

**FORUM FÖR  
HEALTH POLICY**

# Innovation in elderly care

An insight into innovation and its application in elderly care

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## FOREWORD

As population demographics changes, it is clear that there is an increase in the ageing population as well as the amount of people living with chronic diseases worldwide. Many healthcare systems across the world will have to cope with the increasing demand of care services among the elderly. To respond to this demand in a financially sustainable way, innovative solutions will need to be employed. Innovation is the phenomenon which aims to create new concepts, new methods and improved solutions to cater to our needs. The phenomenon of ageing and innovation could be deemed as opposites, but in the wake of the increasing elderly population, it would seem that they might not be contradictory after all. With the increase in the healthcare demands due to the rising ageing population, innovative solutions are needed.

With a rise in technological developments, it is natural to see an increase in innovative technological solutions which are helping us through our daily life. From smart watches which can track our health status to advances in the use of robotics, technological innovation is on a rise in all fields. This technological development is also seen in the field of healthcare. However, many studies show that the progress of innovation in elderly care is too slow. With these crucial ideas in focus, the aim of this report is to discuss and present examples of innovation in the care of the elderly population which ultimately promotes active, healthy ageing.

Forum for Health Policy, a non-political think tank, aims to strengthen development and innovation in elderly care. This report is part of that effort.

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Stockholm, November 2020.

## THE CHANGING DYNAMICS OF AGEING POPULATION

Population ageing is a growing demographic phenomenon, with many countries already experiencing a rapid increase in the number of persons aged 65 years and above (1). This indicates that a large proportion of the population in the upcoming years will have longer life expectancies, bringing to attention key questions which need addressing in order to promote healthy and active ageing. This rise in ageing population has implications for healthcare systems in all countries in terms of costs, increased demand of care facilities and societal challenges. At the same time, progress in science and technology will introduce developments which will greatly improve healthcare. There is a need for healthcare systems to incorporate and adapt to these developments, promote innovation and offer efficient care services.

### TRENDS OF AN AGEING POPULATION

#### - Global

Globally, the number of individuals aged 65 years and older is estimated to reach 1.5 billion by the year 2050 (1). Life expectancy increased by 12% (7.7 years) between 1990-1995 and 2015-2020 and is expected to increase further by 6% (4.5 years) between 2015-2020 and 2045-2050 (1). This phenomenon of population ageing can be attributed to factors such as increased longevity due to improved healthcare systems, advances in public health systems, technological innovations, and better living conditions (1).

As per the United Nations World Population 2019 report (1), Eastern and South-Eastern Asia is expected to observe the largest increase in older population (aged 65 years and above) from 260.6 million persons in 2019 to 572.5 million persons in 2050 (+120% increase). Conversely, in Europe and North America older population is expected to increase from 200.4 million persons in 2019 to 296.2 million persons in 2050, indicating a relatively small increase of 48%.

#### - Regional (EU)

The population demographic is rapidly changing in Europe with the proportion of elderly steadily increasing. As of 2018, 101.1 million persons aged 65 years and above were living in EU-28 and this number is projected to increase to 149.2 million, equating to 28.5% of the total population, in 2050 (2). This phenomenon is well reflected in Sweden's demographic structure where in the 1960's the percentage of people aged 65 years and above was 11.8% and recent statistics show that this increased to 20% in 2019 (3). Many countries in the EU are already facing this rise in share of population of the elderly. The proportion of elderly aged 80 years and above, is also projected to grow at a fast pace in the EU, from 5.6% of the total population in 2018 to an estimated 11% in 2050 as per Eurostat's projections (4).

## - Gender differences

On average, women tend to live longer than men and this is reflected in trends at a global level, where women's life expectancy between 2015-2020, at birth, was 4.8 years higher than men's life expectancy (1). This gender gap is also prevalent when looking at life expectancy at 65 years, where women are expected to live for an additional 18 years compared to 16 years for men, in the years 2015-2020 (1). Among the global population of 65-year old's and above in 2050, women will comprise of 54% of that population group (1). Naturally, there are variations in life expectancy among sexes across different countries, but on average the data describes a trend where women have higher life expectancies compared to men (5,6).

At a regional level, Europe also faces similar trends, however there are variations among different countries in the EU. In countries like Latvia and Lithuania the gender gap in life expectancy at birth was 9.9 years and 9.8 years respectively in 2017 (7). In contrast, countries like Sweden and the Netherlands had a gender gap of 3.3 years and 3.2 years respectively (7). It is also important to keep in mind that despite differences between countries, there are differences in life expectancy within different regions in countries. An example of this is seen in Sweden whereby in the different regions of the country life expectancy varies between men and women. In 2014-2018, in the Norrbotten region of Sweden, average life expectancy for men was 79.1 years and 83.2 years for women compared to region Uppsala in the same period, where average life expectancy was 81 years for men and 84.7 years for women (8). Life expectancy was higher for men and women in the Uppsala region compared to the Norrbotten region. This highlights the importance of continuous public health action, as despite having higher life expectancy than other countries, there are differences within regions in Sweden itself.

## IMPLICATIONS OF AN AGEING SOCIETY IN HEALTHCARE

The progression of this global phenomenon of population ageing has been extraordinary. People are expected to live longer, have access to better healthcare and technological advances have made impressive changes in how societies and individuals' function. However, as the underlying trends of demographic changes are evaluated, it is evident that increased longevity and higher life expectancies have profound implications for societies and health systems across the world. Below we highlight some key challenges of a growing ageing society on the healthcare sector.

### **- Cost**

The cost of sustaining an increasing older population is not only limited to pensions, but a large proportion of total ageing costs are expended on healthcare and elderly care. As per the 2018 Ageing Report by the European Commission, total public ageing costs in the EU was 26% of the GDP in 2016 and is estimated to increase to 28.2% by 2040 (9). Projections made, differ from country to country and are based upon underlying trends. However, projections made until 2070 estimate that countries such as Belgium, Luxembourg and Finland will have ageing costs expenditure higher than 30% of GDP (9).

In addition to the total expenditure, the ageing costs can be subdivided into sections such as pensions, long-term care and healthcare costs to observe the impact of the different sections on the total ageing costs. As per the European Central Bank, predictions highlight that long-term care and healthcare costs will account for a large part of the total expenditure (9). It is estimated that countries such as Luxembourg and Malta will have highest increases in total ageing costs change, approximately 13% and 7% respectively (9).

### **- Care services**

With the increase in ageing population, the demand for care and care services will also be on a rise. Care services are not only limited to medical care but also includes everyday care services. Formal care for the elderly is paid care services provided by trained professionals and auxiliaries working in health or social care sector in healthcare organisations. It can include residential care (such as nursing homes) or home-based care for the elderly. Informal care is that which is provided by family members, relatives or close friends. Often, many elderly people either have only formal or informal caregivers or could have a mixture of the two.

To a large extent, caregivers are often composed of family members such as partners or children and are known as informal caregivers. With the rise in the population group of the elderly, policies will need to be restructured to consider the role of informal caregivers. Programmes to facilitate more interaction and opportunities to provide informal care to family members could considerably reduce the burden on professional caregivers but also reduce the costs related to care demands. The increase in demand for caregivers will need to be met, while also ensuring that the physical and mental well-being of the caregivers is accounted for. Innovative solutions which could potentially help reduce the workload on caregivers and burden on healthcare systems will be mentioned in this report.

### **- Multimorbidity**

Multimorbidity can be defined as the occurrence of two or more chronic diseases and is a common health issue among the elderly. Multimorbidity is often limited to co-existence of the physiological diseases however it can also include mental health problems, interactions between different chronic diseases, functional and cognitive limitations. Being a patient with multiple chronic diseases, the healthcare related expenditure increases greatly along with decreasing quality of life. Individuals with multiple health conditions often have long-term, complex diseases and require ongoing care.

For healthcare systems, individuals with chronic diseases often need efficient and safe primary health care services. In order to deliver well-organized care services, different healthcare actors need to coordinate, which in Sweden, still is a challenge. Healthcare systems need to focus on patient-centred and integrated care services. More importantly, health care systems need to start addressing this issue by making policy level changes, by utilising primary health care services to identify individuals with multiple chronic conditions and by implementing efficient manageable treatments and self-care options.

An example of increasing prevalence of multimorbidity in Sweden can be seen in the figure below (10). In Sweden, where the healthcare system is easily accessible and provides universal care services, in 2017, the percentage of people above the age of 65+ years who had at least 2 chronic diseases was 13% and for EU25 it was 20% as per the 2019 OECD country health profile for Sweden (10). These projections are only expected to increase over the upcoming years due to the increase in ageing population.

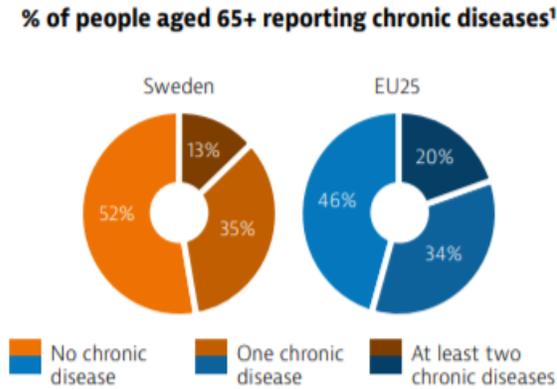


Figure 1: Distribution of chronic diseases in people aged 65+ in Sweden and EU25 (10)

**- Mental health**

With positive developments such as increasing life expectancy and an increasing ageing population, a rise in the number of healthcare issues is also to be expected. Physical and mental illness will rise with advancing age and this can have an impact on the quality of life of an older person. Some of the most prevalent mental health issues that affect the elderly population today are dementia and Alzheimer’s disease. As per the World Health Organisation it was estimated that in 2019 around 50 million people worldwide had been living with dementia with projections estimating that these numbers will increase by 2050, to around 152 million (11). In addition, depression and its related symptoms have been affecting older people, especially those who are living alone in long-term care facilities (11,12).

The impact of such diseases is not only biological and limited to affecting quality of life of the elderly, but also has a major impact on public health institutions. There are direct and indirect costs related to the management and prevention of such illnesses. Healthcare and elderly care needs to be improved at all levels from formal care to informal, social care to address the question of increased mental illness among elderly people. Public health strategies aimed at improving mental health and early interventions can help reduce the burden of the diseases on both the individual level and for healthcare organisations.

## ROLE OF INNOVATION IN HEALTHCARE

Active ageing as defined by the World Health Organisation represents the concept of ensuring equal opportunities for health, for participation in society and for security. It combines the idea of healthy ageing and social wellbeing to ensure that quality of life for individuals can be maintained even as they age (13). This concept is central in creating and adopting policies which shifts the focus from the traditional ideologies of old age to one where positive physical, mental and social well-being along with continued participation in society is observed throughout the ageing process.

To ensure good quality of life, the needs and demands of the elderly population need to be defined. Often, care for elderly is limited to addressing physiological and medical needs. However, psychosocial needs which include positive mental health and non-physical wellbeing also need to be addressed in order to promote healthy ageing. Factors such as social isolation, loneliness along with physical morbidities can have negative impacts on well-being.

Along with the changing ageing population demographics, technological developments are also increasing at unprecedented rates. This implies that financial resources will need to be appropriately distributed and resourced to maximise usage of such technological developments, in order to avoid economic strain in the long run. In many countries, examples of innovative solutions to improve care for the elderly have been developed. Such solutions in the long run can help overcome the burden of chronic diseases and multimorbidity on healthcare systems.

Below, we have provided some examples of innovations in elderly care. Due to the COVID-19 pandemic, the role of innovation has never been more important. One of the biggest risk groups during the pandemic has been elderly people. Therefore, examples of care innovation during the pandemic for elderly people will also be mentioned to highlight the growing importance of planning essential care services for the ageing population.

## SWEDEN

### - Memory Clinic

Life expectancy in Sweden is among the highest in the world at 82 years (3). Demographic projections estimate that by 2050 almost 25% of the population will be over the age of 65 (1). The healthcare system in Sweden is well established, with the aim to provide high quality care for its elderly population. With the increasing ageing population, regions and counties in Sweden need to start developing care models and develop health systems that can provide efficient health services to its ageing population both for those at home and people living in nursing homes.

An example of a well-functioning and innovative idea in elderly care is demonstrated in the region of Skåne in Sweden. As every region has its own administration, region Skåne has developed a functioning and efficient chain of care. It is based on the need of the elderly and involves not only professional care teams, but also fast-track care and direct referrals. This ensures timely and accurate treatment for the individual.

They established the concept of Memory Clinic with a vision in mind to reduce the number of in-patients for dementia care. The clinic has no in-patient wards but has mobile teams, a memory health unit and an out-patient ward. It was first established around 1980 and since then the number of in-patient registrations has been reduced to nearly zero in-patients (14). In addition to clinical outreach, the clinic also performs social, research and educational activities to improve dementia care.

Dementia is one of the leading health conditions affecting the elderly. It can lead to decreasing quality of life and also impacts mental and physical well-being of caregivers of the patients. Establishment of such innovative care models can greatly reduce the strain on health systems to finance in-patient care and it also provides time-efficient and coordinated care.

For more information: <https://skanecare.com/speciality/memory-disorders/>

### **- Smart watches to smart bracelets: developments in eHealth**

The development of digital tools which incorporate artificial intelligence systems is on the rise. Artificial intelligence systems are used in many different fields from engineering to healthcare, aviation to education and also used in day-to-day life such as Alexa or Siri, which are AI based systems. Naturally, there have been many innovative projects in the field of healthcare which use artificial intelligence systems, and which can be used for providing better care services for the elderly.

Aifloo is a company which was established in 2015 and works with information and technology (ICT). They have developed an innovative digital tool which advances development in eHealth. The tool is a smart bracelet which can be worn by the elderly all day. The concept is similar to other smart watches such as an Apple smart watch. It can record data such as pulse rate, movement patterns and can also be used as an alarm system. This can be used to create and learn the activity pattern of the individual. The bracelet also tracks any anomalies which can then be used to alert the formal or informal caregivers. This removes the need of the patient having to press a distress alarm, and in many cases, such as fall cases the patients are unable to press alarms and alert their caregivers.

Such innovative tools can help health care institutions like care homes, nursing homes but also informal caregivers. It allows for remote telecommunication and telecare without disrupting daily routine for both parties. Testing and developing these tools are highly important in today's fast-paced technologically driven world, and greatly help shape the future of healthcare.

For more information: <https://en.vitalis.nu/2018/03/digital-innovations-providing-smarter-care-elderly/>

### **- Artificial Intelligence, sensors and fall prevention**

Ageing is often accompanied by a variety of health care related issues but also a decrease in the ability to function physically and mentally. Many of the elderly population are often moved to care homes in order to ensure that care services are provided, especially for those with multiple chronic diseases. A very common condition that the very old residents in care homes face is that of developing pressure ulcers. Prevention of bedsores can be done by screening for patients who are at risk by nurses and clinicians. Another common problem among elderly is that of limited physical dexterity which can lead to higher chances of falling. Health care systems spend increasing amounts of money on fall prevention. Preventing falls among elderly decreases both costs and suffering. The prevention of such problems often requires innovative thinking and design. Below we have presented an example of a technologically innovative tool that can be used as potential solution for the issues mentioned above.

SafeBase is a company that has developed an innovative tool which can potentially be extremely useful in monitoring lifestyle patterns among elderly who live alone, by their formal, informal caregivers or family members. The idea is that by using a sensor embedded in the bed, which is connected to an AI, caregivers can see for how long the elderly person has been out of bed or how many times they have had to get up at night. This sort of information is vital in cases where the older person is known to be at a risk of falling and can help update the caregiver if any such incidents might have occurred.

These innovative tools can be highly useful in providing efficient care services to the elderly. However, in countries like Sweden the responsibility of care service management is fragmented to both municipal and regional level care. Policies and decisions regarding incorporation of such innovative tools need to be improved by enhancing communication between the different actors in healthcare. Without coordination from all care providers starting from health policy makers to informal caregivers, efficient care services cannot be granted.

For more information: <https://en.vitalis.nu/2018/03/digital-innovations-providing-smarter-care-elderly/>

### - Future Meals: can we really 3D print food?

Due to the rise in ageing population, healthcare systems need to adapt healthcare policies to incorporate the impact of multimorbidity. The presence of one or more chronic conditions is common among elderly, which can lead to decreased quality of life. One such condition that affects the elderly is dysphagia. Dysphagia occurs when the individual has troubles chewing and swallowing food. This can seriously hamper health status as the essential nutrients are not being consumed.

RISE is a research and innovation institute in Sweden. They are working on a project which aims to develop tasty and appealing food for the elderly. This very innovative project aims to develop food that is 3D printed. 3D printing is a technological tool that allows uploading data files to print 3D models. 3D printers are still limited and not widely commercially used but if such projects show promising results, they can drastically improve delivery of food and nutrition to older people.

Many elderly have difficulties eating or have special dietary needs which need to be fulfilled. With such innovative tools, meeting the nutrition requirements can be made possible. However, it is important to keep in mind the physiological effects of 3D printing food and the interaction between the food and the cellular physiology. These questions and limitations of such innovative designs can be answered by conducting tests and repeated experiments.

For more information: <https://www.ri.se/en/our-stories/3d-printers-replace-cooks>

**- The digital friend: Alexa**

Voice-activated devices and voice recognition has recently been incorporated in many digital tools such as mobile devices and computers. Elderly people who suffer from memory related disorders often require constant care, ask questions repeatedly and need assurance in case of anxiety.

Amazon Echo's Alexa is a digital tool with great innovative potential. Caregivers in nursing homes who usually have more than one patient in their care, need to ensure that the elderly get sufficient human contact and conversation, but also need to ensure that their own mental and physical well-being is preserved.

This is when a digital friend can be useful, such as Alexa. The voice-activated feature can help create conversation. Naturally, the digital tool cannot completely mimic human conversation, but it can help reduce the burden on caregivers. As dementia patients often ask the same question repeatedly throughout the day, an intelligent friend like Alexa can help answer some simple questions such as "What is the weather like today?".

Alexa can also be used by dementia patients to create shopping lists, play audiobooks and music and also be used to remind the seniors to take their medications. Seniors with physical disability like Parkinson's disease often have mobility issues, which means a simple task such as switching on lights can be hampered. This is when voice-activated devices like Alexa can be useful to regulate heating temperature or turn on the lights.

Innovation of such digital tools can be very useful in not only helping the seniors but also caregivers who spend every day taking care of them.

For more information: <https://dailycaring.com/amazon-echo-for-dementia-technology-for-seniors/>

## **- In-app signing: an example of electronic signature use in healthcare**

Technological developments have been at a forefront in countries like Sweden. For almost a decade now, mobile payment apps such as Swish and electronic signature apps like BankID have been used by banks and individuals to conduct monetary transactions and identification check when handling different health care systems. Development of such applications has incorporated digital technology in everyday lives for people in Sweden.

An example of digital signature/electronic signature in healthcare has been developed in Norrtälje for elderly care. Tiohundra switched from having manual drug prescription to working with an app that can be used by caregivers to update drug prescriptions in all their elderly care homes in Norrtälje. Previously, nurses had to manually make changes to medications by visiting each accommodation. With the use of an app, prescriptions can be refilled, or changes made more efficiently, but can also help nurses track whether the patients have taken their medication.

In addition, the use of the app also reduces mistakes made when changing prescriptions manually. Tiohundra conducted an analysis and discovered that between the 3rd quarter of 2017 and 2nd quarter of 2018, errors in drug handling reduced from 96 to 54. This shows that e-signing improves safety for the patients by reducing errors.

By implementing and testing new digital tools, as Tiohundra did in their elderly care homes, innovation in healthcare can progress alongside the technological developments. The use of e-signing not only reduces human error but can help ease the workload on the healthcare personnel at elderly care homes.

For more information: <https://www.tiohundra.se/artikel/halvering-av-avvikelser-med-e-signering>

**- Robot assisted showers for the elderly**

For many elderly people, physical limitations can hinder day to day living. For elderly with disabilities help needs to be provided to carry out everyday activities such as taking a shower or going grocery shopping. Being able to maintain one's personal hygiene is an important factor in independent living. For elderly people who have disabilities, this task often requires assistance and can hinder the individual's integrity.

An innovative digital development has been developed and is being tested by Robotics Care AB, a company in Västerås. The company has developed a hygiene robot Poseidon which can help people with disabilities shower independently. There are 5 test robots in use today, and they are testing the safety, efficiency and collecting user feedback.

Implementation of robotic showers can greatly improve independence among the elderly. In addition, privacy is also preserved, and a sense of integrity is maintained for the individual. For caregivers, this entails reduced workload and increased safety as the risk associated with falls due to helping someone shower is reduced, for both the patients and caregivers.

Naturally, more pilot studies would need to be conducted to study the safety and efficacy of robotic care. In addition, user feedback is also important to improve design and functionality. Despite being in the early stages of development, such innovative tools like robotic shower can greatly improve hygiene care and reduce the costs in the long run.

For more information: <http://robotics.hostit.se/poseidon/>

## **- GoFar: motivating physical activity among the older generation**

Physical activity steadily declines as we grow older. For many older people, it is not due to lack of motivation but due to physical limitations. However, for many others the motivation to do physical activity declines with growing age. Physical activity is very important for the elderly as it can help reduce risk of developing severe comorbidities and also promote good mental health. Interventions have been designed to improve physical activity and movement, but innovative solutions need to be developed to increase motivation.

GoFAR is a collaborative project between the region of Västra Götaland, Halmstad Municipality, Health Profile Institute, Kairos Future and Sport Competence. It is a project which aims to gather different actors in the field of healthcare such as psychologists, interaction design researchers and researchers in machine learning to work together and develop an evidence-based digital tool. The aim of this research is to help create evidence-based support tools such as digital apps which are quality-assured, cost effective and can stimulate motivation for doing physical activity.

This sort of digital tool, which is person-centred and promotes healthy behaviour, can greatly improve healthcare among not only the elderly but also at a public health level. Such projects which aim to provide eHealth services not for profit but for societal change and progress need to be sustained. Developing tools which do not generate only profits for private companies but can be used for the good of all individuals in a society and improve the health care system are very much needed today.

For more information: <https://www.hh.se/forskning/forskningsmiljoer/centrum-for-forskning-om-valfard-halsa-och-idrott-cvhi/forskningsomrade-hallbart-deltagande-i-idrott-och-fysisk-aktivitet/gofar.html>

**- AgeLab: promoting digital welfare among the elderly**

Older people are often lost to the world of digital and online communication. Despite advances made in the field of communication, their needs and knowledge regarding the digital world are not prioritised. In a society where the ageing population is rapidly growing, we need to make reforms to help older people learn digital communication and bridge the digital exclusion gap. Naturally, digital literacy among older adults is not always low and ability to use technological devices differs at an individual level.

A project started by the Göteborgs Stad Intracare, Family Relative Association in Gothenburg and educational institutions, called AgeLab is a prime example of a project which is innovative and beneficial for the society. A relative, resident or staff in care homes can access welfare technology which can then be used for testing by the elderly. This not only promotes more dialogue between the caregivers and elderly but also promotes knowledge development and enhances digital use skills among the elderly.

The project in its pilot phase was quite successful. The elderly showed interest in certain technological tools and welfare technology knowledge increased among the caregivers. The different welfare tools include products that can be used to control light and TV using voice control. These projects which incorporate different actors in healthcare and study their products can be very useful to increase awareness and knowledge about technology among elderly people.

For more information: <https://www.vinnova.se/en/p/agelab/>

## - Health Status Monitoring: Skin Patches

Many elderly people in Sweden live alone at home or with a partner if not living in elderly care or nursing homes. This has many benefits in terms of less burden on the healthcare workforce and cost reduction of supplying healthcare services. The elderly people living alone or with a partner at home however do not get the daily care and health monitoring that would have been available if they were in care homes. Informal and formal caregivers who provide care services at home can only dedicate a certain amount of their time.

A research group in Linköping University from the Laboratory of Organic Electronics is working on a very innovative and novel project. They aim to develop skin patches which collect information about the patients' blood pressure, heat sensors for leg swelling and many other applications. The aim is to make the patches discreet and portable. It will analyse the user's health status and provide feedback to the healthcare providers or caregivers.

This innovative tool can help with monitoring healthcare status among elderly people living alone and also living in care homes. Innovative projects like these are necessary to keep the healthcare systems up to date and reduce the burden of diseases.

For more information: <https://www.vinnova.se/en/p/continuous-health-status-monitoring-of-elderly-people-using-flexible-skin-patch-sensors2/>

## UNITED KINGDOM

### **- Torbay: an integrated healthcare model**

Many healthcare systems in the world have fragmented health and care services. Often services related to diagnosis, treatment, acute care and long-term care is provided and managed by different actors. For an elderly patient living with multiple chronic diseases, alone or in a nursing home, this necessitates efficient coordination between all the different health and care providers.

Integrated care is a concept that has started gaining more recognition in the field of healthcare. The concept highlights that services from all the different areas in healthcare such as treatment, diagnosis, therapy, long-term care needs to be provided in a way which ensures easy access, high quality, efficiency and user satisfaction. In many parts of the world efforts to establish this concept have begun. An example of successful integrated care model is provided below.

Torbay is a borough in UK where collaborations with the NHS have resulted in the development of integrated care programmes for the elderly. The model was piloted in 2004 and aimed to develop integrated care models in order to include telecare services. This included monitoring and support for the elderly using telecommunications or remote monitoring. The model aims to achieve the concept of integrated care but at the same time provide efficient care services. The model brought together care services from different healthcare providers for an elderly person with multiple healthcare needs, by ensuring collaboration via a strong general management source. The results of this model showed reductions in the number of daily averages of occupied beds from 750 in 1998-1999 to 502 in 2009-2010. In addition, the delays in transfer of care from hospitals have reduced substantially.

With such innovative models which integrate all the essential care services and operating at local levels can drastically improve healthcare services in countries like Sweden where healthcare service management is managed both by regions and municipalities. Integrated care not only allows healthcare services to be coordinated but also ensures that elderly people who need continuous care management are offered the best possible services. Inclusion of different fields of healthcare personnel and caregivers can help enhance care quality, improve quality of life for the patients and reduce costs.

For more information: <https://www.kingsfund.org.uk/sites/default/files/integrating-health-social-care-torbay-case-study-kings-fund-march-2011.pdf>

### - **KOMP: computers promoting easier communication**

Technological advances have made communication faster, more efficient and convenient. Using technological devices has become akin to learning how to play an instrument. For younger generations, this task is not considered very daunting but for older people who are not technologically inclined, operating smartphones and tablets can be challenging. Older people often face social isolation and loneliness despite advances being made in the digital world, because many of them lack the experience and knowledge of using technological devices. Below we provide an example of an innovative tool designed for older adults which can better facilitate communication.

KOMP is a computer with only one button, a high contrast screen and clear audio. The device requires no passwords and can be utilised by family members to stay in touch with the senior members of their family. The device is relatively easy to use, and personal data is kept safe as well. KOMP was started by a Norwegian company.

The development of such innovative devices helps meet the needs of the ageing population in ensuring that communication between them and their loved ones is possible. Many older adults often require assistance with daily activities, to gain information from online sources, and in some cases even learn how to operate devices and talk to their physicians online.

For more information: <https://www.noisolation.com/uk/komp/what-is-komp/>

**- One Digital: promoting digital literacy among the elderly**

Technological advancements have been on the rise for the past decade. Advances in virtual reality, robotics, information and technology, apps on phones have led to massive changes in lifestyle, society and also healthcare. However, living in a technologically driven and fast-paced world with a rapidly growing ageing population can have drawbacks. Older people are often at a disadvantage when it comes to the technological and digital tools. They can face challenges in operating devices or may not have sufficient knowledge regarding the tools which can lead to hindrances in their ability to online shop, watch news online, gather health information unlike the rest of the generations.

In this era of digital transformation, digital literacy can empower them with knowledge and skills which can in turn improve their own lifestyle and quality of life. There are a variety of digital healthcare related apps which can serve the purpose of telecare such as smart pill dispensers, telemonitoring to provide caregivers with everyday information, and telecommunication between healthcare providers and patients. Apart from the practical and healthcare aspect, digital literacy among the elderly can also enhance social inclusion and personal development which can contribute to enhancing quality of life.

One Digital is a project which aims to support older people who are not digitally inclined to be able to develop the required skills and knowledge to go online. Digital Champions are volunteers who are recruited and along with other specialities and training, they are the ones who teach the elderly on how to go online, use digital tools such as mobile phones and apps to contact their loved ones, or do online shopping. This is a project funded by the Big Lottery and in a collaborative effort between Age UK, Digital Unite, SCVA, Clarion Futures and Citizens Online. After phase 1 of the project, the results showed that the project had helped 11,000 people across the UK to be online and 80% of the participants reported more confidence, better understanding when using digital tools.

With innovative projects such as One Digital, focus on the mental well-being and participation in community aspect of active ageing is being fulfilled. Education for the elderly in improving digital skills can make them more active members of society. This can promote decreased social isolation and loneliness in addition to promoting mental health well-being. It grants them a sense of purpose which can improve their quality of life.

For more information: <https://www.ageuk.org.uk/our-impact/programmes/one-digital/>

## THE NETHERLANDS

### - Hogeweyk: the dementia village

Dementia affects approximately 50 million people worldwide and is a chronic and debilitating condition leading to deterioration in memory, behavioural changes and impaired day-to-day function (11). Older people are at a higher risk for dementia and it is one of the major causes of disability. Currently, there is no treatment available for dementia or medications to halt its progression. In light of this, dementia care needs to be optimised to ensure that those diagnosed with it, can continue living life as normally as possible.

Hogeweyk is a dementia village in the Netherlands with 23 houses for older people with advanced dementia grouped together to form a village. There are approximately 152 residents in Hogeweyk living with different stages of dementia. The village serves as a nursing home but is designed to resemble a normal residential area. The staff working in the village are experienced caregivers who monitor and tend to the needs of the residents. Residents have access to supermarkets, theatre, a clinic and community centres in addition to their homes.

This innovative idea not only includes the medical aspect of tending to dementia patients but also incorporates a major social aspect. The residents living in Hogeweyk are given autonomy over their life and are provided with the opportunity to have a sense of normality despite living with dementia. The inclusion of theatres, community centres and pubs not only help with keeping the residents physically active but also helps decrease social isolation.

Often caregivers for dementia patients are informal caregivers such as family members or partners (15). Informal and formal caregivers often face many mental and physical challenges while caring for dementia patients. To cope with such stressors, healthcare systems need to implement policies and provision systems in place to support the caregivers. Apart from the social and medical impact that dementia has, it also has significant economic implications. As per a WHO factsheet, in 2015, the total cost related to dementia was estimated to be US 818 billion dollars (11). Health expenditure increases to ensure that medical, social and informal care is sustained. More important than ever, research regarding dementia needs to be funded in order to learn more about the condition. Innovative care and research regarding dementia need to be at the forefront of all public health agendas, in order to tackle this large-scale health and social issue.

For more information: <https://hogeweyk.dementiavillage.com/en/>

**- cMED: a smart pill dispenser**

Comorbidities tend to increase as individuals grow older. Among the elderly who have chronic diseases, medication use also increases. Medication adherence is important in order to treat the conditions but also because lack of adherence can lead to increased clinical visits and deteriorating health for the patient. Medication adherence can be negatively affected by a lot of reasons during old age such as physical problems in terms of dexterity or issues such as forgetfulness. Several studies have been conducted in order to study the reasons behind medication nonadherence among elderly (16). Innovative solutions ensuring that adherence to medication is being fulfilled while maintaining the individual's autonomy and well-being is presented below.

FocusCura is a leading company working with e-health in The Netherlands. They also work in countries such as Belgium, Sweden and Germany. The aim of the company is to create innovative digital solutions which bridge the gap between technology and healthcare. Quality care delivery via technological concepts for both healthcare professionals, patients/clients is what FocusCura strives for.

One of their innovative technological developments for healthcare is the cMed product. The product is designed to deliver reminders and dispense medications. It is linked to the internet portal and integrates technological innovation. Healthcare professionals, pharmacists or caregivers can be alerted if the medication is not removed from the dispenser, thereby ensuring virtual communication between the patient and the healthcare/care provider.

A smart pill dispenser can radically improve medication adherence. For elderly who suffer from forgetfulness, pill dispensers which send out reminders are highly useful. Additionally, many elderly people suffer from physical dexterity issues. If designed with physical limitations in mind, a smart pill dispenser can save time and energy where there is easy access to the medication. Medication mismanagement such as taking the wrong pill or incorrect dosage can severely endanger the health of the patient. With a smart pill manager, such issues are avoided and elderly patients who suffer from multiple chronic diseases can manage which medication they are taking. Lastly, one of the most important aspects of such innovative tools is that it uses technology to enhance communication between the patient and the healthcare provider without having to put a strain on the healthcare system such as automatic refilling of smart pill dispenser instead of having scheduled visits for refilling prescriptions.

For more information: <https://www.focuscura.com/en/cmed-medication-support>

**- eWare: improving lifestyle monitoring for elderly and caregivers**

Lifestyle monitoring is a form of telecare technology where the concept of monitoring daily activities via sensors can be used to monitor health status for people living alone at home, such as the elderly. eWare stands for “Early Warning (by lifestyle monitoring) Accompanies Robotics Excellence” and is one of the projects under the European programme, AAL (Active and Assisted Living). The eWare project aims to improve the lifestyle for not only patients with dementia but also caregivers. Formal and informal caregivers often experience high levels of stress when caring for a person with dementia. eWare aims to reduce this stress by enhancing quality of life for the carer and the patient, while also promoting communication between the formal, informal carers and the patient. It integrates two innovative technologies: lifestyle monitoring by Sensara and social robotic technology Tinybots. Together with lifestyle monitoring and social robotics the caregivers get an insight into the routine and daily life of the patient which can help communication and planning.

This is an ongoing project with several partners involved. There are pilot tests being carried out in different countries and one of them is in the Netherlands. Vilans, the national expert organisation for long-term care in the Netherlands, is the main research and development unit, Sensara B.V and Tinybots B.V are suppliers and ZZG Zorggroep is where the pilot testing will be done. Switzerland, Norway and Italy are also involved in this innovative project.

This innovative project not only helps out caregivers who work with dementia patients, but also caregivers for the elderly in general. The impact of such projects can reduce the stress on caregivers but also provide the patient with autonomy to live their own life. Caregivers can monitor lifestyle activity and act accordingly, while studying the needs and routine of the individual with dementia. Effectiveness and quality of care is improved by monitoring lifestyle patterns or changes in patterns (such as infrequent visits to kitchen could entail decreased appetite). Such technological advances in the care delivery can greatly improve effectiveness, quality of care and reduce some of the burden from health systems.

For more information: <http://www.aal-europe.eu/projects/eware/>

**- Palette: bringing older people together**

Social isolation poses a great risk among the ageing population. Studies have shown that loneliness and social isolation can lead to cognitive and mental health decline, depression and reduce overall quality of life among the elderly population (17,18). Older people who are at a higher risk of experiencing social isolation and loneliness need supportive environments which can keep them mentally and physically active.

Palette is a digital tool which serves as an online platform connecting older people with each other via common interests such as reading books or knitting. It enables activities to be created on the platform and shared with others. Such digital tools which connect elderly people to each other on the basis of common interests can decrease the effect of social isolation. It promotes activity in daily life and can greatly improve quality of life.

Online apps and tools have become very common and serve as interventions to tackle many challenges faced by the elderly population. It is important to not only promote physical well-being among the elderly but also strive to ensure that mental health issues such as depression, loneliness, anxiety are reduced.

For more information: <https://www.vilans.org/project/palettev2-eliminates-barriers-to-information/>

## SWITZERLAND

### - Cardioexplorer: Merging AI and medical diagnosis

Artificial intelligence (AI) research and incorporation of AI in technical devices is done across a variety of fields. When it comes to healthcare, innovative tools supported by AI have been rapidly emerging on the market. Many countries have started adopting AI technology in healthcare. One prime example of an innovative AI supported digital tool is seen in Switzerland.

Exploris, a company from Switzerland has developed an eDiagnostic tool to detect stenosis from coronary artery disease. Cardiovascular diseases are the leading cause of death worldwide and timely intervention is necessary to prevent increasing mortality due to CVD. This innovative diagnostic tool made by Exploris is a non-invasive eDiagnostic test which is based on artificial intelligence. It can help detect stenosis (closure of arteries) in a timely fashion. This rapid testing eDiagnostic tool is made by Prof. Zellweger of University Hospital Basel and had been validated with high sensitivity and specificity through three clinical trial studies.

Among the elderly, cardiovascular diseases risk increases due to changes in the structures of the heart and arteries. This puts the elderly population at a high risk of suffering from heart attacks, stroke or coronary heart disease. This combined with other morbidities can greatly reduce quality of life for elderly patients. Thus, innovative tools which help detect these diseases in time can help prevent further progression of the disease.

For more information: <https://www.exploris.info/Cardio-Explorer/>

**- MindMotion: neurorehabilitation solution for continuum of care**

Elderly people are often at a higher risk of suffering from falls. Many healthcare systems have started investing in fall prevention among elderly. Being at risk for falls can lead to neurological injuries, for which the recovery process is quite extensive.

MindMotion™ is a series of products developed by MindMaze team from Lausanne, Switzerland. The team consists of neuroscientists, software developers, experts in artificial intelligence and hardware and mixed reality design. The company developed products, MindMotion™ GO and MindMotion™ PRO, which use virtual environment-based technology and neurorehabilitation to deliver optimised therapy after a neurological injury. The products have been clinically tested and approved, helping healthcare providers to deliver quality care and improve patient's motivation during their recovery.

MindMotion™ PRO can be used to increase upper limb neurorehabilitation during early bedside use. It is an intervention that can be used as early as 4 days into recovery after a stroke or other neurological injury affecting the upper limbs. The VR technology helps patients practice basic upper limb movements such as elbow flexion and extension. The difficulty for each of these movements can also be adjusted as per the patient's comfort. There are exercises in the form of games which can be used to practice everyday life movements.

Such innovative tools which combine technology and therapy can advance healthcare quality. Rehabilitative care for neurological injuries can often be challenging. Elderly people who suffer from neurological illness such as Parkinson's disease often need rehabilitative therapy and care. With such innovative tools, this form of healthcare and therapy can be made easy and motivating.

For more information: <https://www.mindmotionweb.com/>

**- CARU: communication between informal caregivers and elderly made easier**

Feelings of isolation and loneliness are often very common among elderly people who live alone at home or in elderly care homes. Communication with grandparents and older relatives in this technological age has never been easier. We can simply pick up our mobile telephones and call our loved ones to talk to them. This is especially important with older people as they can often feel lonely and depressed. As informal caregivers, managing communication with older relatives and managing everyday life can often get difficult.

The development of innovative tools such as CARU can help with everyday communication between older people, informal and formal caregivers. CARU is a voice activated, sensor-packed digital assistant, similar to Alexa and Siri. It can be used by older people to send messages to their family members but can also be used in case of emergency whereby the device connects the individual to their family member and also caregiver.

Such designs which use voice activation and other technology are greatly advancing healthcare quality. It helps easier communication between family members and older people which can reduce mental health issues such as depression among elderly people.

For more information: <https://www.caruhome.com/en/>

## COVID-19 PANDEMIC

With a public health crisis such as the COVID-19 pandemic, affecting individuals at a global scale, digital tools which have made care for elderly possible during such difficult times need to be highlighted. Elderly above the age of 65 years are in the high-risk group, such that if they contract the virus, it can be dangerous for their health. Due to underlying comorbidities their health can worsen if they are infected. In many countries, elderly care homes have seen a sharp increase in the number of deaths due to the COVID-19 disease. Family visits are restricted and only essential care staff are allowed to be in contact.

As reduced family visits can hinder communication, an example of creating safe places for elderly people to meet their families has been demonstrated by a Swedish nursing home in Falkenberg (19). These safe places are often outside the care home, where both the elderly and their relatives can meet. During the meeting, a transparent glass wall separates the two parties and prevents the transmission of the virus (19). This helps prevent loneliness and anxiety for the elderly during a time of crisis. Many other responses have been developed in Sweden such as the conversion of a conference centre to an army field hospital and research projects in order to find antibodies against the SARS-CoV-2 virus.

In the UK, a radio podcast called Later Life Audio and Radio Network (LLIARN) where elderly people can help share their views of different topics of interest and inspire discussion (20). This keeps them active thereby preventing development of depression. In Belgium, in order to keep physical activity routines on going and to ensure that older people do not lack motivation to move around, an organisation called OKRA is providing online workout classes for older people (21).

OECD has established a platform named 'Observatory of Public Sector Innovation' (OPSI) and has an innovative response tracker for the COVID-19 pandemic (22). In countries like Portugal, 35 innovative responses have been reported. One of these tools has been CovidAPP, a smart management platform, which can help patients and potentially infected citizens to monitor their symptoms (23). The healthcare personnel can be updated using these apps and can track the patient's symptoms and health. This is an innovative tool as by using machine learning and prediction models, the cases which could potentially need hospitalisation can be tracked. This reduces the burden on the hospital capacity, ensures communication and optimises care.

## POLICY RECOMMENDATIONS

As the ageing population continues to increase, it is important to ensure that healthcare systems are able to meet the increased demands but also provide efficient, high-quality care. Along with the increasing technological advances, innovation in healthcare is also on a rise. In this report, we have mentioned some innovative projects and digital tools that serve as prime examples of innovation in healthcare. Below, we present some key policy recommendations that could serve to enhance innovation in healthcare.

- Involve patients and patients' associations in all levels of dialogue: from policy to test phases of innovative projects
- Strengthen discourse between different actors: policy makers, healthcare service providers, personnel, researchers and patient associations.
- Enhance reimbursement systems with incentives for integration of health care and social services
- Increase health promotion by funding research and innovation projects focusing on prevention
- Reinforce ICT infrastructure to ensure integration and better use of healthcare data
- Increase the use of healthcare databases and registers to enhance knowledge about care patterns for patients living alone, with multiple chronic diseases to improve quality of care
- Improve and establish stringent policies regarding data collection to ensure privacy of patient's data

## CONCLUSION

With the rapid increase in ageing population, it is expected that in the upcoming years healthcare for the elderly will act as the cornerstone for policies at all levels. The reason for an increased ageing population can be attributed to the technological and social development that has been made over the last few decades. Advances in medicine, increased research and development, collaboration between countries and large organisations are all factors worth mentioning. Innovation in elderly care has started growing rapidly and in the upcoming years this trend is expected to increase, with more projects being developed. Innovation has many different stages from research and development, to pilot testing the ideas to incorporation of the projects on large scales and finally to make policy level changes.

Naturally, with innovation progress in elderly care, such as using digital smart pill dispensers or AI based systems for health status monitoring, a key aspect in development should be regarding equity in healthcare. Development of innovative healthcare should be such that individuals from every stratum should be able to maintain their right of equal access to healthcare. Progression in innovation and technology and adaptation at systemic levels is necessary in order to manage the increased burden of ageing population on healthcare systems.

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