Imperial College London

Background Paper for Prioritization exercise on Health Technology Assessment to promote functional ability

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Executive summary

Background

The ageing of populations is accelerating worldwide. Many countries around the world are faced with the challenge of an ageing society due to its profound impact on health, health systems and public budgets. The WHO Kobe Centre aims to strengthen collaboration with international experts, academic institutions and other relevant stakeholders, and foster innovations for the purpose of advancing universal health coverage and quality of life in the context of population ageing.

Aims

The purpose of this report is to identify prioritisation criteria for topic selection for health technology assessment for the population of older adults facing declining functional capacity, with the focus on low- and middle-income countries. Also, the aim is to conduct a prioritisation exercise of the most promising health technologies for the target population.

Methods

A rapid review of peer-reviewed and grey literature was conducted in order to identify prioritisation criteria applicable to emerging health technologies that tackle problems of ageing populations. Major scientific databases, including MEDLINE, EMBASE™ and the Cochrane Library, were searched for relevant studies for the period from January 1st 2000 to September 1st 2017. This was supplemented with targeted searches using Google search engine and Google Scholar. Additionally, a review of existing horizon scanning systems was performed to examine prioritisation criteria and processes that have been used to prioritise emerging health technologies.

The compiled criteria were applied to a publicly available compilation of health technologies developed by the Canadian Agency for Drugs and Technologies in Health (CADTH) in order to perform an identification exercise. The compilation contains 66 emerging health technologies which were identified in the late 2016 and the first six months of 2017. All technologies identified by CADTH were reviewed in order to filter technologies relevant for the target population. As a result, 25

technologies were included in the prioritization exercise. Finally, these 25 technologies were examined against criteria designed for the population of older adults.

Results

The prioritisation criteria for topic selection for health technology assessment for the population of older adults facing declining functional capacity were grouped into eight groups: need, clinical benefit, cost, evidence base, equity and equality, personal wellbeing, patient autonomy and culture. The identification exercise resulted in six health technologies that have the potential to improve health and quality of life of target population.

Conclusion

The proposed criteria reflect the needs of the population of older adults who experience decline in their physical and intrinsic capacity, and present factors that have the potential to influence further acceptance and adoption of new technologies. The developed criteria can be applied on various information sources that collect data on emerging technologies, both in developed and developing countries. The findings of this report can be used to inform the future prioritisation process for the target population. Further research is necessary to define key public health problems of the population of older adults with most urgent need for innovation in order to refine the existing criteria and formalise the prioritisation process.

1. Introduction

The WHO Kobe Centre (WKC) aims to foster stronger collaboration with international experts, academic institutions and other relevant stakeholders to identify the most promising innovations in order to advance universal health coverage (UHC) and quality of life in the context of population ageing. The aim is to encourage countries to invest in research and their health care systems to inform their decisions and achieve UHC.

Researchers from Imperial College London (ICL) were commissioned to carry out a rapid review of prioritisation criteria for topic selection for health technology assessment (HTA), and a prioritisation exercise of the most promising health technologies that promote functional ability in older adults. These criteria can contribute to the horizon scanning process for the technologies that address challenges of population ageing and could be applied to broadly identify a list of the most promising innovations, with the focus on low- and middle-income countries (LMICs).

Health technologies are defined as “the application of organized knowledge and skills in the form of devices, medicines, vaccines, procedures and systems developed to solve a health problem and improve quality of life”.[1] Technologies in the scope of this review are those that target individuals who are experiencing declining functional capacity. These health technologies are intended to be used within a country’s health and social care system.

To achieve the outlined aims, a rapid review of prioritisation criteria for health technologies that target declining capacity of older adults was conducted. Findings from this study provided insights into prioritisation processes and criteria relevant for innovations that tackle challenges of an ageing population. These criteria were then applied to a publicly available compilation of health technologies developed by the Canadian Agency for Drugs and Technologies in Health (CADTH) in order to perform a prioritisation exercise, thus creating a prioritised list of health technologies that promote functional ability among older adults. This database was chosen as it contained a freely-available compilation of recent emerging health technologies that are likely to have a significant impact on the populations’ health.

Horizon scanning process and prioritisation of health technologies in particular have a high public health value. The identification of emerging technologies provides timely information on the impact of new innovations which can assist decision-makers and relevant stakeholders in allocating resources cost-effectively and according to the principals of the UHC. This report aims to highlight important aspects of healthy ageing and determinants of the functional ability of older adults that will inform prioritisation process of technologies in the scope of this review. Attention was given to practices that are likely to be suitable for use in resource-constrained settings, regardless of economic development.

This report is organised as follows. Section 2 introduces the problem and describes the horizon scanning process and its relevance for the innovations aimed at addressing challenges of ageing populations. Section 3 describes the methodology used to identify relevant prioritisation criteria and obtain insight into prioritisation processes. It furthermore provides an overview of the process used to identify the most promising innovations. Results are presented and discussed in sections 4 and 5. Finally, section 6 presents concluding remarks. Additional findings are presented in the appendix of this report.

2. Background

2.1 Public-health framework for healthy ageing

One of the underpinnings of modern societies is the emphasis on preserving good health and increasing the quality of life. Advancement in the field of medicine, improved access to medicines and health services, improved sanitation and hygiene, and better nutrition are some of the factors that enabled attainment of better health outcomes across the globe. This incentivised major transitions in human health on a global level, including a transition from high to low fertility, an increase in the life expectancy and the shift in the leading causes of death and illness from acute infectious to chronic conditions.[2] In the last two decades, global life expectancy has increased by 5 years, which is the fastest increase since the 1960s.[3]

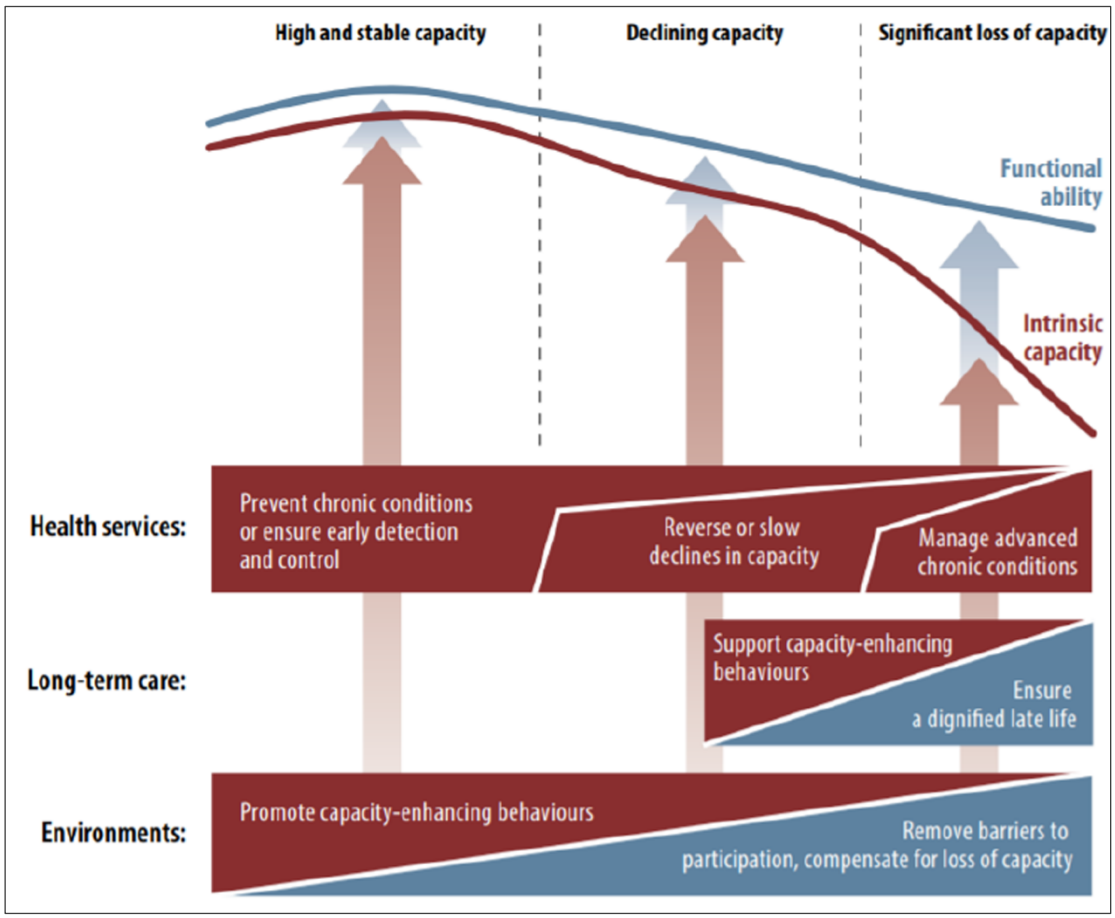
These changes have led to population ageing, a phenomenon observed in many countries around the world. The proportion of the world's population that is over 65 years continues to grow at an unprecedented rate. It is estimated that the proportion of people who are 65 and older will grow from 8.5 percent (617 million inhabitants) of world's population to almost 17 percent (1.6 billion inhabitants) by 2050.[4] Population ageing has many social and economic implications and presents a challenge in securing conditions for appropriate and cost-effective health care.

The global population has experienced a significant increment in the prevalence and burden of disease and disability.[5] Nowadays, older adults may suffer from multiple morbidities, such as chronic conditions alongside mental health issues and musculoskeletal disorders. The burden of multimorbidity increases exponentially towards the end-of-life.[6] During the last years of their lives, many older adults are exposed to a greater risk of poor health[7] and a functional decline.[5] Healthy ageing is defined as "the process of developing and maintaining the functional ability that enables well-being in older age".[5] It goes beyond the absence of disease and encompasses other dimensions, such as preserving cognitive and physical functioning and engagement with life, that are the essential part of good quality of life for elderly.

Population ageing carries a higher burden for developing countries compared to developed ones, which highlights the importance of addressing the gap of functional disability particularly for LMICs. Even though the improvement in life expectancy was particularly dramatic in LMICs in the past decades, the gap in life expectancy between the industrialized and the developing countries is still substantial. In 2012, a baby born in a high-income country (HIC) can expect to live on average 17.5 years more than a baby born in low-income country (LIC).[8]

The role of the health and social care system is to enable people to slow down the decline in their functional capacity and promote conditions for improved quality of life and dignified ageing and death.[5,9] The World Health Organisation (WHO) has developed a public-health framework for healthy ageing that shows trajectories of functional ability and intrinsic capacity over the second half of the individual's course of life, and the role of public health strategies (Figure 1). This framework goes beyond the health and social care system and includes broader determinants of healthy ageing and wellbeing of older adults. General trajectories can be divided into three periods: a period of relatively high and stable capacity, a period of declining capacity and a period of significant loss of capacity. Even though people may experience different trajectories when they age, this framework can support design and implementation of public actions aimed at countering the consequences of ageing. In this study, it was used to guide the work focused on health technologies applicable within health and social care system that target issues related to population ageing.

Figure 1: Public health framework for healthy ageing



Source: WHO. (2015). World report on ageing and health. WHO.

The target population of this study is older adults facing declining functional capacity. At this stage, individuals may already have established chronic conditions. The focus of health and social care system interventions should be to minimise the impacts of these conditions in order to slow down the individual's declining capacity. Choosing appropriate interventions requires an understanding of determinants of healthy ageing, cultural diversity, social preferences and available resources.

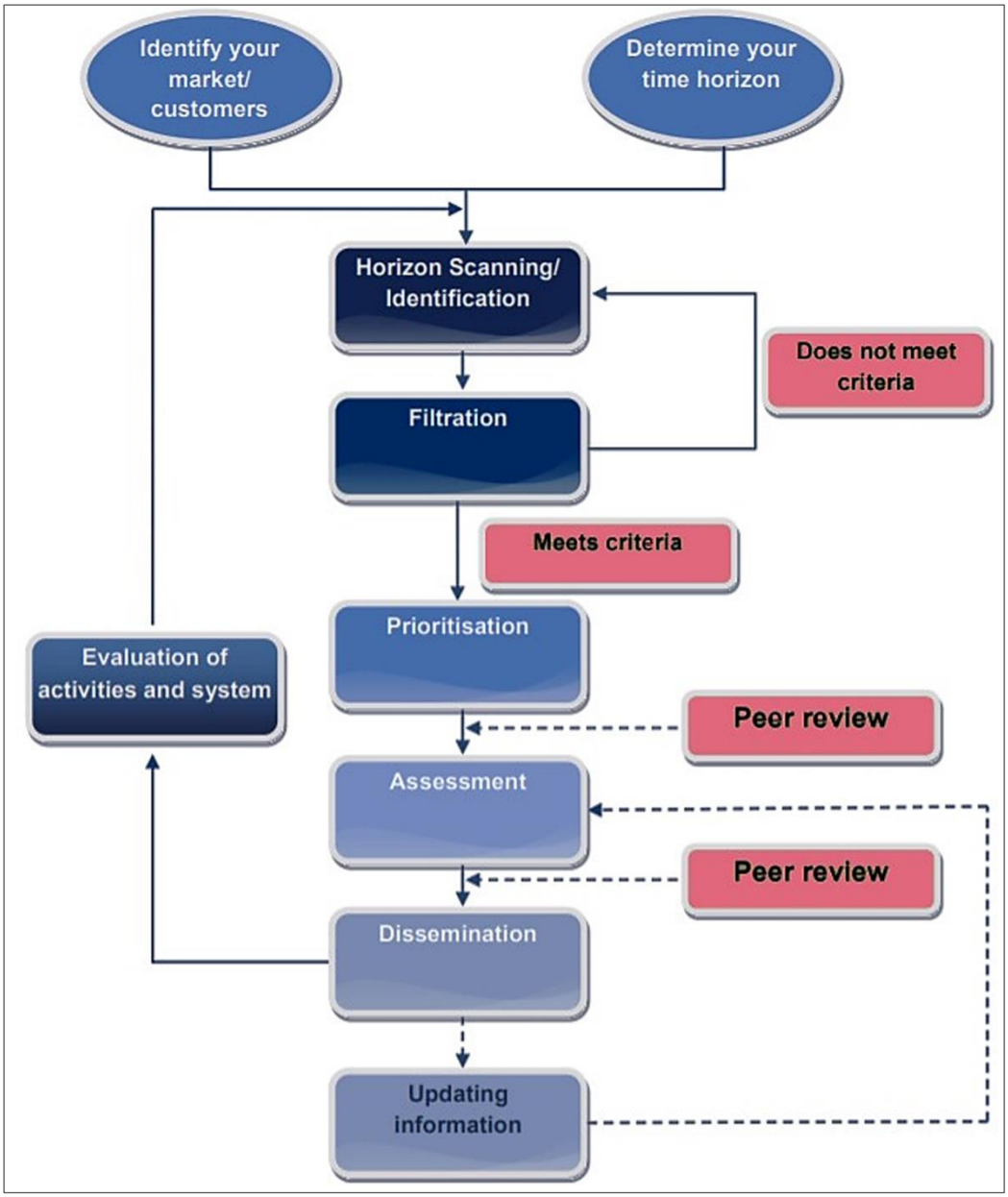
2.2 Importance of prioritisation in horizon scanning

Technological advancement is shaping the future of health care. The continuous growth of new innovations helps people live longer and provides better quality of life as they age. However, despite the growth in innovations, evidence about their possible impact, quality and safety are lacking. Existing innovations and technologies with evidence of efficacy and effectiveness have not yet been fully adopted, particularly in LMICs.

Since the resources for health and social care are finite and technological innovations tend to come at a high price, it is important that funds are directed to areas where they accrue the highest benefit. HTA can assist in this process, as it promotes the systematic evaluation of technologies and interventions in order to inform allocation decisions that achieve greatest health outcomes. Having an established HTA process can assist in evidence-based decision-making, selection and procurement of health technologies, as well as formulating evidence-based clinical practice guidelines and protocols for sustainable public health programs for UHC.[10]

Health care horizon scanning systems and programs, also known as early awareness and alert systems, or early warning systems, “seek to identify, filter and prioritize new and emerging health technologies; to assess or predict their impact on health, costs, society and the health care system; and to inform relevant decision-makers” (Figure 2).[11,12] Health technology includes medications, procedures, devices, diagnostics, medical and surgical interventions and clinical models of care.[11] The role of horizon scanning is to identify health innovations that are likely to have significant impact and to disseminate relevant information in a timely manner, to enable appropriate decision-making, facilitate adoption and identify further research requirements.[13]

Figure 2: Stages involved in horizon scanning process[12]



Source: Simpson S. (2014). A toolkit for the identification and assessment of new and emerging health technologies. Birmingham: EuroScan International Network.

Horizon scanning programs have two main components: 1) identification and monitoring of relevant innovations and 2) evaluation of potential impacts of the identified technologies. Since the available resources are scarce, health care horizon scanning program cannot appraise all identified technologies. Therefore, a prioritisation method needs to be applied to select innovations that are in most urgent need for evaluation.

Different horizon scanning programmes target different groups of health technologies. 90% of the EuroScan member programs consider devices and diagnostics, 80% consider procedures, 70% consider pharmaceuticals, 60% consider programs, and 50% consider health care settings.[14] The general objective of the prioritisation process is to identify the most promising innovations that will be evaluated further. The purpose of the prioritisation is to maximise the benefits using the available budget for HTA. An important part of judging the benefits of an assessment is to identify the benefits that can be expected as a result of the evaluation process. Moreover, these are the benefits that can be expected from the reduction in uncertainty about the effectiveness of a technology rather than only the benefits from using that technology.[15] As an example we consider an emerging technology that has a potential to improve health outcomes at modest cost to a large number of people. The benefit of assessing the technology will depend upon the degree of uncertainty about the actual effects of the technology. If there is little doubt about its cost-effectiveness, there will be little value in assessing it, even though the technology is of substantial value to a great number of people.[15] Therefore, it is more beneficial to assess a technology of lesser value, but associated with greater uncertainty in effectiveness of that technology.

Priority setting involves both quantitative methods and scoring systems, as well as consensus guidelines to ensure accountability and transparency.[16] The process may involve a checklist of explicit or implicit criteria that are applied to assess technologies. The particular technology needs to satisfy certain criteria or achieve a score above predefined threshold to be considered for further evaluation. Prioritisation criteria differ across various programmes and may reflect the differences in type of technologies that are being evaluated, cultural values and the economic environment. An expert panel is usually involved during the process of prioritisation. The final decision on the technologies that will be prioritised can be delegated to the expert panel, horizon scanning group or the organisation that is hosting horizon scanning programme.

This report focused on health technologies that can adequately support individuals that experience a decline in their functional and intrinsic capacity. It included those that promote healthy ageing, those that help older people with multiple chronic conditions to maintain functional ability, as well as innovations that help older people

with significant loss of capacity to improve physical functioning and mobility, and promote social participation. Innovations may also include organizational and social changes that promote better quality care, self-sufficiency or community participation. Technologies are intended to be applied within country's health and social care system to improve people's health. To address the technologies in the scope of this report, we aim to build on the existing approach and criteria that are used across different horizon scanning systems. By exploring characteristics of target population and technologies that target challenges of population ageing, we have collated a list of additional, more specific criteria for prioritisation of such topics for HTA, as opposed to general criteria for carrying out the HTA. These criteria were used to perform a prioritisation exercise creating a list of health technologies that can help people preserve their functional capacity, focusing not only on resource-rich, but also, on resource-constrained environments.

3. Methods

3.1 Literature review of prioritisation criteria for topic selection for HTA

This literature review examines the following research questions:

1. Which criteria have been used to prioritise technologies for the population of older adults;
2. Which factors are important determinants of healthy ageing;

To address these objectives, the ICL team performed a rapid review of peer-reviewed and grey literature in order to identify existing prioritisation criteria applicable to emerging health technologies that tackle problems of ageing populations. Relevant articles were identified and retrieved from electronic searches of major medical databases including MEDLINE, EMBASE™ and the Cochrane Library. To supplement this, the team conducted targeted searches using Google search engine and Google Scholar. Additionally, references in key papers were checked and reviewed to ensure that all relevant papers were included. The searches were restricted to title and abstract level and papers published in the English language. The searches covered the period from January 1st 2000 to September 1st 2017. Search terms were designed based on AHRQ report[14] and relevant systematic reviews which target elderly population[17, 18] (Table 1).

Table 1: Search terms

Concept	Search statement
1. Horizon scanning	Health technology assessment Early awareness Horizon scan* Scenario planning Technology roadmapping
2. Prioritization / decision-making	Priorit* Priority-setting Criteria Decision-making
3. Older adults	Older adult* Old people Palliati* Terminal* Frail* End of life* Geriatric* Elder* Old*

Notes: "*" *Truncation symbol*

Studies were selected based on predefined criteria (Table 2). Inclusion and exclusion criteria were developed on the basis of previous studies[14] and expert opinion of the ICL research team.

Table 2: Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
Study population was the population of older adults	Study population did not include population of older adults
Studies that described or evaluated the process of prioritisation and decision-making for the population of older adults	Studies that were not technology-focused studies
Studies that provided information required for understanding the important aspects and factors of healthy ageing	Studies published before year 2000
Studies that described or evaluated factors that influence adoption of technologies designed for the population of older adults	
Studies that have used qualitative, quantitative, mixed method or literature review research	
Studies published in English	
Studies that included human subjects	
Full studies available	

The review focused on criteria for the prioritisation of topics for HTA relevant for the population of older adults in the context of country's health and social care system. The aim was to document criteria that have been used to prioritise technologies in the scope of this review and investigate important aspects of healthy ageing to inform future prioritisation process tailored to the health technologies for the population of older adults. When multiple studies of the same programme or process were available, the latest version or version that contained data not reported in other studies was used as the primary information source. Slides, abstracts, and other grey literature were considered for inclusion if 1) the material was from a credible source; and 2) provided sufficient information about the aspects investigated in this review. Extracted information includes objectives, methods, setting, and results. Results were focused on prioritisation criteria and prioritisation process or, if not available, on determinates of healthy ageing, relevant for our target population.

Additionally, a review of horizon scanning systems was performed to additionally examine prioritisation criteria and processes that have been used to prioritise emerging health technologies. This work built on the existing review conducted by AHRQ[14] which provides a comprehensive overview of the scanning methods by 2011. Websites of EuroScan[19] and The International Network of Agencies for Health Technology Assessment (INAHTA)[20] were searched to identify existing horizon scanning systems and to update the findings from 2011. Websites and supporting documents of identified horizon scanning programmes were searched and information on the purpose of the process, stakeholders, target technologies, prioritisation criteria and prioritisation process was extracted. Findings from this phase gave insight into the prioritisation of emerging technologies and provided a valuable input in designing and validating the prioritisation criteria for the innovations that target population of older adults declining in their functional capacity.

3.2 Identification of technologies

Developed criteria were applied to the Horizon Scan Roundup – a compilation of new and emerging health technologies from around the world gathered by the CADTH. This compilation was used as an example database of emerging technologies as it contains a publicly available collection of recent emerging technologies. Similar databases that target only resource-constrained environments

are not available. Also, a more comprehensive database - EuroScan has a restricted access enabling use of resources only to members of their international network. For these reasons the CADTH database was chosen, in agreement with the WKC, to conduct the prioritization exercise given the short time period available.

The CADTH database includes 66 technologies which were identified in the late 2016 and the first six months of 2017 from 12 major international horizon scanning services and selected health organizations recognized for their identification of innovative technologies. Information regarding specific timeframe is not available. Organisation websites that were included in the search are: CADTH (Canada), Cleveland Clinic Innovations (US), ECRI Institute (US), Health Policy Advisory Committee on Technology (Australia), Institute for Safety, Compensation and Recovery Research (Australia), The King's Fund (UK), Technology Assessment Unit of the McGill University Health Centre (Canada), National Institute for Health and Care Excellence Medtech Innovation Briefings (UK), National Institute for Health Research Diagnostic Evidence Co-operative Horizon Scanning Programme (UK), National Institute for Health Research Innovation Observatory (UK) and University of York Science and Technology Studies Unit (UK). The focus of this compilation was restricted to non-drug medical technologies including medical devices, laboratory tests, biomarkers, programs and procedures. Majority of these health technologies are approved and used in the originating country although not in widespread use across other health and social care systems.

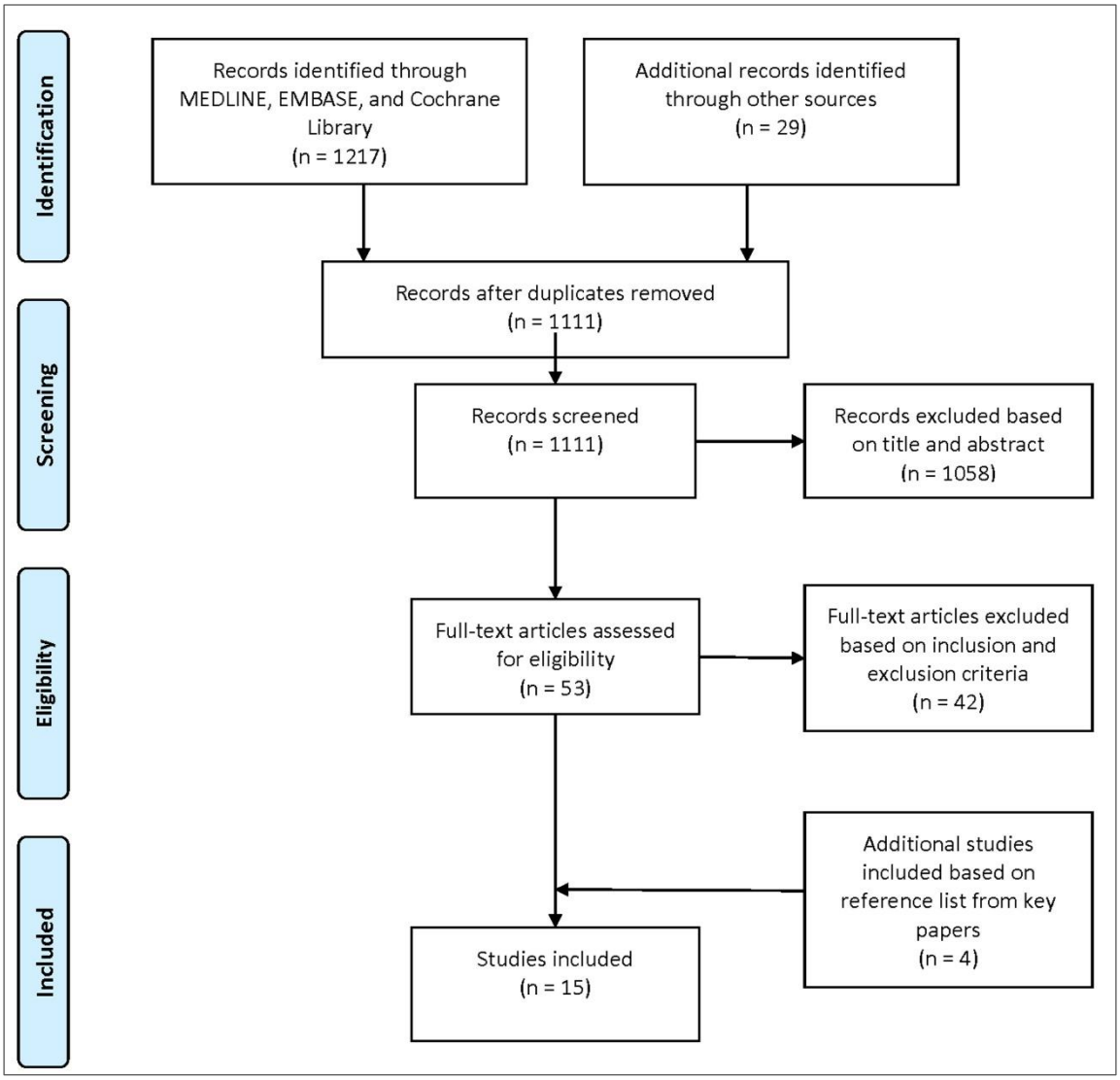
All 66 technologies identified by CADTH were reviewed by researchers from ICL in order to filter technologies relevant for the target population. As a result, 25 technologies were included in the prioritization exercise. Finally, these 25 technologies were examined against criteria designed for the population of older adults. Each element of criteria groups was examined in relation to the technology of interest. If the information provided in the health technology summary satisfied at least one criterion in each criteria group, that criteria group was considered satisfied (Appendix 3). The criteria served as a checklist to validate the health technology and to make decisions on individual segments of the technology, enabling easier comparison and ranking.

4. Results

4.1 Selection procedure and characteristics of selected studies

In total, 1217 studies were found by searching electronic databases (Figure 3). Additional 29 studies were identified through a search of the grey literature. Title and abstract of 1111 unique studies were screened and 53 articles were shortlisted for full-text examination. 42 studies were excluded based on inclusion and exclusion criteria. Further, the reference list of 11 studies that satisfied predefined criteria was examined and 4 additional studies were included in the final step, giving a total of 15 studies included in the review.

Figure 3: Flow diagram of the article selection process



Source: Designed by authors.

The literature on the prioritisation of technologies for the population of older adults is scarce. In this review, we did not identify any horizon scanning programme or system specifically designed to detect emerging technologies for the target population. This required investigation into prioritisation of technologies for the population of older adults in general terms, to address the objectives of this review and to identify relevant factors that may assist in the future formation of horizon scanning system tailored to the needs of the study population. The majority of studies included in this review were referred to developed countries, except few studies which also included developing countries.[21-23] Six studies were literature reviews[21-26], five applied qualitative methods[27-29] using expert interviews or focus groups interviews and two used a combination of qualitative and quantitative research methods[30, 31]. Two studies[32, 33] did not apply traditional methodological approach, but presented policy discussions and valuable insights around the objectives of this study. Additional information about these studies is presented in the Appendix 1.

4.2 Prioritisation criteria for the population of older adults

Studies included in the review have been used to collate a list of prioritisation criteria for topic selection for HTA for the population of older adults declining in functional capacity (Table 3). The framework presented in Golan et al. (2011)[34] was utilized to group individual criteria identified in the literature. That framework was designed based on prioritisation criteria of existing horizon scanning systems, but can also be used to guide grouping of prioritisation criteria for technologies. Included criteria outline factors that have been highlighted as important determinants of healthy ageing. Criteria are grouped into eight categories: need, clinical benefit, cost, evidence base, equity and equality, personal wellbeing, patient autonomy, and culture.

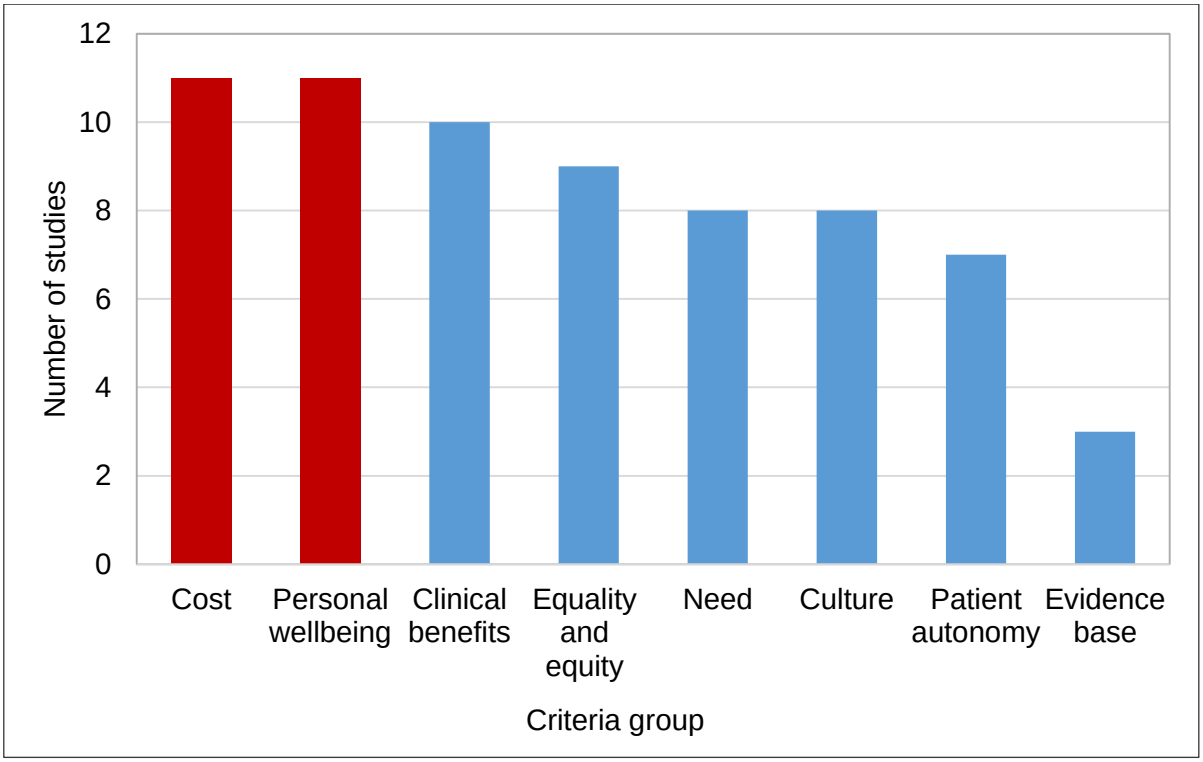
Table 3: Prioritisation criteria for topic selection for HTA for the population of older adults

Criteria group	Criterion	Definition	Number of studies that included criteria	Number of studies that included criteria group
Need	General	Need in terms of the number of patients and burden of disease	8[21, 24, 26, 28, 30, 33, 35]	8
	Availability of alternatives	Availability of alternative technologies or care from their family/carers	2[24]	
Clinical benefits	General	Expected clinical benefit of the technology	9[21, 24-27, 30, 32, 36]	10
	Increased safety	Increased ability to manage risk associated with current health condition(s)	5[21, 24, 25, 33]	
	Perceived usefulness	Degree to which an individual believes that using a particular technology would enhance his or hers overall health	6[21, 24, 27, 33, 36]	
Cost	Implementation costs	Cost of setting up a technology	10[21, 22, 24-26, 28, 30, 32, 33, 35]	11
	Training costs	Costs required for education of health professionals and patients to adopt and properly utilise particular technology	6[22, 24, 26, 28-30]	
	Time for implementation and dissemination	Time as a resource required to fully implement and disseminate technology to intended users	1[26]	
Value for money	Cost-effectiveness evidence	Availability of cost-effectiveness evidence of sufficient standard	3[22, 30, 33]	3
Equality and equity	Accessibility of care	Availability of required care when needed to every individual who requires it and securing adequate comprehensive care	7[22, 23, 25, 28, 31, 35, 36]	9
	Securing equal	Securing equal access to care across genders, ages and	7[22, 23, 25, 28-30, 35]	

	access to care	disabilities		
	Principal of human dignity	Individual's right to decent minimum of support and health care	2[22, 30]	
Personal wellbeing	General	General wellbeing and quality of life	10[21, 23, 25, 27, 30-33, 35, 36]	11
	Enabling communication	Enables social interaction with individual's social network	6[21, 24, 25, 33, 36]	
	Supporting independence	Retaining of functional ability in everyday life	7[21, 23-25, 27, 33, 36]	
	Enabling to age in place	Providing sufficient support to enable good quality of life in individual's preferred place	4[21, 23, 24, 36]	
	Reduced burden on family and caregivers	Individual's satisfaction that comes out of the perception of not being burdensome to his or her family and caregivers	3[21, 23, 24]	
Patient autonomy	Ease of communication	Clarity of communication with medical professionals regarding their care	5[21, 25, 28, 31, 36]	7
	Participation in decision-making	Degree of autonomy in making decisions regarding care	5[21, 25, 26, 31, 33]	
Culture	Cultural beliefs and expectations	Societal values and expectations regarding older adults and ageing in general	4[21, 23, 24, 35]	8
	Propensity to accept new technology	Willingness to embrace new technology in everyday life	2[21, 24]	
	Personal preferences	Preferences regarding desired ageing and care pathway	5[21, 23, 27, 33, 36]	
	Health literacy and consumer skills	Familiarity with available alternative interventions and familiarity with electronic technology	4[21, 24, 26, 35]	

According to this review, the most frequently mentioned criteria encompass factors relevant to the cost of technology (11 studies) and the personal wellbeing (11) (Figure 4). In contrast, the least attention was given to the evidence-based criteria group (3). The reason may be that evidence-based considerations are conducted prior to prioritisation phase, such as filtration where candidate interventions have been previously screened.

Figure 4: Relevance of criteria groups for older adults



Source: Designed by authors.

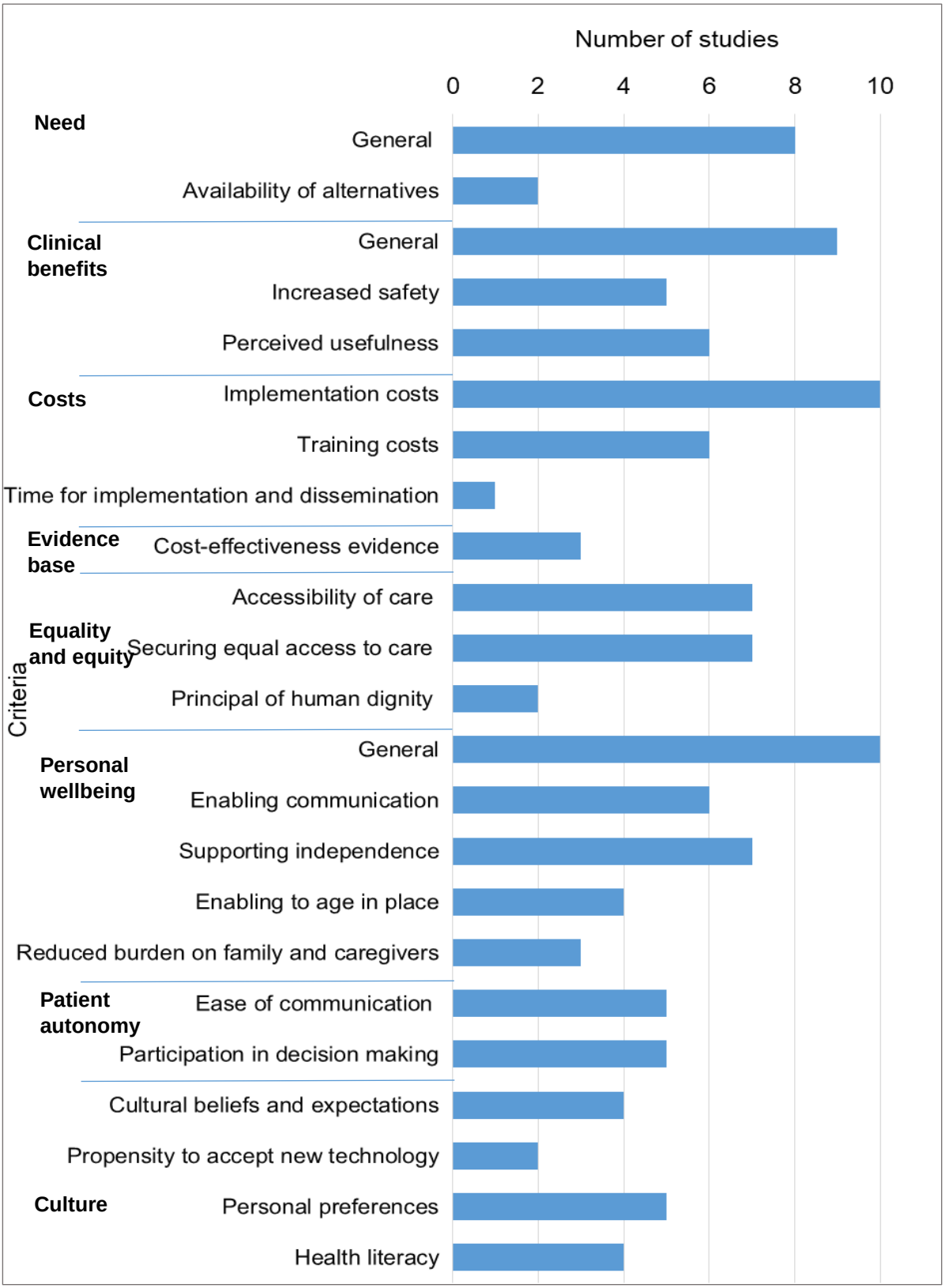
The groups that contain the most criteria emphasised in the studies are personal wellbeing (5) and culture (4), indicating their complexity and the importance of these categories for the population of older adults (Figure 5). The personal wellbeing group includes the following criteria: general wellbeing in a sense of achieving and maintaining good quality of life and living comfortably and happily, communication in terms of enabling social interaction and preventing isolation and stigmatisation, independence as the ability to maintain functional ability in completing everyday tasks, ability to age and live in the preferred place and reduced burden on people who surround them in terms of material and emotional burden.

The culture group includes cultural beliefs and expectations, highlighting the relevance of environment in choosing particular technology and propensity to accept new technology which adds on the previous criterion. These include social opinion and expectations about the role of technology, personal preferences regarding ageing and health literacy as an important component for implementing and achieving the effectiveness of intervention.

Another criteria group that is specific for the target population is patient autonomy, which encompasses participation in decision-making and ease of communication with health professionals regarding care received by the individual. The relationship between physician and the patient is a cornerstone of medical provision. Usually, the physician acts on the behalf of patient and determines the package of care. In general, although less informed than the physician about the possible care options, the patient is considered as a competent individual, fully capable to make independent choices. For older patients, however, this relationship may become more complicated as terminally ill or frail patients may experience high levels of dependency which can limit their sovereignty in decision-making. In such instances family members and carers may become proxy decision-makers to represent the patients' interest. Therefore, any technologies or interventions for the target population should consider the aspect of patient empowerment in order to support individuals' self-esteem and coping skills to manage the physical, emotional and social impacts of ageing in everyday life.

The criteria outlined in this section are specifically tailored for the needs of older adults experiencing a decline in functional and intrinsic capacity. The above outlined criteria are built on traditional criteria such as needs, clinical benefits or quality of evidence base, while also emphasising the characteristics of the targeted population.

Figure 5: Prioritisation criteria for topic selection for HTA for the population of older adults



Source: Designed by authors.

4.3 Comparison with general prioritisation criteria

The prioritisation criteria identified in the previous section were examined against the prioritisation criteria of identified horizon scanning programmes. This was used to examine the alignment of general and our topic-specific prioritisation criteria.

Our rapid review identified 19 formally established health technology horizon scanning programmes. Out of the 19 horizon scanning programmes, 14 are members of the EuroScan. Our search focused on the prioritization criteria and processes established by these programmes. The prioritization criteria are listed in Figure 6 and grouped based on the framework presented in Golan et al. (2011)[34]. Listed prioritization criteria provide guidance for the review of technologies for the general population. There are 8 groups of criteria: need, appropriateness, clinical benefit, efficiency, equality, ethical and social values, legal impact, organizational impact, quality of evidence and timing.

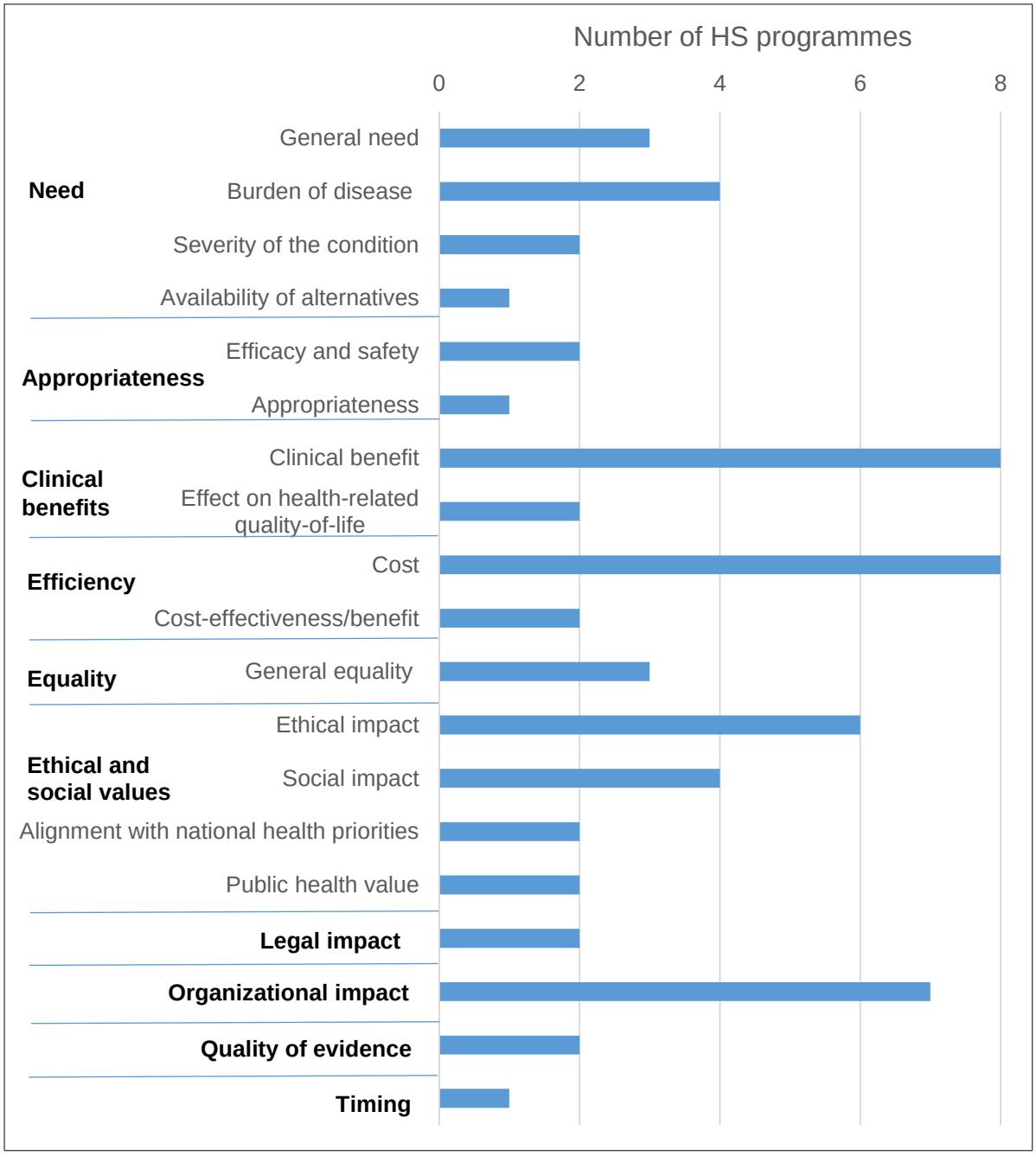
"Need" is defined in terms of the degree of ill health in general population and the availability of alternatives. *"Appropriateness"* incorporates patient's capacity to benefit from treatment. "*Clinical benefit"* refers to the degree that particular technology can relieve the symptoms and improve health outcomes. *"Efficiency"* encompasses the benefit of technology per given monetary unit. *"Equality"* refers to accessibility of technology to everyone in general population. *"Ethical and social values"* incorporate a range of common egalitarian considerations such as ethics, impact on minorities or other vulnerable groups in society, and wider social impact. *"Legal impact"* refers to any potential legal impact and issues with regard to the use of the technology. *"Organisational impact"* refers to the impact of technology on the organization of care provision, including formal structure changes and staff training. *"Quality of evidence"* includes available documentation that demonstrates effectiveness and overall impact of technology. *"Timing"*, mentioned only in one horizon scanning programme[37], considers prioritization of health technologies deemed to be emerging into the health system within a three year time horizon.

Different horizon scanning programmes use similar criteria, and the most frequent were clinical benefit (8), cost (8), organizational (7) and ethical impact (6). Three

major groups of criteria (need, clinical benefits and efficiency) are all equally represented with 10 horizon scanning programmes in each, indicating that there are similar principles guiding prioritization decisions across the horizon scanning programmes. Ethical and social values group was represented in majority of horizon scanning programmes with some programmes having more than one criteria from this group. This indicates that even on general level, horizon scanning programmes include special considerations to ensure equal and equitable access to health care for entire population. However, 8 horizon scanning programmes did not explicitly specify the set of prioritization criteria, but rather used some form of expert committee or board to lead the process. Additional information about the identified horizon scanning programmes is presented in Appendix 2.

In comparison to our topic-specific prioritisation criteria, both the cost and the clinical benefit were important factors to prioritise a particular technology. This indicates the importance of considering these factors during the prioritisation process in horizon scanning. Most of the general prioritisation criteria are to some extent included in the criteria specific to older adults, except legal and organisational criteria. Some aspects that are particularly important for the population in scope of this report, for example personal wellbeing, equal and equitable access to care, and culture, are not appropriately represented in the general criteria. Therefore, some innovations that might have significant impact for improving the lives of older adults, may be missed out under general prioritisation of technologies. This highlights the importance of utilising topic specific criteria to appropriately address the needs of older adults.

Figure 6: Horizon scanning programmes prioritization criteria



Source: Designed by authors.

4.4 Prioritisation process for selecting HTA topics

Prioritization process can be conducted in several ways, depending on available resources, transparency and members involved.[12] According to EuroScan, several prioritisation methods have been identified: 1) prioritisation without use of criteria, 2) prioritisation with explicitly defined criteria, 3) scoring tools, and 4) statistical methods.[12]

- ***Prioritisation without use of criteria*** – The process of prioritisation is not based on explicitly defined criteria, but rather the staff involved in horizon scanning prioritises technologies based on their expertise and prior knowledge of other technologies and policy related priorities. Our review identified several horizon scanning programs using this approach including the Institut national d'excellence en santé et en services in Canada and German Agency for HTA (DAHTA).[38, 39]
- ***Prioritisation with explicitly defined criteria*** – The prioritisation is based on previously defined criteria that a technology must meet in order to be prioritised for further evaluation. Our review identified that this is the most commonly used approach among existing horizon scanning systems, including the Agency for Care Effectiveness (Singapore)[40], the Swedish Agency for Health Technology Assessment[41] and the Assessment of Social Services and Health Policy Advisory Committee on Technology (Australia)[37].
- ***Scoring tools*** – The process can be carried out by allocating values to technologies where only those that score above or below certain threshold, will be put forward for further evaluation. Scoring scale is usually developed by the team of experts that can be formed within horizon scanning programme or delegated to an outside organisation. Generally speaking, this process if applied systematically, can lead to more transparent and more reliable decision-making process.[42] According to our review, the Health Technology Assessment Section, part of the Ministry of Health in Malaysia, is the only agency that uses this method.[43]
- ***Statistical methods*** – The method called Best Worst Scaling (BWS) has been documented in the literature to been applied to early awareness and alert activities. It is a discrete choice experiment that explores members views

involved in the prioritisation process on emerging technologies. Our review did not identify any programme using this method.

Very often agencies use a combination of methods to perform a prioritisation. For example the combination of pre-defined prioritization criteria and a scoring tool are one of the most common approaches. For example, this approach is used by Agencia de Evaluación de Tecnologias Sanitarias in Spain[44] and the Agency for Regional Healthcare in Italy[45]. Also, in the absence of scoring methods, Delphi method is used to generate consensus using existing priority criteria.

Based on the literature, construction of a set of prioritization criteria is recommended approach to be used for prioritisation. This ensures systematic approach and transparency in decision-making[34]. The time horizon of the scanning is usually around 2 to 3 years before the technology becomes available on the market. Very often drugs are excluded from the target technologies of the horizon scanning programme.

4.5 List of technologies

Following the review of 66 technologies identified by CADTH, 25 technologies were found to be applicable to the target population and were included in the prioritization exercise. Available summaries of 25 health technologies were reviewed as part of the prioritization process. Summaries contained information about the use of health technologies, their effectiveness, cost and implementation process. These technologies are approved and in use in the country of origin although not widely available in other health and social care systems. The criteria developed for the population of older adults were applied to these technologies in order to compare them and make recommendations on which ones should be included in the next step of the horizon scanning process. The criteria were used as a checklist to examine whether individual segments of the technologies meet the goals of criteria applied. This resulted in 2 technologies meeting 6 criteria, 4 technologies meeting 5 criteria, 4 technologies meeting 4 criteria and the remaining 11 technologies meeting 3 criteria or less. All selected technologies satisfied the criteria of clinical benefits, personal wellbeing and need. Since there are no weights associated with any of the criteria, we decided to prioritise technologies that meet 5 criteria or more. Prioritised health

technologies are presented in table 4. Additional information about examined technologies can be found in Appendix 3.

The 6 highest ranked technologies differ in indications. They are mostly medical devices for treatment or diagnosis, but also include 1 surgical procedure. Each of these technologies can be used to improve quality of life of older adults in both resource-rich and resource-constrained environments. Depending on the country's capacity, health priorities and available budget, different technologies may be selected. Even though the information regarding the cost of technology was limited, 2 health technologies (Bindex for investigating suspected osteoporosis and Outpatient (Same-Day) Total Hip Replacement) seem to be the least cost intensive and therefore the most suited for the LMICs.

Table 4: List of prioritised health technologies

Technology	Description	Number of met criteria
Bindex for investigating suspected osteoporosis	A portable pulse-echo ultrasound device used to help make decisions on the investigation and treatment of osteoporosis.	5
Flash Glucose Monitoring System for Diabetes	The FreeStyle Libre Pro is a glucose monitoring system intended to replace finger-stick tests; it uses a sensor implanted in the arm that a health care provider scans with a specialized reader for a record of glucose levels, trends, and patterns in people with diabetes.	5
A Hybrid Closed-Loop Insulin Delivery System for the Treatment of Type 1 Diabetes	The MiniMed 670G is a wearable medical device that uses a computer program to automatically adjust insulin levels throughout the day.	6
Portable neuromodulation stimulator for multiple sclerosis	The Portable Neuromodulation Stimulator (PoNS) provides painless electrical impulses to the tongue to help improve balance and walking in people with advanced multiple sclerosis.	5
Outpatient (Same-Day) Total Hip Replacement	Total hip replacement is a widely used procedure that can alleviate pain and disability in people with hip disorders such as osteoarthritis Outpatient hip replacement requires a multidisciplinary team approach that includes careful patient selection, patient education, improved anaesthesia and analgesia, advanced surgical techniques to minimize muscle damage and blood loss, early mobilization, intensive physical therapy, and the involvement of caregivers at home.	6

Spinal cord stimulation to improve function following spinal cord injury	Spinal cord stimulation is a new non-invasive spinal cord stimulation strategy that involves electrically activating the spinal cord using the NeuroRecovery Technolgies, Inc. proprietary prototype device.	5

5. Discussion

In this review we attempted to develop prioritisation criteria for topic selection for HTA aimed at health technologies that tackle challenges of population ageing applicable within countries' health and social care systems. The proposed criteria reflect the needs of the population of older adults who experience decline in their physical and intrinsic capacity, and present factors that have the potential to influence further acceptance and adoption of new technologies. Criteria are grouped into 8 categories: need, clinical benefit, cost, evidence base, equity and equality, personal wellbeing, patient autonomy and culture. These criteria were applied to filtered 25 technologies identified by CADTH in order to perform a prioritisation exercise and demonstrate the process. The aim was to identify the most promising innovations for the target population from the CADTH's compilation of technologies that can be evaluated further through the HTA process. The exercise resulted in 6 technologies that are recommended for prioritized evaluation. These technologies have the greatest potential to improve quality of life of older adults that experience functional decline in both developed and developing countries.

Studies included in this review defined technologies in accordance with the World Health Assembly (WHA) definition for health technologies[1] and included a range of categories from medical devices, pharmaceuticals, procedures and processes developed to improve patients health outcomes and quality of life. This ensures that proposed criteria can be applied to all technology categories as defined by the WHA. The strength of this review is grounded in comprehensive search strategy, covering databases in the fields of health care, technology and social science, as well as grey literature and Google search engines. This systematic and multidisciplinary approach is also reflected in the review of horizon scanning programmes, which was conducted to supplement finding from the literature and provide additional insights into prioritisation criteria and process. Also, this proved to be valuable to compare and validate our topic-specific criteria with general prioritisation criteria used by various horizon scanning programmes. We found that most of the general prioritisation criteria were also present in our topic-specific criteria. This provides assurance that criteria proposed for the population of older adults encompass general prioritisation principles as well as the aspects particularly important for the

target population. Developed criteria were applied to the compilation of emerging technologies to demonstrate the prioritisation process.

However, the conducted review has several limitations. Our review included only materials published in English language. Publications in English tend to be focused on high-income countries and on well-established horizon scanning programmes. Further, since many horizon scanning programmes of non-English speaking area publish documents in native language, some important information may be missed out. Therefore, the findings of this review could be biased towards developed countries and horizon scanning programmes for English speakers. The literature on prioritisation of technologies for older adults is scarce, especially the literature focusing on LMICs. This required examining not only existing prioritisation criteria applicable to target population, but also other factors and determinants of healthy ageing that may be relevant for the prioritisation process. Since the horizon scanning did not receive much attention in LMICs, some important aspects may not be reflect in compiled criteria. Further, this study built upon existing horizon scanning programmes and focused on health technologies applicable within country's health and social care system, so some cutting edge and potentially significant technologies developed for other, non-medical purposes with important applications to health may have been overlooked. Initially criteria were set to be applied to EuroScan database. Unfortunately, the database became available to EuroScan members only, preventing us from using it for the prioritization exercise. The CADTH's compilation of technologies was used as an alternative, even though the amount of resources included is significantly lower than in the EuroScan database. As a result, this compilation of health technologies is focused more on technologies that target acute health conditions. Therefore, innovations that target chronic health condition, which present significant burden to older people, are not appropriately represented. A wide range of scanning sources is necessary to ensure adequate coverage of all types of technologies. In that way, it is possible to identify innovations developed outside of the health sector which might have an important public health impact.

In each horizon scanning programme, the expert panel has an important role. Usually, it is comprised of individuals of various backgrounds and they have the knowledge of country's health priorities and population needs. The list of technologies presented in this report was compiled by the expert team at ICL. It is

important to acknowledge that even though this prioritisation was guided by the evidence identified in the literature, each setting has its own requirements and therefore the final selection of technologies should be informed by the expert committee that have the specific knowledge of the setting where these technologies will be applied. Criteria that were applied to the selected set of technologies all had equal weights and were not associated with any scoring system, even though all prioritised technologies satisfied criteria of clinical benefits, personal wellbeing and need. In the future, expert panel could be involved into gauging the individual criteria and exploring the role of scoring system for the formalisation of the prioritisation process. LMICs experience various issues with implementations of new technologies, such as high cost of technology and affordability issues, underdeveloped infrastructure, lack of trained personnel and lower health literacy.[21,23,46] These issues are also present to some extent in developed countries, but present higher barrier for LMICs. Therefore, technologies aimed for LMICs should be carefully assessed against criteria related to these issues and the final selection should be made by LMIC's specialist that has the insight into national prioritises and available funds. Overall, the compiled criteria reflect the specific needs of the population of older adults and are applicable across different settings. These can be used to guide the future horizon scanning process for technologies in scope of this review. Technologies prioritised for further evaluation should be aligned with national health priorities.

6. Conclusion

Comprehensive public-action is needed to address the challenges of population ageing. Preparing for an ageing population is integral to the achievement of many of the sustainable development goals, ensuring healthy lives and promoting well-being at all ages regardless of their gender, age or wealth. The aim of this report was to identify criteria for topic selection for HTA tailored to the needs of older adults that are experiencing declining capacity, and perform a prioritization exercise of relevant emerging technologies.

Literature review identified a set of criteria grouped into following groups: need, clinical benefit, cost, evidence base, equity and equality, personal wellbeing, patient autonomy and culture. Proposed criteria were used to perform a prioritisation exercise and broadly identify innovations using the CADTH's compilation of new and emerging health technologies. Six health technologies were identified for prioritization for HTA, and found to have potentially the greatest impact on preserving and improving the functional and intrinsic capacity of older adults. This database was used as an example database and the developed criteria can be applied on other information sources that collect data on emerging technologies, both in developed and developing countries.

This report was prepared to foster discussion and collaboration between WKC and international partners on countering the challenges of population ageing while striving to achieve UHC. This report documented literature findings and presented criteria that can be used to inform the future prioritisation process for older adults who experience declining capacity. Next steps could include collaboration with expert panel to define key public health problems of the population of older adults with most urgent need for innovation. This can help further refine the criteria by introducing a scoring or weighting system. Also, as the prioritization exercise focused on innovations within a health and social care system, further work could focus on identifying alternative sources of potentially significant medical and non-medical technologies. This could lead to the development of a common list of valuable information sources. Also, this would ensure that technologies developed for other, non-medical purposes, could be identified, thereby increasing the comprehensiveness and the efficiency of scanning process.

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Appendix

Appendix 1 – Review tables of included studies

Title	Objective	Methods	Setting	Results
Heyland 2010 - Defining priorities for improving end-of-life care in Canada[31]	To identify aspects of end-of-life care that are high in priority as targets for improvement using feedback elicited from patients and their families.	A multicentre, cross-sectional survey involving patients with advanced, life-limiting illnesses and their family caregivers. They used the Canadian Health Care Evaluation Project (CANHELP) questionnaire along with a global rating question to measure satisfaction with end-of-life care. They derived the relative importance of individual questions on the CANHELP questionnaire from their association with a global rating of satisfaction, as determined using Pearson correlation coefficients. To determine high-priority issues, they identified questions that had scores indicating high importance and low satisfaction.	Canada	Items for the questionnaire were generated based on literature review, focus groups of experts and patient interviews. These were grouped in the following domains: characteristics of the doctors and nurses (8 items), illness management (7 items), health service characteristics (4 items), communication and decision-making (11 items), relationships with others (4 items), and spirituality and meaning (3 items) From the perspective of patients, high-priority areas needing improvement were related to feelings of peace, to assessment and treatment of emotional problems, to physician availability and to satisfaction that the physician took a personal interest in them, communicated clearly and consistently, and listened. From the perspective of family members, similar areas were identified as high in priority, along with the additional areas of timely information about the patient's condition and discussions with the doctor about final location of care and use of end-of-life technology.

Peek 2014 - Factors influencing acceptance of technology for ageing in place: A systematic review[24]	To provide an overview of factors influencing the acceptance of electronic technologies that support ageing in place by community-dwelling older adults. Since technology acceptance factors fluctuate over time, a distinction was made between factors in the pre-implementation stage and factors in the post-implementation stage.	A systematic review of mixed studies. Seven major scientific databases (including MEDLINE, Scopus and CINAHL) were searched. Inclusion criteria were as follows: (1) original and peer-reviewed research, (2) qualitative, quantitative or mixed methods research, (3) research in which participants are community-dwelling older adults aged 60 years or older, and (4) research aimed at investigating factors that influence the intention to use or the actual use of electronic technology for ageing in place.	Not mentioned	Sixteen out of 2841 articles were included. Most articles investigated acceptance of technology that enhances safety or provides social interaction. The majority of data was based on qualitative research investigating factors in the pre-implementation stage. Acceptance in this stage is influenced by 27 factors, divided into six themes: concerns regarding technology (e.g., high cost, privacy implications and usability factors); expected benefits of technology (e.g., increased safety and perceived usefulness); need for technology (e.g., perceived need and subjective health status); alternatives to technology (e.g., help by family or spouse), social influence (e.g., influence of family, friends and professional caregivers); and characteristics of older adults (e.g., desire to age in place). Quantitative results showed that a small number of variables have a significant influence in the pre-implementation stage.
Normand 2012 - Setting priorities in and for end-of-life care: challenges in the application of economic evaluation[32]	It is argued that the assumption that units of time of different quality of life can simply be added to assess the overall experience at the end of life may not apply, and that alternative perspectives, such as the Peak and End Rule, might offer useful perspectives.	Not mentioned	Not mentioned	As the programmes of evaluation and priority setting in end of life care develop, it is becoming more important to have tools and approaches to measurement that are fit for purpose and enable identification of benefit. It may be more feasible in the short run to develop outcome tools that are useful in setting priorities within palliative care, and then to try to calibrate these against the metrics commonly used in other contexts. The comparisons of evidence that use different measurements and metrics can be helped using approaches and ideas discussed by Petrillo and Cairns (2008), where the approach is to make comparison between outcomes of different metrics rather than to use a single set of metrics in evaluation.

Sixsmith 2000 - Smart care technologies: meeting whose needs?[33]	This paper outlines some of the conceptual, methodological and practical problems that potentially constrain a needs-led approach and illustrates the emergent issues with a case study of the development of an intelligent home monitoring system to support the independent living of older people.	They describe the example of the development of an intelligent monitoring system to illustrate some of the factors that may constrain the way that technologies are developed.	Not mentioned	In general, the development of telecare and assistive technologies has been based on a fairly limited view of user needs and, in particular, there has been a focus on instrumental factors, such as mobility, communication, physical and sensory deficit and ability to perform activities of daily living. While these are obviously important considerations, technological solutions must adequately account for the full complexity of human experience if they are to be useful. One way to achieve this is to include the user early-on, in the development stage.
Marengoni 2016 - Strategies to Improve Medication Adherence in Older Persons: Consensus Statement from the Senior Italia Federanziani Advisory Board[26]	To provide recommendations from the scientific advisory board on adherence to treatment	In September 2014, a European group of experts in the field of multimorbidity, geriatric pharmacology, and medication adherence were invited by Senior Italia Federanziani to form a scientific advisory board on adherence to treatment, with special focus on care of older adults. A modified RAND appropriateness method was adopted, combining the best available scientific evidence with the collective judgment of the experts as follows.	Europe	The following interventions were identified as relevant: 1. Comprehensive Geriatric Assessment (CGA). 2. Optimization of treatment (reviewing medications and dosage schemes). 3. Use of adherence aids. 4. Patient (and caregiver if needed) education to improve patient empowerment. 5. Physician and other health care professionals' education. 6. Adherence assessment. 7. Facilitating access to medicine by service integration. For each intervention, experts assessed (a) target population, (b) health professionals potentially involved in the intervention, (c) strategies/instruments needed for implementation, and (d) time of the intervention.

Peek 2016 - What it Takes to Successfully Implement Technology for Ageing in Place: Focus Groups With Stakeholders[27]	To provide insight into the positions of stakeholder groups involved in the implementation of technology for ageing in place by answering the following questions: What kind of technology do stakeholders see as relevant? What do stakeholders aim to achieve by implementing technology? What is needed to achieve successful implementations?	Mono-disciplinary focus groups were conducted with participants (n=29) representing five groups of stakeholders: older adults (6/29, 21%), care professionals (7/29, 24%), managers within home care or social work organizations (5/29, 17%), technology designers and suppliers (6/29, 21%), and policy makers (5/29, 17%). Transcripts were analysed using thematic analysis.	Netherlands	Stakeholders considered 26 different types of technologies to be relevant for enabling independent living. Only 6 out of 26 (23%) types of technology were mentioned by all stakeholder groups: health monitoring, assistive technology, home automation, household appliances, computers, and video telephony. All stakeholder groups felt that the implementation of technology for ageing in place can be considered a success when (1) older adults' needs and wishes are prioritized during development and deployment of the technology, (2) the technology is accepted by older adults, (3) the technology provides benefits to older adults, and (4) favourable prerequisites for the use of technology by older adults exist.
Slettebo 2010 - Clinical prioritizations and contextual constraints in nursing homes – a qualitative study[28]	To describe nurses' and physicians' experiences of prioritization factors in nursing homes.	The study was conducted through semi-structured interviews with 13 physicians and nurses in six nursing homes. The interviews were analysed by manifest content analysis based on first- and second-level categories describing relevant factors. The categories were developed after preliminary readings of the texts.	Norway	This study revealed that there was a complex set of contextual constraints which influenced the care provided. There were three main findings: (i) some overall challenges related to providing good care to nursing home residents; these in turn influenced (ii) prioritizing dilemmas and (iii) factors influencing prioritization decisions. Important factors influencing clinical prioritizations were severity and level of acuteness of illness, age in combination with other conditions and the primacy of acute biological and medical needs over psychosocial needs when physicians and nurses are faced with prioritization dilemmas.

Penno 2017 - Change, Connectivity, and Challenge: Exploring the Role of Health Technology in Shaping Health Care for Ageing Populations in Asia Pacific[21]	To assess the current state of development across the region and carry out a review of the literature surrounding the present and future applications of a range of health care technologies and the challenges associated with implementing technology-based initiatives as a core component of this.	A semi-structured review of the literature was conducted to gain an understanding of the scope of development and associated issues surrounding ageing populations and health technology initiatives, with a particular focus on developments in the Asia Pacific region.	Asia Pacific region	The article has highlighted a dearth of robust studies evaluating the effectiveness of various technologies. The lack of evaluative studies is problematic but also an opportunity for the research community, given the considerable hope that policy makers and industry attach to health technologies for transforming how health care for older people is delivered and received.
Mak 2011 - Health care prioritization in ageing societies: Influence of age, education, health literacy and culture[35]	To examine how Chinese people in Hong Kong view health care prioritization and to compare the findings with those from a United Kingdom survey.	A cross-sectional opinion survey was conducted in Hong Kong and 1,512 participants were interviewed.	China	Ranking of priorities between two groups were similar, except that Chinese people value end-of-life treatments less than UK people. In general among Chinese, death is still a taboo subject and even health care professionals may not be comfortable in discussing it openly. As a result there may be much misconception about the importance of these services in achieving a measure of quality of life at the end, or placing importance on the quality of dying. They found that factor that may affect prioritization in any given society include the percentage of elderly people, the level of education or health literacy, and cultural factors determining the status of older people.

Oliver 2014 - Making our health and care systems fit for an ageing population[25]	Report presents evidence and guidance for how to provide high-quality care, with examples of local innovations.	Literature review.	UK	Study identified key components to improve services for older people: - healthy, active ageing and supporting independence - achieving good quality of life - rapid support close to home in times of crisis - good acute hospital care when needed - good discharge planning and post-discharge support - good rehabilitation after acute illness or injury - high-quality nursing and residential care for those who need it - choice, control and support towards the end of life - integration to provide person-centred co-ordinated care.
Peng 2016 - Identifying user requirements of wearable health care technologies for Chinese ageing population [36]	Exploratory study that investigated Chinese older people's user requirements towards wearable health care devices.	Five focus groups were conducted to collect insights and opinions respectively from five Chinese families. Each family participated in the focus group contained at least 1-2 elderly member, together with 2-4 family members who held caring responsibilities. The thematic analysis approach was used to analyse the collected qualitative data.	China	User requirements of Chinese elderly people contained three main categories, namely healthcare, data privacy and security, and commodity and entertainment needs.

Marasinghe et al 2017 - Assistive technologies for ageing populations in six low-income and middle-income countries - a systematic review[23]	To explore if currently available assistive technology (AT) and existing legislation related to AT-provision are sufficient to support 'ageing in place' rather than ageing in institutionalised care homes; facilitate better health for older adults, especially in terms of functioning and independence encourage inclusion and full participation in community activities; and enhance older adults' overall well-being and quality of life.	A systematic approach was taken to conduct the systematic review. The search strategy aimed to retrieve literature in English language that focused on AT to assist older populations (60 and above). Databases searched were MEDLINE (1950 to 2014), EMBASE (1980 to 2014), Scopus (1966 to 2014) and Cochrane Library (1996 to 2014).	Brazil, Cambodia, Egypt, India, Turkey and Zimbabwe	The systematic review retrieved 17 relevant studies; four studies related to AT in Brazil, seven related to India, three related to Turkey and one study per each country for Cambodia, Egypt and Zimbabwe. AT for ageing populations have received some attention in LMIC. Analysis of review findings indicate the need for a comprehensive, integrated health and social system approach to increase the current availability of AT for ageing populations in LMIC. Implementation of AT has enable individuals to maintain functional ability, preserve independence, age in place, improve wellbeing and quality of life. Many technologies were low or no cost solutions that relieved burden for families and carers and enabled equitable access to wider population, and make these high priority.
Werntoft et al. 2007 - Older people's reasoning about age-related prioritization in health care[30]	The aim of this study was to describe the reasoning of people aged 60 years and over about prioritization in health care with regard to age and willingness to pay.	Healthy people (n =300) and people receiving continuous care and services (n =146) who were between 60 and 101 years old were interviewed about their views on prioritization in health care. The transcribed interviews were analysed using manifest and latent qualitative content analysis.	Sweden	The participants' reasoning on prioritization embraced eight categories: feeling secure and confident in the health care system; being old means low priority; prioritization causes worries; using underhand means in order to be prioritized; prioritization as a necessity; being averse to anyone having precedence over others; having doubts about the distribution of resources; and buying treatment requires wealth. Three principles for prioritisation that are deemed important are: 1) the principle of human dignity; 2) the principle of need and solidarity, 3) the cost-efficiency principle.

Alsaeed et al 2016 - Older people's priorities in health and social care research and practice[29]	To identify and prioritise issues important to older people that would benefit from further research and act as a platform to promote sharing of ideas and problems related to these important issues	A public engagement workshop focusing on the priorities of older people for research and practice in health and social care was attended by seventy-five people aged 70 years and above in London	UK	Participants identified a range of priorities that they felt were important areas for research including: isolation and loneliness; research on age-related conditions that have a negative impact on quality of life; post-surgical care at hospitals; support and training for both professional and family carers. Older people often felt that information, public services and support are sometimes inaccessible to them due to their age. Also the felt that there is a negative perceptions of older people and inequality related to public services and health care.
Borg et al 2010 - Assistive technology in developing countries- a review from the perspective of the Convention on the Rights of Persons with Disabilities[22]	To summarize current knowledge on assistive technology for low- and lower-middle-income countries published in 1995 or later, and to provide recommendations that facilitate implementation of the CRPD.	Literature review of web-based databases and reference lists. Studies carried out in low- and lower-middle-income countries, or addressing assistive technology for such countries, were included.	Low- and lower-middle-income countries	Following recommendations are made to facilitate implementation of the required CRPD measures: - As there are variations in access to assistive technology across genders, ages and disabilities, these perspectives should be considered in the planning, implementation and evaluation of activities. - Evidence to guide development of effective policies and legislation is needed as such evidence is scarce. - Research and development on design, evaluation, production and use of assistive technologies are still required. - Research on assistive technology to facilitate work and education is required from a human rights perspective as well as to reduce poverty. - Research is needed to guide the development of cost-effective strategies that ensure assistive technology is equitably available, accessible and affordable. -To prevent a lack of adequately trained personnel to staff new services, suitable training programmes need to be developed. - To guide the utilization of available resources, good quality studies of outcome and cost-effectiveness are greatly needed.

Appendix 2 – Review tables of horizon scanning systems

HS programme	What is the purpose of HS programme?	Who are the key stakeholders of HS programme?	What are the target technologies of HS programme?	What criteria are used for prioritisation of technologies?	What is the process of prioritising technologies?
AETS – Agencia de Evaluación de Tecnologias Sanitarias (Spain)[44]	To identify new and emerging health technologies for future evaluation, and to collect relevant information and their possible impacts.	Decision-makers, health officials	Any technology except drugs	1) Health impact 2) Economic impact 3) Ethical impact 4) Social impact 5) Legal impact 6) Organizational impact	For each technology individual criteria are rated 1-5 (5 being highest) and a final grade "Priority for evaluation" is given also 1-5. The final output of the EAAS covers the potential for future impact, safety and efficacy/ clinical effectiveness of the technology. The output takes the form of a short 1-4 page report (technical card).
AETSA – Andalusian Agency for Health Technology Assessment (Spain)[47]	To pinpoint and monitor the emerging health technologies development in the major diagnostic and therapeutic fields; as well as to provide tools that anticipate the impact of emerging technologies with the aim of providing timely, and relevant information to assist decision-making.	Regional Ministry of Health, Andalusian Public Health System (SSPA)	Major diagnostic and therapeutic fields	1) Burden of disease 2) Potential benefit 3) Economical consequences 4) Ethical, legal and organisational aspects 5) Possible inclusion in any priority working lines of the organisation	A Committee, including representatives from Regional Health Ministry and Regional Health Services prioritize the technologies to be assessed.
Agenas – The Agency for Regional Healthcare (Italy)[45]	To: 1) support policies related to new health technologies (for institutional decision-makers); 2) support clinical practice (for health professionals); 3) direct the search (for entities performing research and HTA activities)	Ministry of Health, University, Directorate General of Drugs and Medical Devices	Any technology except drugs	As far as medical devices are concerned, it is prioritized according to the priority criteria submitted and approved by the Single Medical Devices Commission (CUD) of the Ministry of Health: 1) Epidemiological Criterion 2) Criterion of Demand 3) Criterion of availability and quality of simple or cost-	Process is not mentioned but it is clear that these criteria are weighted based on needs expressed by the decision-makers.

				effective efficacy tests 4) Economic-organizational criterion	
CEDIT – Comité d´Evaluation et de Diffusion des Innovations Technologiques (France)[48]	Early awareness and assessment, by identifying and anticipating the technologies with a clinical, economical, or organisational impact on the hospital	Paris University Hospital (AP-HP)	Innovative health technologies likely to have an impact on the hospital	1) Clinical 2) Economical 3) Organisational	The CEDIT acts upon request from administrative, medical or paramedical staff of the AP-HP, or sometimes on self-request (mostly innovations identified by horizon scanning). All new information published in the collection field (Medical journals, Euroscan etc.) is selected by the two biomedical engineers from the Scientific Secretariat of the CEDIT - Innovation and Technology Watch Division. The collected information is then indexed in several Excel data files, one for the early warning and the others for the evaluation. For each information they collect the source of the information, the date, the link to the information, the discipline concerned and the type of technology. Information is distributed via "Watch letter"
CONITEC – National Committee for Technology Incorporation (Brazil)[49]	To identify new and emerging technologies that are affordable to the health system and have favourable impact on clinical practice, service organization and on the social and ethical aspects related to their use.	National policy-makers.	Drugs, medical devices and procedures.	1) Affordable 2) Clinical benefit 3) Social impact 4) Ethical impact	The priority setting consists in obtaining the preferences of committee members. The Interactive Multi-Criteria Decision Making method is applied to reveal the individual preferences which is then used to calculate the group preferences. In advance, committee members receive a summary of evidence and the description of priority criteria to be used in the priority setting process. A special form is created to determine the weight for each criteria.

DAHTA @ DIMDI – German Agency for HTA at the German Institute for Medical Documentation and Information (Germany)[39]	HS programme is not mentioned but DAHTA´s main task is to manage the HTA process with special regard to quality, reliability, and actuality.	Health policy makers, clinicians and others	Medical procedures and technologies	Importance in health care	Topics for the HTA reports can be entered publicly into a database of topics via an internet questionnaire. That means that any interested person has the possibility to formulate HTA topics. Twice a year the HTA Board of Trustees which represents the decision- making groups in German health care, selects the topics corresponding to their importance in health care by a standardised procedure (Delphi). For the preparation of the reports the prioritised topics are commissioned to collaborative scientific groups consisting of the disciplines necessary for HTA. In this context a standardised quality assured process has to be followed. DAHTA develops and controls this procedure continually.
HealthPACT – Health Policy Advisory Committee on Technology (Australia)[37]	To forewarn policy makers about emerging technologies.	Commonwealth Department of Health, State and Territory Departments of Health and New Zealand's National Health Committee.	Non-pharmaceutical technologies: devices, diagnostics, procedures and programmes.	Identified technologies must satisfy pre-defined criteria or a priority threshold including: 1) It is associated with obvious safety or ethical issues or controversies 2) It has not been assessed and is rapidly diffusing throughout the Australian health system; 3) It is applicable to a large proportion of the Australian population and may have considerable clinical or cost impact 4) It is applicable to a small proportion of the population but has obvious and far-reaching benefits.	Technologies that have been identified as new and emerging are first classified into the following categories: Not yet emerged; Experimental; Investigational; Newly established; Established; Established but changed indication or modification of technique; Should be taken out of use. Once classified, new technologies are examined to determine whether they meet a “prioritizing threshold,” in that the technology is likely to emerge in the Australasian health scene within 3 years and satisfies at least one of the prioritization criteria.

				5) Technologies must be deemed to be emerging into the Australian health system within a three year time horizon.	
INESSS – Institut national d'excellence en santé et en services (Canada)[38]	To promote clinical excellence and the efficient use of resources in the field of health and social services. At the heart of its mission, INESSS assesses, in particular, the clinical advantages and costs of health technologies, medications and interventions used in the fields of health care and social services	Québec's Minister of Health and Social services, stakeholders of the health care and social services' network	Not mentioned	HTA requests are assessed and prioritized by INESSS' advisory board	HTA requests are assessed and prioritized by INESSS' advisory board which consists of professionals and managers from the health and social care sectors, patient organizations, the Ministry of Health and Social Services, and the Régie de l'assurance maladie du Québec. Assessment reports are conducted by INESSS, often in collaboration with other HTA units in the network. Upon the completion, the assessment is submitted to the scientific committee for technologies in the health and social services sector (Comité scientifique permanent en santé et en services sociaux), and then to the Board of Directors for formal approval of the final content and recommendations.
MTU-SFOPH – Medical Technology Unit – Swiss Federal Office of Public Health (Switzerland)[50]	Not mentioned	Swiss Federal Coverage Committee, Swiss Federal Department of Interior	Depends on the priorities set out by the management	If the technology is considered controversial (appropriate, effective, cost-effective) by Swiss Insurers Body (SIB) or the Swiss Medical Association (SMA) or both, a complete assessment must be undertaken	1) An application is sent to MTS from the requestor 2) MTS sends a standard letter to the SIB and the SMA asking whether the technology in question is controversial 3) If the technology is considered controversial by SIB or SMA or both, a complete TA must be undertaken 4) MTS then prepares comprehensive documentation; staff members of MTS visit and discuss the technology with the applicant and check whether it conforms with the requirements stated in the Manual 5) The recommendation of MTS and

					the applicant's documentation are both presented to the Swiss Federal Coverage Committee
NECA – National Evidence-based healthcare Collaborating Agency (South Korea)[51]	To identify, filter and prioritize new and emerging health technologies; to assess or predict their impact on health, costs, society and the national health care system; and to inform the activity's outcome to decision-makers, industries, health care professionals, purchasers, reimbursement agencies, patients and patient organisations.	Korean Ministry of Health and Welfare, decision-makers, industries, health care professional purchasers, reimbursement agencies, patients and patient organisations	Pharmaceuticals, medical devices, medical procedures, and national level health care programs or services	Topics are prioritized by subcommittees	1) Research is classified 2) Adding a related information and reference to suggested topics 3) Topic prioritisation by subcommittees 4) Topic selection by the research-planning committee 5) Refining topics into research projects and selecting principal investigator 6) Submission of the research project plans
NIPH – Norwegian Institute of Public Health (Norway)[52]	To produce short alerts on new technologies close to introduction (0-1 years before introduction). Alerts on Pharmaceuticals are produced in Collaboration With the Norwegian Medicines Agency (NOMA). The alerts serve as proposals for national HTA within The National System for Managed Introduction of New Health Technologies within the Specialist Health Service.	The National System for Managed Introduction of New Health Technologies within the Specialist Health Service	All health technologies	Not mentioned	An Ordering Forum, Bestillerforum RHF, consisting of the four medical directors (one for each regional health authority) and two delegates from the Norwegian Directorate of Health, has the mandate to prioritize the STAs and HTAs to be conducted on the basis of submitted proposals and horizon scanning reports.
OSTEBA – Basque Office for Health Technology Assessment (Spain)[53]	To inform decisions on partial coverage and setting of monitoring systems, and to inform decisions on disinvestment.	Basque Government, Basque Health Service Osakidetza, Spanish Ministry for Health, Social Services and Equity	All types of health technologies	Not mentioned	Sortek uses clinicians in over twenty different specialties and policy makers to identify potentially significant health technologies and to validate resulting early assessment reports.

SBU – Swedish Agency for Health Technology Assessment and Assessment of Social Services (Sweden)[41]	To identify effective and ineffective practices in social services and health practices.	Key organizations, both in the Swedish health care system and in social services	Methods used in health care delivery	Submitted proposals for assessment are ranked according to a number of criteria. The more criteria met, the more urgent the issue. The criteria are: 1) Major importance for life and health 2) Affects many 3) Wide variation in practice 4) Uncertainty about the strength of scientific evidence 5) Major economic consequences 6) Important ethical issue 7) Major impact on organization or staff 8) Controversial or popular issue	Technologies are prioritized using a set of criteria and after discussions in the Board and in the Scientific Advisory Committees. A project group of 5 to 10 members is selected with clinicians, economists, epidemiologists, SBU staff, and other professionals important for the topic of the project. The group's task is to systematically review the entire body of scientific literature in the field. At SBU the members of the group learn about the method of systematic and critical reviews, based on the Cochrane Collaboration model. The literature review usually takes up to two years to complete. The group's report is then reviewed by both external reviewers as well as the Board and Scientific Advisory Committee.
ACE – Agency for Care Effectiveness (Singapore)[40]	To support policy makers to provide high-quality care, ensure value and sustainability of health care system.	National policy-makers, health care institutions, doctors and patients	Drugs, medical devices and medical services.	1) Alignment with national health priorities 2) Disease burden 3) Evidence of suboptimal outcomes 4) Practice variation 5) Knowledge gap 6) Potential impact on patient outcomes	Expert group is in charge of scoping and selection of technologies that will be prepared for evaluation. Their decisions are informed by various health professionals, but the decision-making process is not further described.
AHRQ – Agency for Healthcare Research and Quality Healthcare Horizon Scanning System (USA)[54]	To conduct horizon scanning of emerging health care technologies and innovations to better inform patient-centred outcomes research investments at AHRQ through the Effective Health Care Program. It is NOT the goal of the AHRQ Healthcare Horizon Scanning System to make	Interested public, researchers, funders of research	Drugs, devices, procedures, treatments, screening and diagnostics, therapeutics, surgery, and care delivery innovations	First, All leads selected by searchers for consideration must pertain to one of the 14 AHRQ-defined priority areas or a cross-cutting area. Secondly, there are internal and external expert scoring (Score his/her impression of each parameter using a 1- to 4-point scale).	Topics added to the Horizon Scanning Production Queue are prioritized for searching, profile development, and expert comment according to the schema outlined below (1 = lowest priority; 4 = highest priority). Topic prioritization is an ongoing process; therefore, analysts meet twice each month to discuss topics as necessary to ensure that all target topics are properly prioritized according the

	predictions on the future utilization and costs of any health care technology. Rather, the reports are intended to help to inform and guide the planning and prioritization of research resources.			There are 7 parameters: 1) Potential Importance of the Unmet Need it Intends to Address 2) Potential to Improve Patient Health 3) Potential to Affect Health Disparities 4) Potential to Disrupt the Healthcare Delivery System 5) Potential for Acceptance/Adoption by Patients and Clinicians 6) Potential Impact on Healthcare Costs 7) Overall Potential to Fulfil the Unmet Need	schema outline below. 1. New topics that the team determines to have lower potential for high impact than other topics in the system (e.g., equivocal data, incremental potential benefit) and previous, active, target topics being updated that were considered for a previous High Impact report for which expert comments will be older than 12 months immediately prior to the next scheduled High Impact Report. 2. New target topics that the team considers to have higher potential for high impact than other topics in the system (e.g., strong data, Breakthrough Designation, FastTrack Status, Priority Review). 3. Previous, active, target topics currently being updated that were included in a previous High Impact report and for which expert comments will be older than 12 months immediately prior to the next scheduled High Impact report. 4. Previous, active, target topics being updated that were considered for or included in a previous High Impact report and for which new information exists that could change experts' perspectives regardless of the recency of the prior expert comments.
HIS – Healthcare Improvement Scotland (UK)[55]	To provide early intelligence on health technologies in development.	NHS Scotland board	Any technology except drugs	Evidence Review Committee (ERC) determines whether or not the topic is potentially suitable for further consideration for the SHTG work programme.	SHTG operates an open topic referral process with occasional themed calls. Anyone can submit a topic referral form – NHS boards, clinicians, manufacturers and members of the public. All referrals received are reviewed by the

					Evidence Review Committee (ERC) to determine whether or not the topic is potentially suitable for further consideration for the SHTG work programme. This screening is based on the information contained within the topic referral form, supplemented by exploratory work undertaken by the secretariat, and a presentation from the topic referrer.
MaHTAS – Health Technology Assessment Section, Ministry of Health Malaysia (Malaysia)[43]	To identify health technologies that are: 1) new and emerging 2) represent a change in indication or use of an existing technology, or 3) part of a group of developing technologies that as a whole may have major implications for the health system.	1) Policy-makers and regulators within Ministry of Health 2) Medical Device Authority (MDA) 3) Universities and research institutes 4) Investment agencies such as (e.g.Ministry of Science, Technology and Innovation) 5) Health care providers/ practitioners 6) Other related agencies	The system covers all health technologies as per below: 1) Medical devices 2) Diagnostics 3) Biologics 4) Regenerative technologies 5) Procedures 6) Pharmaceuticals 7) Traditional and Complementary Medicine 8) Public health interventions.	1. Population-based criteria a) Disease burden b) Current options for patients 2. Potential impacts of technology a) Impact on patients (morbidity, mortality, quality of life, b) Cost (system cost, direct and indirect costs for patients and society) c) Organisation (increase or decrease utilisation of service, structural changes and staff training) d) Societal and/or ethical issues e) Safety/adverse events	The technologies are prioritised using scoring system. The team members give scores to the filtered technologies based on the outlined criteria. Technologies are prioritised according to their score rank and discussion among the team members. Score scale is 1 to 10 [score 1-3 (low priority), score 4-7 (moderate priority), score 8-10 (high priority)].

NIHR – National Institute for Health Research (UK)[56]	To provide advance notice to the Department of Health, national health policy makers, national research funders and the wider National Health Service of new and emerging technologies (including changing applications and uses of existing technologies) that need further research, evaluation of clinical and cost impact, or modification of clinical guidelines or guidance.	Department of Health, national health policy makers, national research funders and the wider National Health Service	Drugs, medical technologies, diagnostic tools and health care services	Topics are prioritised by expert panels	Once identified, new and emerging technologies pass through a multi-stage filtration and selection process to identify those that would benefit from further evaluation. After collection of relevant information, a short technology briefing or alert is written.
CADTH - Canadian Agency for Drugs and Technologies in Health (Canada)[57]	To identify and describe the evidence on new or emerging health care technologies that may be important in Canada and describe what their potential impact may be for patient care and for the health care system.	Health care decision-makers and providers across Canada	Drugs, devices, diagnostic tests or imaging, surgical procedures, or other health interventions	Not mentioned	CADTH does not seem to prioritize health technologies. CADTH's Horizon Scanning service identifies and monitors new and emerging health technologies and reports on the findings. The publications summarize the available evidence on technologies that are not yet in widespread use - either not yet licensed for use in Canada, not yet widely available, or not in routine clinical use. Publications describe the intended use of the technology, its regulatory status, the patient population, costs, current practice, adverse effects, and any potential implementation issues.

Appendix 3 – Review of health technologies using developed prioritization criteria

Technology	Description	Need	Clinical benefits	Costs	Evidence base	Equality and Equity	Personal wellbeing	Patient autonomy	Culture
Bindex for investigating suspected osteoporosis	A portable pulse-echo ultrasound device used to help make decisions on the investigation and treatment of osteoporosis.	■	■	■		■	■		
Mobile Stroke Units for Prehospital Care of Ischemic Stroke	Mobile stroke units are similar to ambulances but are equipped with a portable computed tomography (CT) scanner and specially trained staff for the rapid diagnosis and treatment of ischemic stroke.	■	■			■		■	
Review - New and emerging technologies for hearing loss	55 technologies that fitted the identification criteria: five educational programmes, six auditory and cognitive training programmes, five assistive listening devices, eleven hearing aids (HAs) and alternative listening devices, eight implants and devices, twelve drugs, one regenerative medicine approach, and seven surgical procedures.	■					■	■	
Flash Glucose Monitoring System for Diabetes	The FreeStyle Libre Pro is a glucose monitoring system intended to replace finger-stick tests; it uses a sensor implanted in the arm that a health care provider scans with a specialized reader for a record of glucose levels, trends, and patterns in people with diabetes.	■	■			■	■	■	
A Hybrid Closed-Loop Insulin Delivery System for the Treatment of Type 1 Diabetes	The MiniMed 670G is a wearable medical device that uses a computer program to automatically adjust insulin levels throughout the day.	■	■		■	■	■	■	
A Transdermal Glucagon Patch for Severe Hypoglycemia	The ZP-Glucagon Patch uses microneedles to deliver glucagon through the skin into the fluid surrounding the cells below. Still in the early stages of human testing, the patch may be a more user-friendly option for glucagon delivery.							■	

Technology	Description	Need	Clinical benefits	Costs	Evidence base	Equality and Equity	Personal wellbeing	Patient autonomy	Culture
Boston Keratoprosthesis Type I for corneal blindness	It is an artificial cornea used to provide a transparent optical pathway into the eye of people with corneal blindness, in whom corneal transplant may not be suitable.		■				■	■	
NaviCam for diagnosing gastrointestinal tract conditions	NaviCam is a magnetically controlled capsule endoscopy system. It is used for diagnosing conditions of the upper gastrointestinal (GI) tract and small bowel.								
Permacol for treating anal fistulae	Permacol is a collagen paste made from pig skin that has been developed to treat anal fistulae. It is injected into the fistula, where it expands to fill and seal the fistula tract.		■						
RIDASCREEN tests for monitoring infliximab in inflammatory bowel disease	RIDASCREEN IFX Monitoring and Anti-IFX Antibodies are tests used to measure infliximab levels in the body, or antibodies to infliximab in the blood or plasma of patients receiving treatment for inflammatory bowel disease such as ulcerative colitis or Crohn disease.		■						
Rapid sepsis detection	Two emerging technologies to rapidly diagnose sepsis, T2Candida and IRIDICA, analyze patient blood samples to detect the microorganisms that may cause sepsis, and have the potential to improve patient outcomes and reduce use of antibiotics.	■	■						
Endovascular arteriovenous fistula creation systems	Arteriovenous fistulae is a new less invasive devices provide endovascular access without requiring an open surgical procedure to create the fistula.	■	■						
U-Drain for people needing night drainage of urine or dialysis fluid	The U-Drain has been developed for people who need overnight drainage of a urinary catheter or urostomy pouch, or for people on automated peritoneal dialysis who need drainage of urine or dialysis fluid.		■				■	■	
Monarch external Trigeminal Nerve Stimulation System for drug-refractory epilepsy	The Monarch device is a non-invasive treatment for drug-resistant epilepsy. A patch applied to the forehead is used to deliver a low-intensity electrical current from a small stimulator the size of a large cell phone.							■	

Technology	Description	Need	Clinical benefits	Costs	Evidence base	Equality and Equity	Personal wellbeing	Patient autonomy	Culture
Portable neuromodulation stimulator for multiple sclerosis	The Portable Neuromodulation Stimulator (PoNS) provides painless electrical impulses to the tongue to help improve balance and walking in people with advanced multiple sclerosis.	■	■			■	■	■	
SecurAcath for securing cerebrospinal fluid catheters	SecurAcath is a single-use device with a small metal “anchor” that is inserted under the skin to hold a cerebrospinal fluid drainage catheter in place, thus preventing accidental dislodgement or removal.								
StimQ peripheral nerve stimulator system for the relief of severe difficult to manage persistent pain	StimQ is a small, implantable device that uses electrical pulses to stimulate peripheral nerves (those outside of the brain and spinal cord) to relieve severe chronic pain in the limbs and body but not in the head or neck.	■	■				■	■	
Barricaid prosthesis for partial annulus replacement	Barricaid is a small, polymer fibre mesh that is inserted into the space created when a herniated spinal disc is removed in a discectomy.		■					■	
Neo Pedicle Screw System for spinal fusion surgery	This single-use set of instruments, screws, and rods is for use in spinal fusion surgery for treating back or leg pain in adults.			■					
Outpatient (Same-Day) Total Hip Replacement	Total hip replacement can alleviate pain and disability in people with hip disorders such as osteoarthritis Outpatient hip replacement requires a multidisciplinary team approach that includes careful patient selection, patient education, improved anaesthesia and analgesia, advanced surgical techniques to minimize muscle damage and blood loss, early mobilization, intensive physical therapy, and the involvement of caregivers at home.	■	■	■	■		■	■	
Ekso exoskeleton for rehabilitation in people with neurological weakness or paralysis	The Ekso GT robotic exoskeleton is designed to be used as part of a rehabilitation program for people with weak or partially paralyzed legs due to spinal cord injury, stroke, or other neurological conditions.	■	■				■	■	

Technology	Description	Need	Clinical benefits	Costs	Evidence base	Equality and Equity	Personal wellbeing	Patient autonomy	Culture
Spinal cord stimulation to improve function following spinal cord injury	Spinal cord stimulation is a new non-invasive spinal cord stimulation strategy that involves electrically activating the spinal cord using the NeuroRecovery Technolgies, Inc. proprietary prototype device.	■	■			■	■	■	
Endobronchial valves for patients with advanced heterogeneous emphysema	Emphysema is a type of chronic obstructive pulmonary disease where the air sacs in the lungs become damaged, making it difficult to breathe. Endobronchial valves can be placed into diseased parts of the lungs, allowing air to exit but not enter.		■						
Smart One for measuring lung function	Smart One is a portable spirometer — a device used to measure the function of the lungs. The device measures both peak expiratory flow and forced expiratory volume in one second.						■	■	
Hemosep for cell salvage	Hemosep is an ultrafiltration and hemoconcentration system that recovers a patient's blood during surgeries that can involve significant blood loss, such as cardiac surgery.		■						

Notes: Highlighted box denotes that particular technology satisfies criterion.