

p > 0.05

Asc1 = alternative specific constant for programme A.

SE = standard error

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