Technologies in care for older people

EPTA report 2019

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Preface

Distinguished reader,

The theme of this year's EPTA report deals with technologies and social innovations in elderly care. This important topic addresses future challenges posed by a growing elderly population. Globally, the proportion of the population aged 80 years or more is projected to increase more than threefold between 2017 and 2050. Similar increases are expected in European countries. Ageing societies will thus face more complicated and costly demands for improved – or even sustained – welfare. These challenges will require major changes including new technologies and social innovations in elderly care. Guaranteeing a new agenda for active and healthy ageing using technologies and innovations while at the same time minimising potential adverse effects on the rights, capabilities and resilience of older persons will thus be essential. Technology assessments (TA) are playing a crucial role in both understanding and tackling these issues.

This report, with contributions from 17 EPTA members, provides an up-to-date international overview of policies linked to the topic of technologies in elderly care. It delves into various aspects of the topic, such as the challenges involved in the implementation of health and social care technologies. The report also provides examples of solutions and best practices and elaborates on future perspectives and policy implications of various aspects ranging from ethical issues – centred around autonomy, consent, and privacy – to both employment/training and legal/regulatory concerns. It gives the reader a general introduction and a synthesis of the current state of affairs in the EPTA countries.

I would like to take this opportunity to thank all the contributors to this report. In particular, I would like to thank Helene Limén for compiling the report. Last but not least, I would also like to thank Grant Hill-Cawthorne, Maartje Niezen and Tore Tennøe who – in a joint effort with Helene – compiled the report's valuable synthesis of the different member reports.

I wish you enlightening and enjoyable reading!

Thomas Larue, EPTA President 2019
Director of the Evaluation and Research Secretariat (ERS) of the Swedish Parliament

Stockholm, October 2019

About the report

This report is the result of a joint effort of the members of the *European Parliamentary Technology Assessment* (EPTA) network. The EPTA partners advise parliaments on the possible social, economic and environmental impact of new sciences and technologies. For the annual EPTA conference, the members make a report on different topics concerning the relationship between technological change, society, economy and politics.

The aim of this year's report is to present the current use of technologies and social innovations in elderly care, describe different policy initiatives, and discuss its societal implications and future perspectives.

The backdrop for this is that many countries now experience rapidly ageing populations, with fundamental implications for employment, health care and finances. As the reports show, a range of new technologies such as mobile health devices, smart homes and robots can support an active life, safety, and independence.

However, technology alone is not enough. Improvements in elderly care are to a high degree based on social innovations, with inclusion of users and different stakeholders, and a policy framework that stimulates and shapes the development.

Furthermore, as technology such as artificial intelligence opens for new modes of work and care, there will be an urgent need to consider privacy, integrity, human rights, and social inclusion. Technology assessment can thus play an important role in informing the debate around what is "good" social and health care in a modern digital society.

Our main target groups for the report are decision makers in parliaments, governments, and institutions interested in technology assessment. The report provides:

- a unique up-to-date overview of policies linked to the topic
- an international view of 17 countries around the world, mainly from Europe but also with contributions from US, Mexico and Japan.
- both promises and challenges with technologies in elderly care that go beyond a purely technological perspective, including sociotechnical, ethical, and long-term perspectives.

The different institutions are responsible for the description of the country or region where they belong. For the purpose of this report, a synthesis of the country reports has been put together by Grant Hill-Cawthorne (UK), Helene Limén (Sweden), Maartje Niezen (Netherlands) and Tore Tennøe (Norway).

Elderly population – worldwide and in Europe

Globally, the number of persons aged 80 years or over is projected to increase more than threefold between 2017 and 2050, rising from 137 million to 425 million. Population ageing has implications for the health of the population and the number of people requiring extended care due to disability or functional limitation is likely to increase in all countries and has important implications for sustainable development. A collective effort is needed to support a new agenda of active and healthy ageing that can reduce these vulnerabilities and enhance the rights,

capabilities and resilience of older persons, and thus fulfil the pledge of the 2030 Agenda to leave no one behind[1].

In Europe, the population structure is rapidly changing with an increasing proportion of older people. It is estimated that by 2030, older people (60 years and over) will constitute more than 25% of the population in Europe. Eurostat's population projections to 2080 indicate that population ageing will continue across all of Europe, with a considerable reduction in the number and share of working-age persons. The ageing process that is underway is projected to lead to an increasing number of very old persons (80 years and over, Fig 1).

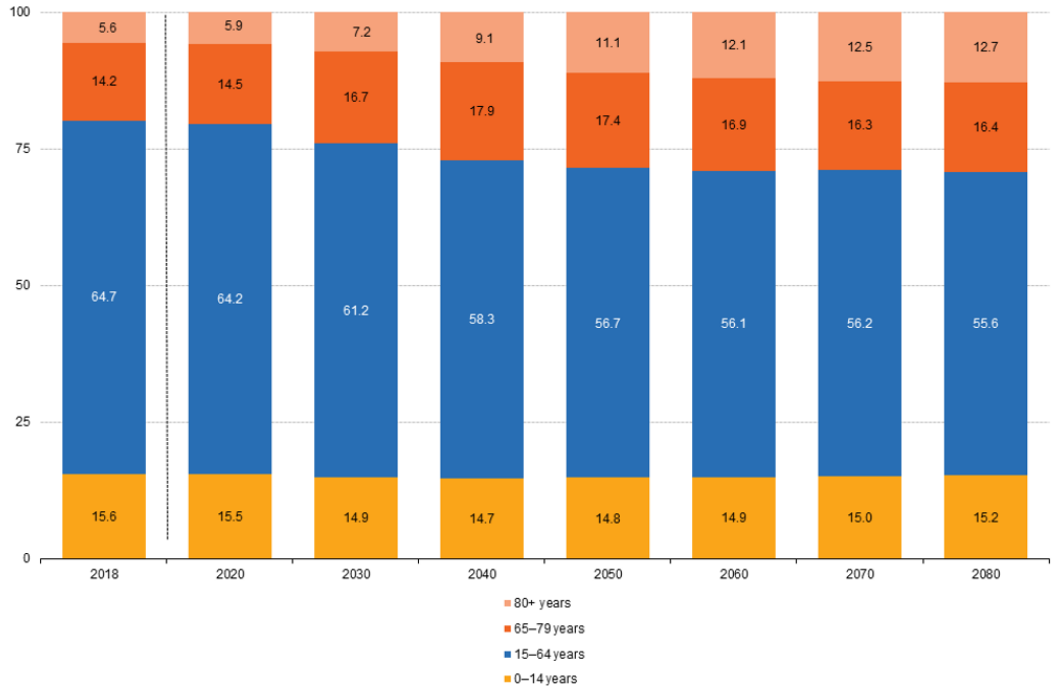

Fig. 1. Population structure by major age groups (EU-28) 2018 and projections to 2080. Source: Eurostat

The facts and figures about the ageing society in the country reports show a similar development, although some particular trends and differences can be picked out. For example:

- *Differences between countries.* Japan is facing a rapidly ageing population – unprecedented in the world. In 2007, Japan's ageing rate (the proportion of the total population over 65 years of age) exceeded 21%, becoming the first super-ageing society in the world. Mexico has a relatively younger population, but will face a much faster transformation in the coming 30 years as a steep increase in the proportion of elderly is expected.
- *Regional differences.* In Germany the share of people of working age is falling particularly fast in the new federal states (i.e. East Germany), as mainly young, qualified women moved away and left an additional demographic gap.

[1] UN (2017) World Population Ageing – Highlights. Department of Economic and Social Affairs.

- *Urban/rural divide*. In the Netherlands rural population shrinking is leading to pressure on elderly care, as older adults live in rural regions at a large distance from their children.
- *Gender balance*. In many countries the proportion of elderly differs between men and women, where a larger proportion in older age groups are women (e.g. in Austria, 67% of over 80-year -olds are female).

Implications for ageing societies

An increasing part of the population is becoming older and at the same time the number of caregivers is decreasing. This has a number of implications for society:

Employment. Relatively fewer hands are available in an ageing society. The dependency ratio (the ratio between the number of persons over 65 and the number of persons aged between 20 and 64) is increasing. In the federal states of Germany the ratio is particularly high at 44%. This is one of the highest figures in the world, second only to Japan.

Economy. More money goes to pensions and at the same time the share of taxes decreases.

Healthcare. Diseases connected to ageing, such as dementia, are increasing. Dementia is considered to be one of the greatest challenges for health and social care in the 21st century. Around 50 million people worldwide have dementia today, a number that is predicted to triple by 2050.

Social care. Lack of caregivers in social care leads to a greater share of that responsibility falling on informal carers, usually female family members in their 50s and 60s as stated in the UK report. In Japan, people are leaving their jobs to provide care for family members due to a shortage of nursing staff, which has become a major problem.

Not only a challenge – also an opportunity. The ageing society does not only pose challenges, but also affords a number of opportunities as older people can contribute their multitude of experiences, time and possibly also financial resources to the community. Well-being is in many cases peaking at 70-74 years according to the UK report. Initiatives have been taken, for example in Austria „Arbeit und Alter“ (“work and age”) to offer virtual consulting for enterprises, improving the situation of older adults in real work-life settings.

The promise of different technologies for elderly care

Older adults are a highly heterogenous group with different preferences, needs and lifestyles. Staying fit and healthy is an important factor prolonging work participation and ensuring a good quality of life within the ageing population. A majority of older adults prefer to stay at home as long as possible. This has also been supported by decision-makers and healthcare providers, as it

leads to lower costs for society compared with institutional care. Digital technologies, such as e-health and robotics, have the potential to contribute to active ageing[2] in a cost-effective manner.

E-health – using digital technology for remote care includes a wide range of digital solutions within the health and social care sector. Digital solutions with examples from the country reports are:

- *Telehealth***.** The remote collection of patient data, such as blood pressure. In the US, implementation of telehealth can improve care for Medicare beneficiaries, even though some barriers have been identified – such as payment restrictions.
- *Telecare***.** The provision of remote care with the help of environmental sensors to detect, for example, falls or fire. A local project in Poland aims to improve the quality and safety at home for older people by providing them with telecare.
- *Telemedicine.* The delivery of medical care over distance. It can be about consultations by phone or video conferences between patient and doctor. In Japan, a lack of medical staff has pushed progress towards the development of telemedicine. In Greece, telemedicine is used by patients located in remote island locations.
- *Telecoaching***.** A method focusing on behavioural change and to aid recovery. It can be delivered by different digital tools, such as a computer and smart phone.
- *Mobile Health* (mHealth). The use of mobile health applications for self-diagnosis and health monitoring at a distance. Norway has tested a number of technologies, such as automatic pill dispensers, remote COPD (chronic obstructive pulmonary disease) monitoring, and personalized health check-ups.

Active and Assistive Living (AAL) deploys ICT in the form of **assistive technologies** (AT) – **supporting elderly in their daily lives**. They can be defined as home-based systems or devices that support diverse activities of older adults, and allow an individual to perform a task they would otherwise be unable to do, or increases the ease and safety with which the task can be performed. Potential benefits of ATs are increased individual autonomy and quality of life, together with improved social participation[3]. There are trade-offs that have to be assessed as the technologies are developed, such as risks of substituting human assistance by technology, threats to privacy or other unintended side-effects[4].

Robotic technology - is expected to help older people to **gain independence** and is emerging as an approach to assist older adults with, for example, robotic wheelchairs, shower chairs and technologies to prevent falls. Robotic technologies can also be applied indirectly for older people through the provision of support to caregivers. In Sweden, for example, an evaluation of the shower chair, Poseidon, shows that older people feel that they can control their shower situation to a greater extent and become more independent. In addition, it has led to a better work situation for care staff, with reduced risk of injuries.

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[2] "Active ageing" can be defined as "… *a process of optimizing opportunities for health, participation and security in order to enhance the quality of life as people age"* according to WHO.

[3] Bechtold U et al (2017) *Futures of ageing and technology – comparing different actors' prospective views*. Journal of Responsible Innovation 4:157-176.

[4] Bechtold U & Sotoudeh MEng M (2013) *Assistive technologies: Their development from a technology assessment perspective*. Gerontology 11: 521-533.

Socially assistive robots can enhance well-being of older people but ethical issues have been raised in some studies, including the reduction in human interactions. A Swiss study, for example, advises caution when using robots to replace human interaction as it could increase the user's sense of isolation.

Companion robots have received more attention in research studies compared with other important aspects of older people's independent living, such as bathing or falls[5]. The robot seal, Paro, is often used in therapies for older people having problems with emotional contact and sleeping in a number of countries (Germany, Japan, Netherlands, UK).

Implementing health and social care technologies – what are the challenges?

A number of challenges have been identified in the country reports concerning the implementation of new technologies in the health and social care sectors.

Access and use of the internet. Internet use among older adults in Europe differ significantly between countries (Fig 2). A comparison of countries in Europe from 2016 shows that weekly users of the internet is relatively high at more than 70% in northern countries, the Netherlands and UK, but lower in Southern Europe.

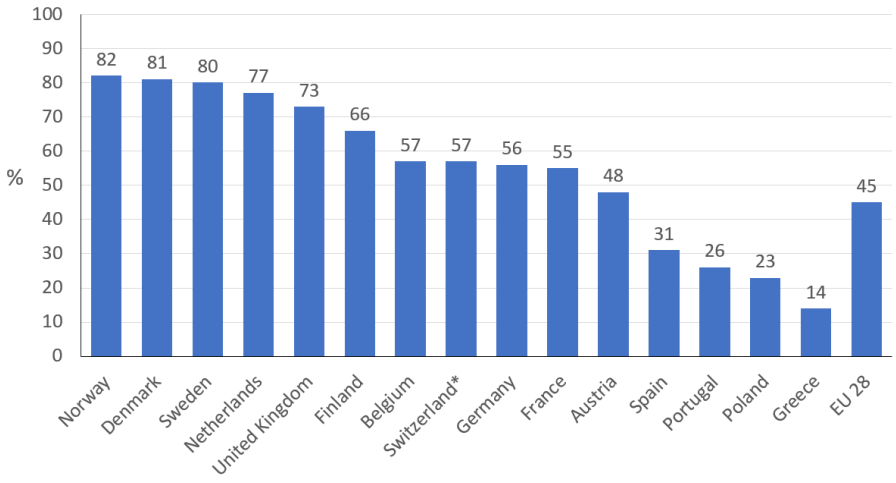

Fig 2. Use of internet - at least once a week within the age-group of 65–74 years, 2016, *data from 2015. Source: Eurostat.

Digital alienation among older people is a challenge, particularly for the older age group (above 74 years) but there are ongoing positive developments in most the countries. This also applies for healthcare workers and social caregivers, who will need *life-long learning* to adapt to a more digital working environment. In Poland and Greece, digital alienation is, in comparison with other EU-countries, more widespread among the elderly population.

[5] Shishehgar M et al (2018) *A systematic review of research into how robotic technology can help older people*. Smart Health 7-8: 1-18

Loneliness is widespread among the elderly and this calls for socio-technological innovations rather than technological solutions (Netherlands). Training programs for older users to master technological tools can provide additional benefits, such as larger social networks and reduced loneliness (Norway, Sweden). The report from UK brings up concerns that the quality of social care may diminish with the use of robots, because robots are incapable of fulfilling the social or emotional needs of older care recipients, which may increase loneliness and isolation amongst this group.

Lack of digital infrastructure in the health and social care sectors is an obstacle, for example, in Germany. A prerequisite for developing e-health and m-health is patient access to online medical records, which has been recommended as a key action in Europe. However, most member states still lack legislation to support such access (STOA). A sound e-health platform requires putting in the effort to harmonise standards, ensure interoperability, and optimise the integration of new and existing ICT solutions.

Funding. Costs for e-health applications and AAL technologies hinder the technology pull in many countries. For example, in Austria and Mexico, the purchase of AAL technology is private and not subsidised by the state. In Germany, the healthcare insurance system only covers some innovative aids. New financial models will be required in the future to support the implementation of care technologies for older people.

Integrity and privacy are always an issue with digitalisation. Machines dehumanising nursing and medical care is, for example, a concern in Germany.

Importantly, in most of the country reports it becomes obvious that the care of elderly people and their participation in society, requires far more than a simple technological fix.

Solutions and best practices

The country reports demonstrate various solutions and best practices that increasingly focus on the heterogeneousness of elderly people and their abilities and needs to participate in society in a positive way. The reports provide an oversight of the current state of the art in the various countries and the attempts made to increase the participation of elderly people in society by making use of supporting technologies. Most of the best practices or solutions discussed in the reports are still at an experimental phase or are not yet widely distributed within and across countries (see e.g. Germany, Poland, UK). Hence, the importance of evaluation and sharing of insights and knowledge should gain attention.

Digital skills

Several of the countries report on programs aiming to support and increase the digital competencies of older people (Norway, Finland, Austria, Catalonia, Poland, Sweden and the Netherlands). Training programs for older users to master technological tools lead to additional benefits, such as increased social networks and reduced loneliness (Norway). In the Netherlands, municipalities offer computer courses to residents. In addition, a national expert centre focus on

reducing health differences due to digital alienation by allowing older people to benefit from eHealth usage.

The "Digital Poland" programme provides co-financing to projects that encourage citizens to use the internet and improve their digital competencies. These activities are implemented mainly by non-governmental organisations in partnership with local governments. Currently (by 30th June 2019), 11 such projects are being implemented. Necessary actions include not only building digital competencies, but also relieving potential concerns of the elderly resulting from the fact that modern forms of care are limiting personal relationships.

Other initiatives focus on improving digital skills for health and social care professionals. Norway has interdisciplinary training programs on legislation and ethics, methods for mapping user needs and introductions to technological tools and methods. In the Netherlands, Academic Collaborative Centres and applied science laboratories also focus on the training of healthcare professionals. These health education programs are adapted to face future demands in more digitised ageing care and focus on life-long learning. In Sweden a support unit for welfare technology was established that had the responsibility for the education of healthcare professionals and turned out to be one of the key factors for the successful implementation of e-home care.

Examples of further training for staff in Sweden are two web-based education packages that have been developed with the aim to support municipalities and other actors in implementing digital technologies. One of them "*Ethics and integrity when introducing welfare technology*" focuses on e-health solutions in elderly care and includes subjects on ethics, integrity and independence, the need for human contact, conflicting goals and opportunities and risks in data collection. The other education program, "*E-health and welfare technology in the social services*" concerns how e-services and welfare technology facilitate administrative work and increase the benefits for the caregiver, the profession and decision makers.

Innovation policy

The country reports give examples of a range of initiatives to stimulate innovations for elderly care in general, and particularly for staying safely at home longer through e-health applications and new residential care arrangements.

Norway has launched a *care technology program* with a total budget of around €1 billion. The goal is that care technology will be an integral part of all municipalities' care services by 2020. User-friendly care technology; such as safety alarms, remote health monitoring and better scheduling; and training for users, next-of kin and employees have been the top priorities. Preliminary results show that overnight hospital admissions were reduced by 33%, and users felt safer.

Similarly, the Swedish city of Västerås has demonstrated a high rate of return: each Swedish crown invested in e-home care has given 5 crowns back. In all steps, the implementation of e-home care has received support from politicians and stakeholders and has been done with a user-centred approach in collaboration with key actors. The city has established a separate support unit for welfare technology with responsibility for education of care professionals.

In Finland, several regional *testbeds and living labs* to enable longer living at home have been established and organised around the university hospitals. These involve extensive piloting, commercialization and/or collaboration with business and other stakeholders. In the city of

Helsinki, a living lab has been established in a new district as part of a "smart city"-concept, where the local authorities and companies can invite inhabitants to participate in experimental projects.

The local government in Kitakyushu, Japan, has actively facilitated the development and practical implementation of nursing care robots since 2016. In the development process, the details of work required for nursing care are analysed in advance, in cooperation with the nursing staff. The robots will be tested in nursing care facilities and enter the market after being improved based on feedback from caregivers. Fukuoka city has taken a similar role as a testbed for telemedicine.

Initiatives have been taken in Germany as a response to increased travel and waiting time of older people, who need long-term and medical care. A concerted political effort on many levels has been taken which includes initiatives for schooling and training of personnel, salary improvements and cross-border recruitment of skilled nursing and medical professionals.

In Catalonia the Barcelona Town Hall and 5G Barcelona launched a new call for applications through the d-LAB programme to provide innovative technological solutions to improve the quality of life of elderly people. These innovations can play an important role in optimizing older people's health and well-being, offering them support, assistance or prevention, helping them to stay at their homes (familiar living environment) as long as possible.

Social innovations

Many reports demonstrate how social innovations and technological innovations, when combined, offer a better answer to the social inclusion of elderly people than merely technology-driven solutions. Integrated care models in the Netherlands offering various resources in the care of the elderly population have proven successful for personalised, proactive and preventive care and support.

In Sweden, a model including changes in working methods, living environment and technology use decreased the restraints in the living environment for people with dementia. Social innovations, such as co-operative housing projects and connecting peer companions to older people when needed, are another example from Finland. Furthermore, attention on the prevention of falls and other support for elderly people via non-technological measures is recognised as a valuable way for innovating care for older adults (e.g. Mexico, Finland). GAO (USA) reports on the importance of transportation for older people and the use of supporting applications in order for them to stay in their homes as long as possible.

Various reports demonstrate that when developers of technological solutions put the needs of older people first and foremost, and, for example, not focus on their frailty, this leads to innovations being more likely accepted and used by elderly people, health professionals and caregivers. Technologies that aim to stimulate older people's participation in society focus on the various stages in their lives and their various needs; whether it is to participate in working life, or to live longer and comfortably at home, or move to a nursing home (Austria, the Netherlands, Sweden, Finland). The reports also demonstrate how various solutions can be offered to older people living with, for example, visual and hearing impairments (STOA), dementia or other ailments. The type of technologies supporting elderly people's participation vary, from sharing health data, telemedicine, robotics and AI, to assistive technologies and ambient assistive living.

New models of work can, for example, include flexible workloads allowing older citizens to contribute to the labour force – a suggestion resulting from a participatory Technology

Assessment in Vienna, Austria. In addition, several national measures in Austria have been taken to improve the situation for older adults in working life. A study by STOA concludes that ATs can contribute to the social inclusion of older people with hearing impairments, thus enabling them to continue participating in working life.

Inclusion of stakeholders and users

The inclusion of relevant stakeholders during the development of technologies supporting elderly people is considered to be a key element for success according to several country reports. Austria, Germany, the Netherlands, Portugal, Sweden and Finland report on integrated participatory research projects, testbeds, living labs or other integral methods that aim to contribute to the knowledge of all involved actors.

In order to improve elderly care, the Dutch Ministry of Health has stimulated various parties to collaborate. With the so-called *'Pact for care for the elderly people'*, various stakeholders, from governmental bodies, insurers, tech-developers to care providers, come into action together to, identify and break through loneliness, organize good care and support at home, and improve the quality of nursing home care. Policy and financial incentives are put in place for each of those themes.

A senior citizen representative has been nominated by the City of Vienna, Austria, who acts as a mediator between society, city and policy makers, and is involved in the development of projects and strategies in terms of proactively posting and integrating the needs of older adults. The "SeniorInnenbüro" (Office for seniors) of the city of Vienna serves as a platform for direct communication with citizens and their needs. Similar tasks, especially communicating ideas, wishes and needs of older adults to the city agencies are realised by the advisory council of seniors.

Future perspectives and policy implications

When examining technological options for supporting longer living, it is not enough to consider the basic pros and cons of particular technologies. Instead the use of these technologies lead to wider societal discussions around how a nation looks after its older population, and what good care looks like. Technology assessments can play an important role in informing the debate around what is "good" social and health care in a modern digital society. A number of the projects highlighted in the different country reports are striving to analyse e-health platforms, active and assistive living (AAL) including assistive technologies (AT) and robotic technology to understand the potential for supporting older people and people with disabilities.

Many of the ethical challenges that the different technologies present are similar, regardless of technology, and instead reflect the population group that they are potentially having an impact upon. The issues raised here also need to be balanced against the potential benefits, of which there are many.

When considering the use of robots in the care of older people, it is clear that health robots and monitoring technologies can be used to promote the individual's quality of life, integrity and self-determination. They can support existing services to provide an increased quality of care in the health and social care services, more efficiently and more effectively. They can improve care staffs' working environment by, for example, avoiding tough and heavy work tasks. Monitoring

with GPS can prevent older people from getting hurt if they become lost, and monitoring can mean security for relatives.

Similarly, computing in healthcare can play a key role in expanding access to diagnostic services, improving their quality, increasing coordination between providers, and helping to overcome physical distances between patients and healthcare workers.

Autonomy, Consent and Independence

Work by the Rathenau Instituut, the Netherlands, on human rights in the robot age suggested that new potential human rights are needed to keep the robot age human-friendly: 1) the right to not be measured, analysed or coached, and 2) the right to meaningful human contact. Robots can both benefit and adversely affect an individual's autonomy and self-determination. They can improve the autonomy of elderly people by assisting them when they change their clothes or take a bath, but they may also restrain an elderly person if their developers have programmed them to do so, even if this is unintentionally. When robot technology forces users to take a particular course of action because developers believe they know what is best for these users, the possibility of unwanted paternalism occurs.

Focus groups with older people and caregivers have identified concerns about: the degree to which robots could prevent people from engaging in risky behaviours like smoking; the extent that robots could make users do something if they did not wish to, like take scheduled medication; and the potential that users may become dependent on robots, undermining their ability to do things for themselves and reducing independence. However, it should be noted that concerns about dependence have also been raised when considering the use of human caregivers.

Similarly, the use of machine learning can make predictions about an individual's behaviour and preferences more accurately and inexpensively than before. It therefore becomes possible to influence and manipulate actions and attitudes as well. An AI-assistant can, in theory, be so clever that people trust their advice more than their own judgement, leading to blurring of the boundaries between person and machine. As discussed under deception below, this may also risk a patient not knowing whether they are in contact with a machine or a human. When machine learning is used for people with dementia, it will need to be continuously fine-tuned to stay in harmony with the patient. However, it is not clear who would make tuning decisions: the AI system, healthcare professionals, next of kin or the patient?

Privacy

All of the technologies detailed will need to counterbalance giving up medical information with the need for privacy. For example, machine learning to help people with dementia will need to learn from a variety of information sources, from patient journals to sensors in their environment and on their bodies. This can reveal very personal and intimate knowledge about individuals, while at the same enabling personalised assistance and decision support.

As with other internet-enabled and recording technologies, robots that are capable of accessing the internet and recording large amounts of data raise questions over privacy and security. Those capable of processing personal data will be subject to regulation under the EU General Data Protection Regulation (GDPR), which requires 'privacy-by-design', with data protection safeguards built into technology early on.

However, this may not cover other kinds of data, such as social media activity and internet search history, which could be used to reveal information about users and those around them. To balance this, robots may be seen as more objective than human caregivers, which may promote users' privacy. The future use of digital technologies for care recipients and by care staff will need to preserve users' privacy and ensure that the principle of informed consent is maintained. How this will work in practice for people with dementia or for children is not clear.

In contrast in the United States, the Government Accountability Office (GAO) reported in 2019 that there is no comprehensive internet privacy law governing the collection, use and sale or other disclosure of consumers' personal information. At the federal level, the Federal Trade Commission (FTC) currently has the lead in overseeing internet privacy but it hasn't yet issued any regulations other than those protecting financial privacy and the internet privacy of children, which were required by law. GAO found that there are limited privacy protections under federal law for consumer data used for marketing purposes.

Security

Robots and other Internet of Things devices with poor security could be vulnerable to hacking, posing risks to video and voice recordings, with the potential to be controlled remotely by an attacker. In the UK, all providers with access to NHS patient information are required to annually demonstrate compliance with the data security and information governance requirements set out in the NHS Data Security and Protection Toolkit (DSPT). However, as of November 2018, just over half (53%) of the 24,000 providers in England had registered on the DSPT website and, of these, 77% had submitted the assessment, 2% had started but not submitted, and 10% had yet to start it.

Bias, Deception and Infantilisation

The European Parliament has noted that assistive technologies can lead to gains in independence through human-non-human contact, but this in turn can have negative effects on the levels of social inclusion and human interaction (human-human interaction). Some researchers believe that contact with care robots cannot compensate for the lack of human contact, and claim that robots should only be used instrumentally for routine care jobs, and that care-giving tasks that require emotional, intimate and personal involvement should be done by people.[i]

While some technologies (e.g. iPads) symbolise social status, independence, modernity and joviality, others (e.g. alarms or incontinence detectors) symbolise precisely the opposite. Many technologies still embed stigmatising notions such as 'frail' or 'limited ability'.[ii] As a consequence, many older adults do not recognise themselves in these technologies' scripts. The potential users see the technologies as interesting and worthwhile, though not for themselves but another elderly person who is in need or ill, hence the acceptance is low. The experts all argue for developing technologies related to an elderly individual's capabilities and desires, and not simply for their expected needs.

Robotics and AI technologies can have in-built biases that may reinforce stereotypes and discriminate unfairly. Robots designed to resemble animals or humans may deceive users, particularly vulnerable users who may not be able to distinguish the robot from a real pet or person.

A number of country reports noted the importance of co-development of technologies *with* and *for* the potential users, and not *on* them. This in turn requires the development of new methods that include the elderly during the development process. An example given was the Assisted Living Project (Norway), which aims to engage people with mild cognitive impairment and dementia (MCI/D) in developing technological solutions. In five dialogue cafés, participants identified challenges, discussed solutions, tested alternative assistive technologies and provided their feedback.

The "ARCHIE framework" is a set of guidelines and principles for the development of these technologies.[iii] First, both technology designers and assistive technology services need to shift their focus from developing, installing and monitoring a particular technology to a more dynamic focus on performance (supporting technologies-in-use). Second, those who commission telehealth and telecare services need to shift from standardised care packages (the one-size-fits-all 'home care contract') to personalised solutions. Third, industry (perhaps supported by relevant incentives by government) must drive a shift in the design model from 'walled garden' branded solutions (packages that are designed to interface only with a particular manufacturer's products) to components that are designed to be combined creatively by people making their own ad hoc solutions to one-off challenges, and which must, therefore, be interoperable across multiple devices and platforms.

During the development of an innovation and its daily usage in care practices one should keep an eye on their fit in the various stages of becoming older and on the (potential) risks of using the technologies. For example, a person with later stage dementia may benefit from the FreeWalkeriv and feel empowered to freely move around, but a person with early stage dementia might feel paternalised if their usage is not based upon personal indication and/or motivation. Similarly, digital inclusion should be a key concern for technology developers. Developers should not only focus on a safe and secure design, but also on how the interface remains accessible, developing applications that work equally well for groups that lack digital skills in order to allow for equal access.

Public Attitudes

Citizen panels have been organised in a number of countries and have led to the generation of central values for future development: autonomy of older people, information and education, justice and the importance of human interaction. As noted above, co-development of solutions will aid in achieving these targets. This will allow for the individual motivation and abilities, rather than disabilities of the user, to be the focus. It will also take into account accessible applications adapted for groups lacking digital skills.

Attitudes to robotics are shaped by people's previous experience and expectations and may be indicated through their attitudes to computers and related technologies more generally. Studies have reported mixed attitudes towards the use of robots in social care amongst users and caregivers, and it is unclear how such attitudes vary across age groups and between different types, and functions, of robots. Research suggests that the design of robots is key to their acceptance and effectiveness, for example in the UK, the use of collaborative robots (cobots) is viewed more positively as they are less likely to replace caregivers. Population surveys in Germany have found that technical assistance systems for medical treatment and independent living tend to be more acceptable than the use of autonomous robots in personal care. However, the opinion towards

these technologies seems to be strongly influenced by emotions and personal attitudes (both curiosity and reservations).

Responses to e-Health systems have been cautious. The Austrian electronic health record, "ELGA", was heavily debated when it was first introduced. In total, approximately 280,000 people opted out (figures until 2018). Of particular impact seemed to be the opening up of health records for research and development.

Employment and Training

While caregivers are going to increasingly have been brought up in a digital environment, there will be the need for ongoing training in care technologies as these continue to develop. In particular, a system of life-long learning will need to be in place. Examples of such training have been reported by the Netherlands, with laboratories simulating socio-technical innovations within elderly care and then exploring the training needs of current and future health and social care professionals.

Current limitations for full integration of AAL, telemedicine and care robotic technologies into the care and health system in Germany are the competencies of the people involved as well as access and financing. Their use is likely to require training of users, with the remuneration of this needing to be included within the health and social care system rather than being the responsibility of another function of government.

The European Parliament notes that a new profession of experts in the application of assistive technologies could play an important role in addressing several of these issues. As well as providing support for individuals in the adoption of ATs that respond to their specific needs and individual circumstances – including old age – they could also help individuals without impairments to interact more effectively and inclusively with people using ATs. Their experience would also be valuable in informing the development of new ATs, as well as mainstream technologies, that will be used by people with and without impairments.

Regulating Robots

In the UK, organisations that set regulatory standards for the design of social and care robots include the British Standards Institution (BSI) and the International Organization for Standardization (ISO), and a number of standards currently apply. A 2017 European Parliament report called for the creation of a European Agency for robotics to supply public authorities with technical, ethical and regulatory expertise and a voluntary ethical code of conduct.

Legal and regulatory challenges include determining legal personality and determining legal liability for decisions made by robots. However, an open letter signed by 156 AI experts from 14 European countries warned that this would be "inappropriate" from a legal and ethical perspective. The diverse functions of robots may mean that robots are regulated differently. For example, robots that remind users to take medication may be classified as medical devices and regulated by medicines agencies while those processing personal data could be regulated under GDPR. Clarifying ownership of data collected by robotics has also been highlighted as an issue of concern. While the data gathered from robots may be beneficial to roboticists in developing the technology, improving AI, and for machine learning, it may also include personal or sensitive data.

Funding and Legal Concerns

Several barriers hamper the wider uptake of e-health solutions in Europe (STOA). They include: a lack of confidence in e-health among patients and healthcare professionals; limited interoperability between e-health solutions; limited evidence of the cost-effectiveness of e-health tools and services; a lack of legal clarity, e.g. for mobile health applications; a lack of transparency regarding the utilisation of data collected by such applications; a lack of reimbursement schemes for e-health services; high costs involved in setting up e-health systems; and EU national and regional differences in accessing ICT services.

Current funding structures are complicated. In Germany, smart phones or tablet computers are defined as everyday commodities, which are excluded from the official lists for assistive technologies that are covered by the statutory insurances. Similar problems exist with smart home systems.

In a number of countries, access to high-speed broadband is still limited, particularly in rural areas. For example, in Poland, citizens use the internet less frequently than the average European due to limited access to infrastructure and a generally low level of digital competence. As a result, modern technologies risk contributing to territorial and social segregation, with the risk that social inequalities are perpetuated. A number of other countries have noted a similar risk, with the result that the state needs to take responsibility for the provision of reliable national broadband systems, in the same way that electricity or water and sewage are provided. The state also has a responsibility to facilitate regulations to prevent potential obstacles for the future development of elderly care.

Serious concerns relate in particular to the healthcare sector, including the civil and criminal liability for medical mistakes that occur while providing remote medical services, the classification of medical applications as medical devices, patients' rights and patents issue. Ensuring users' safety, including the safety of sensitive data, still poses an important challenge.

Some countries noted that there is currently a disconnect between new technologies and established regulatory structures, particularly where technological convergence has occurred. This is because: (a) the one-to-one relationship between a converging technology and a regulatory entity is no longer clear, and (b) a converging technology may create a new sector where a regulatory entity has not been identified. This means in the US, for example, multiple agencies may need to regulate a single converged technology, increasing timelines and the cost of reviews and reporting.

A significant example of early and timely policy intervention has been Japan, where early Acts and guidelines have led to a regulatory environment that is in line with technological developments. The Guidelines of Measures for Ageing Society (2018) introduced the use of technological innovation as a basic concept, with measures including on telework, learning opportunities, care robots and the support of a safe and comfortable movement.

Austria

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Elderly population

Facts and Figures

In 2030, Austria's population is expected to pass 9 million.[1] The age distribution will move towards older cohorts: in 2030 25 % of the population will be older than 65.[2] Currently the larger part of over 65 year old persons in Austria live in their own homes.[3] Yet, only a small proportion of those living at home have adapted their homes in any way as to ease access or increase security and facilitate individual mobility.[4]

In 2013, 67 % of the Austrians older than 80 years were female. Yet, there are quite significant differences between men and women in heath as men display a better physical condition in higher age than women. There is a higher rate of chronical and non-chronical illnesses as well as a higher rate of medication[5] in the group of females. However, if older adults need help, the rate of men needing help (33.3 %) is higher than that of women (26.9 %).[6] The economic situation in Austria today is more precarious for retired older women than for men. The difference in pensions is significant: in 2017 retired women had 16.018 Euro gross income per year, whereas retired men disposed of 26.669 Euro gross yearly income.[7] Also a study among very aged persons attests a significant gender gap in terms of the economic situation.[8]

60.9 % of the Austrian older adults who live at home (i.e. who remain in their ordinary accommodation) and who say that they need help, obtain care allowances.[9] The care allowance is staggered in seven categories from 157 Euro (lowest rate) to 1.689 Euro (highest rate).[10,11] A valorisation is planned for 2020. More than half of those who receive these allowances (68 %), fall

[1] http://wko.at/statistik/bundesland/BevStruktur2050.pdf.
[2] http://wko.at/statistik/wgraf/2012_32_Bev%C3%B6lkerungsprognose_2050.pdf.
[3] ÖPIA, 2015. Österreichische Hochaltrigenstudie. http://www.oepia.at/hochaltrigkeit/wp-content/uploads/2015/05/OEIHS_Endbericht_Endfassung1.pdf.
[4] http://www.oepia.at/hochaltrigkeit/?page_id=5.1
[5] A considerable high rate of potentially inadequate medication for older adults in Austria is attested by Mann, E. et al. (2014). Potentially inappropriate medication in older persons in Austria: A nationwide prevalence study. European Geriatric Medicine, 5(6), 399-405. https://doi.org/10.1016/j.eurger.2014.06.035, https://www.sciencedirect.com/science/article/pii/S1878764914001545.
[6] http://www.oepia.at/hochaltrigkeit/wp-content/uploads/2015/05/OEIHS_Endbericht_Endfassung1.pdf
[7] Statistik Austria: http://www.statistik.at/web_de/statistiken/menschen_und_gesellschaft/soziales/personen-einkommen/jaehrliche_personen_einkommen/.
[8] ÖPIA, 2015 (footnote 3).
[9] ÖPIA, 2015 (footnote 3).
[10] Statistik Austria, 2017, https://www.statistik.at/web_de/statistiken/menschen_und_gesellschaft/soziales/sozialleistungen_auf_bundesebene/bundespflegegeld/052519.html.
[11] https://www.foerderportal.at/pflegegeld-oesterreich/.

into the first three (lowest) stages.[12] 35 % of those who need help make use of social services and 80.5 % receive informal assistance (help and care) by relatives and close friends. The average time of these informal services is three hours per week.[13]

The number of receivers of care allowance declined until 2019.[14] 35.8 % of the persons who need help with their daily activities say that they regularly get social assistance.[15]

Additional to the federal care allowance (as described above), on the regional level in 2017 nearly 2 million Euro net expenditure were dedicated to support 149.442 senior citizens at home and 82.485 older adults in institutional settings.[16] According to the same source, 9.640 persons were treated for short periods in hospitals and 7.928 persons were attended to in day care centers. 3.395 persons lived in alternative settings (assisted living). More than two thirds of the persons who received care were female, more than 70 % of the mobile services were received by persons older than 75 years, and more than 80 % of the hospitalized persons pertained to the same age group.

The "Austria Health System Review 2018"[17] states that the health system in Austria is "complex" as it is shared between federal and regional responsibilities and social insurance funds contributing to finance the health care system. Overall the system is rated as expensive but of high quality due to a very high rate of practising physicians.[18] However, nearly six out of ten of these physicians are 55 years and older – hence well-balanced future health care infrastructure requires establishing a next generation of physicians with a good mix of qualifications to meet the needs of an older population.[19] "In terms of performance, the Austrian health system provides good access to health care services. Austria's residents report the lowest levels of unmet needs for medical care across the EU," say Bachner et al. (2018: 25).[20]

Digital competence among elderly

According to König et al. (2018)[21], 48 % of the Austrian population, older than 50 years is using the Internet on a regular basis.[22] Based on the SHARE data base Halmdienst and Schmidt (2018)[23] analysed the Austrian situation. The most open attitude of Austrian senior citizens is towards health technologies, the most sceptical attitude is in the context of monitoring and surveillance technologies. One third of the Austrian citizens older than 50 years have used or use a computer in their professional lives, which is regarded as crucial for the pattern of use of computer in later

[12] Statistik Austria, 2017 (footnote 10).
[13] ÖPIA, 2015 (footnote 3).
[14] By the end of 2017 485.783 persons in Austria received care assistance (at a total expense of 2.55 billion Euro); in May 2019 it is 462.583 (total expense of 2.29 billion Euro).
[15] ÖPIA, 2015 (footnote 3): household chores: 15.4%, meals 14.6%, extramural mobility 9.8%, cleaning 6.5%, home care 5.7%.
[16] Statistik Austria, 2017 (footnote 10).
[17] Health system in Transition, Austrian Profile: http://www.euro.who.int/en/about-us/partners/observatory/publications/health-system-reviews-hits/country-health-profiles.
[18] Bachner F., et al. Austria: Health system review. Health Systems in Transition, 2018; 20(3): 1-256.
[19] http://www.euro.who.int/__data/assets/pdf_file/0004/355873/Health-Profile-Austria-Eng.pdf, p 18.
[20] Bachner, F. et al. (2018) (footnote 18).
[21] König, R. et al. Univ Access Inf Soc (2018) 17: 621, https://doi.org/10.1007/s10209-018-0609-5.
[22] Compared to the European overall society: „Overall, at EU level, eight out of ten respondents (80 %) have used the Internet for private purposes within the last 12 months. Around six out of ten (59 %) have done so every day or almost every day on average. An additional fifth of respondents (21 %) used the Internet, but less frequently: 15 % used it 1-3 times a week and 6 % used it 2-3 times a month or less. One person in five (20%) never used the Internet, including 8 % who spontaneously say that they have no Internet access." Flash Eurobarometer 404, p 3, http://ec.europa.eu/commfrontoffice/publicopinion/flash/fl_404_sum_en.pdf.
[23] Halmdienst und Schmidt, 2018: Digitale Kompetenz der Generation 50+ in Österreich: http://www.share-austria.at/fileadmin/user_upload/papers/SHARE_Report_10_2018_Digitale_Kompetenz_online.pdf.

life. The older the persons questioned were, the more significant was the gender gap (men seem to have been using computers more frequently in their professional careers). In relation to the correlation that persons who use(ed) computers in their professional career are more likely to display digital literacy, also a clear gap between lower and higher socio-economic levels was shown.[24] Initiatives like "werde digital" ("become digital", our translation)[25] or „Seniorkom"[26] provide specific strategies to reach older adults as to facilitate the use of e-government applications. Other initiatives such as "alt sein – gut leben 2050" ("being old – live well 2050", our translation)[27] aim to direct the focus on ways to improve life for older adults and stipulate public interest – one of the core aspects is an emphasis on competencies of older adults and on fostering "lifelong learning".

Current status of the use of technology and social innovations in elderly care

Compared to Scandinavia, Great Britain or the Benelux states, the Austrian situation differs quite significantly: the purchase of e-health applications and AAL technology remains purely private. A semi or fully publically financed market, where insurance and health systems take over the costs for these applications is comparatively weakly developed.[28] Therefore experts ascertain a lack of technology pull[29] and information about technology applications by older adults.[30]

Policy initiatives

To provide medical practitioners and hospitals with the full patient record, since 2014 the electronic health record (ELGA) is implemented stepwise in Austria (including e-medication and e-medical report) and expected to be completed in September 2019.[31] All insured persons in Austria are part of ELGA, unless they have opted out. For the future the electronic patient decree is planned (so far it is the civil law notaries, who hold the registries). According to a poll in 2012[32] especially older adults were interested in e-medication as to improve the situation in medication perceived as deficient. The problematic area of inappropriate medication for Austrian seniors was also scientifically confirmed.[33]

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[24] Halmdienst und Schmidt, 2018: Digitale Kompetenz der generation 50+ in Österreich: http://www.share-austria.at/fileadmin/user_upload/papers/SHARE_Report_10_2018_Digitale_Kompetenz_online.pdf.

[25] https://www.werdedigital.at.

[26] https://seniorkom.at.

[27] https://alt-sein-und-gut-leben-2050.at/ueber-uns/mission/.

[28] ÖPIA. (2019). Forschung zu Altern und demografischem Wandel in Österreich Situation und Perspektive 2018/19, http://www.netzwerk-altern.at/sites/netzwerk-altern.at/files/dokumente/Forschungsstandbericht%202019-03-01%20final%20(r).pdf.

[29] ÖPIA. (2019) (footnote 28).

[30] Bechtold, U. et al. (eds.) (2016) DiaLogbuch AAL – Dialoge zu Active and Assistive Living. In OCG Schriftenreihe 'reports@ocg.at', rep06; Vienna: OCG.

[31] https://www.elga.gv.at/fileadmin/user_upload/Dokumente_PDF_MP4/Infomaterialien/OEsterreich_Grafik_e-Medikation.jpg.

[32] https://www.apothekerkammer.at/internet/oeak/NewsPresse.nsf/e02b9cd11265691ec1256a7d005209ee/8532ee3a5119574ac12579fa003b7681?OpenDocument.

[33] Mann, E., et al. (2014) (footnote 4).

The national AAL research programme "benefit" is supporting eight AAL test regions on Austria,[34] which partly connect with other European regions.[35] The regions serve to come up with systemic solutions for smart-home technologies, which also allow for support and care at home. This shall include the diverse processes connected to services. The test regions are in peri-urban settings and aim to evaluate potential connections with the smart-city approach not only in terms of feasibility but also concerning social added value.

The Ministry for Science and Education commissioned the Austrian Platform for Questions of Ageing (ÖPIA) to conduct a national report on the state of research in terms of ageing and demographic change.[36]

Also the ministerial agency „Fonds Gesundes Österreich" ("Healthy Austria Fund", our translation) initiated a project line to promote communal settings in terms of social support, participation and active neighbourhoods, which financed elven projects,[37] which are currently conducted.

Best practices – the use of different technologies and innovations

AAL-Austria[38] is a non-profit association with the aim to provide a platform to connect the diverse stakeholders in the area of AAL in Austria (e.g. actors pertaining to research and development, policy, companies SME´s, health system). Primary aims are to facilitate an exchange of experiences between currently 50 members, to provide consultancy, to connect actors of different parts of the value chain, collect knowledge and best practices and to foster framework conditions, which facilitate development, spread throughout the market and broad access to AAL. However, according to the national report on the state of research in terms of ageing and demographic change, conducted 2018/19,[39] networking in Austria could be improved.

The capital of Austria, Vienna, expects a significant increase of older population between 65 and 79 years until 2028 and the count of persons older than 80 years is expected to double.[40] Against this background several initiatives are of relevance to realise high quality of life – especially considering needs of older adults: the Vienna Smart City Framework Strategy,[41] "Urban Innovation Vienna",[42] a competence centre for aspects of urban future, with special regard to housing, mobility and digital Vienna. A senior citizen representative[43] was nominated by the City of Vienna, who acts as a mediator between society, city and policy makers, and is involved in the development of projects and strategies in terms of proactively posting and integrating the needs of older adults. The "SeniorInnenbüro"[44] ("office for seniors", our translation) of the city of Vienna serves as a platform for direct communication with citizens and their needs. Similar tasks,

[34] http://www.aal.at/pilotregionen-3/.
[35] As for instance „gAALaxy", which connects three regions in Austria, Belgium and Italy, where 150 to 180 test households will participate over 12 months. More information: http://www.aal.at/pilotregionen-3/gaalaxy/.
[36] ÖPIA. (2019) (footnote 28).
[37] http://fgoe.org/FGOe_Aktivitaeten_Programmlinie_Kommunales_Setting.
[38] http://www2.aal.at/home.
[39] http://www.netzwerk-altern.at/sites/netzwerk-altern.at/files/dokumente/Forschungsstandbericht%202019-03-01%20final%20(r).pdf.
[40] Stadt Wien, Bevölkerungsprognose, 2018, Zusammenfassung https://www.wien.gv.at/statistik/pdf/bev-prog-2018-zus.pdf.
[41] Magistrat der Stadt Wien (2014). Smart City Wien. Rahmenstrategie. https://smartcity.wien.gv.at/site/wp-content/blogs.dir/3/files/2014/08/Langversion_SmartCityWienRahmenstrategie_deutsch_doppelseitig.pdf.
[42] http://www.urbaninnovation.at/de.
[43] https://www.wien.gv.at/sozialinfo/content/de/10/InstitutionDetail.do?it_1=2098237.
[44] https://www.senior-in-wien.at.

especially communicating ideas, wishes and needs of older adults to the city agencies are realised by the "Wiener SeniorInnenbeirat" ("Viennese advisory council of seniors", our translation).[45]

Implications for elderly, staff and working places

A participatory TA project conducted in Vienna[46] found that those Viennese citizens, who took part in the project, were very open as to new models of work. Most issues they raised touched upon redefining the significance of work in different ways: work was thought as something which should provide personal fulfilment rather than primarily serve as a source of income, informal care settings should be regarded with more respect, working models for older adults should allow for flexibility in terms of workload and intergenerational communication and exchange. This experience transfer was seen as a utterly desirable value.[47]

On a national level several measures should alleviate the situation for older adults in the working place and facilitate their finding a suitable job.[48] Since 2016 Austria implemented a publicly funded option of part time working for older adults. In certain cases a prolonged claim for unemployment allowances exist up to 52 weeks (persons over 50 years who have been working at least 468 weeks during the past 15 years).[49] A so called "come back" payment is provided as a financial support for companies, which newly employ older adults, who have been out of employment over a certain period of time.[50]

In Austria the progression of payment during the lifetime is quite steep which contributes to a comparatively high unemployment rate in age or early retirement. As opposed to Sweden a working person of 55-59 years earns approximately 60 % more than a person between 25 and 29 years. In Sweden this increase is only about 25 %.[51]

The initiative „Arbeit und Alter" ("work and age", our translation) of the Austrian Chamber of Labour and the Federation of Industry offers virtual consulting for enterprises, as to improve the situation of older adults in real work life settings. It provides information on funding, diverse initiatives and ways to promote older adults in work life and how to reorganize work-practice in an age-friendly way.[52] The main topics are leadership, education for older adults, health and workplace.

Education and further training

So far in Austria, unemployed persons, older than 50 years, who are at least 181 days without job can participate in the so called "Beschäftigungsinitiative 50+" ("initiative for occupation for people older than 50", our translation) was launched in 2014. In 2018, 165 Million Euro were additionally provided to support older adults and enterprises to reintegrate older adults in the

[45] https://www.senior-in-wien.at/p/ueber-uns.
[46] https://www.wiengestalten.at/leben-2050-autonomes-leben-im-alter-in-wien/.
[47] Gudowsky, N., et al. (2017). Transdisciplinary forward-looking agenda setting for age-friendly, human centered cities. Futures, 90, 16-30. doi:https://doi.org/10.1016/j.futures.2017.05.005.
[48] https://www.wko.at/service/arbeitsrecht-sozialrecht/BeschaeftigungaeltererArbeitnehmer--Wasistzubeachten.pdf.
[49] https://www.oesterreich.gv.at/themen/arbeit_und_pension/aeltere_arbeitnehmer/1/1/Seite.2010203.html.
[50] https://www.ams.at/unternehmen/service-zur-personalsuche/foerderungen/eingliederungsbeihilfe#vorarlberg.
[51] Christl, M. et al., 2015. Jung, älter, arbeitslos? Wie Ältere länger in Beschäftigung gehalten werden können, ohne die Jungen in die Arbeitslosigkeit zu treiben. Studie Agenda Austria., https://www.agenda-austria.at/publikationen/jung-aelter-arbeitslos/.
[52] http://www.arbeitundalter.at/cms/Z03/Z03_50/home.

workforce. The money is used as direct financial support for the firms employing older adults, and for consultation (measures) as well as education for elderly to remain well informed and improve skills related to the respective work place.[53]
Another aspect, not yet considered in the public strategies, is "learning by encounter", which was one of the future visions as coined by citizens in the participatory TA project "Leben 2050".[54] It also emphasized the importance of (urban) meeting-spaces for different people[55] and the role of exchange by coming together.

Education for elderly including measures against digital alienation

An analysis of three TA projects has been summarised as follows „A discussion of technology as part of quality aging cannot be led without considering the resources needed to choose, understand, purchase, install, and properly maintain these supportive technologies. These resources include financial means and interpersonal assistance, which facilitate continuity for the user on a technological as well as interpersonal level. (…) the personal assistance needed to properly familiarize with the new technological system consists of buddy-systems that provide personal continuity."[56] These resources are not yet part of the Austrian society or health system. Here a focus is put on clearly definable skills which need to be transmitted or refreshed.

The above mentioned "Beschäftigungsinitiative 50+" supports (amongst others) the education of older adults in terms of relevant skills for their job, which are considered important for the respective work-area.[57] Also (communal) initiatives, such as the "Vienna Employment Promotion Fund" seek to "promote the professional development of employees in Vienna who are seeking to enhance their skills".[58] A potentially positive role of peer to peer learning was also identified in a Viennese study[59] about the role of word to mouth in the pre-adoption phase of technology (in this case a social robot). Also this line of transferring know-how is not yet fully considered in the public strategies.

Societal and political debates

The Austrian electronic health record – the so-called "ELGA" – was heavily contested in public debate from its very beginnings. In total, approx. 280.000 persons have opted out until 2018. Thereof 5.000 persons opted out as an immediate consequence of the public debate of opening the health records for research and development purposes.[60]

The way care for elderly is organised in Austria is also quite intensely debated in public. A so-called "Pflegenotstand" ("state of emergency regarding care", our translation) describes the fear

[53] http://www.arbeitundalter.at/cms/Z03/Z03_50.9.1.a/1342550792460/weitere-informationen/foerderungen/beschaeftigungsinitiative-50.
[54] https://www.oeaw.ac.at/ita/en/projects/civisti-aal/overview/.
[55] Gudowsky, N. et al. 2017) (footnote 47).
[56] Gudowsky, N. et al. (2019) Wrinkles and Smiles — What is Good Aging? A Technology Assessment Perspective. OBM Geriatrics, Bd. 3 (2019, volume 3, issue2), p. 26.
[57] http://www.arbeitundalter.at/cms/Z03/Z03_50.9.1.a/1342550792460/weitere-informationen/foerderungen/beschaeftigungsinitiative-50.
[58] https://www.waff.at/en/waff/.
[59] Belviso, C. et al. (2018) Socially Assistive Robots Diffusion in Elderly Care: A Pre-Adoption Study Through Agent-Based Modeling. Journal of Strategic Innovation and Sustainability, Vol. 13 (5), pp. 58-75.
[60] https://www.derstandard.at/story/2000079259475/5-000-elga-abmeldungen-wegen-forschungsdaten-debatte.

that there will be a severe lack of qualified care personnel in future. Several measures (e.g. new careers or a national job guarantee) are discussed as to provide sufficient professional care personnel in future.[61] Yet, at the core of public critics is the fact that the level of the care allowances (see above) introduced in 1993 are not valorised regularly[62,63] (and since show a decrease in value of 35 %[64,65]). According to the current political debate, in 2020 a valorisation is planned.

The previous government (which ended in May 2019) had promised a so-called "Masterplan Care"[66] until the end of 2019. While a clear emphasis on care in family surroundings is detectable, it will also contain measures for digitalisation, which apart from a clearer focus on assistive technology might actually remain quite analogous, when suggesting a phone hotline for care or an Internet information platform.

Future perspectives and reflections

The landscape of welfare for elderly is as diverse as the Austrian health care system itself. The fact that senior citizens often find it difficult to get the right information, support and orientation, should be a strong reason to simplify the support structures and provide a better overview (e.g. on technical support opportunities, care allowance). Existing gender gaps in economic power should be alleviated in future, yet it might still need strong measures as a gender gap in wages still is not overcome in Austria.[67, 68]

According to two recent studies on ageing, which had both a TA perspective, [69, 70] the wishes of Austrian experts in the area of AAL include an improved societal perception of the topic "ageing" and a need to commonly consider how to overcome the so far predominantly negative framing of ageing in public and the media. Moreover they find that better networking and coordination among the national players in the area of AAL would be helpful.

[61] https://www.sn.at/politik/innenpolitik/pflege-debatte-landau-fuer-lehre-und-staatliche-jobgarantie-68770030.
[62] https://diepresse.com/home/innenpolitik/5649915/Pflegegeld_Ein-Drittel-Wertverlust-seit-Einfuehrung-1993.
[63] https://www.derstandard.at/story/2000096852906/rendi-wagner-will-pflegegeld-jaehrlich-anpassen.
[64] https://diepresse.com/home/innenpolitik/5565722/Mehr-Pflegegeld-fuer-alle.
[65] https://www.derstandard.at/story/2000104794031/das-freie-spiel-der-kraefte-im-parlament-geht-weiter.
[66] https://www.bundeskanzleramt.gv.at/bundeskanzleramt/nachrichten-der-bundesregierung/2017-2018/ministerrat-beschlie%C3%9Ft-masterplan-pflege.html.
[67] https://www.rechnungshof.gv.at/rh/home/home_1/home_1/Einkommensbericht_2018.pdf.
[68] Böheim, R. et al. (2013), The gender wage gap in Austria: eppur si muove!, Empirica, 40, issue 4, p. 585-606. https://econpapers.repec.org/article/kapempiri/v_3a40_3ay_3a2013_3ai_3a4_3ap_3a585-606.htm.
[69] Bechtold, U. et al. (eds.) (2016) (footnote 30).
[70] ÖPIA. (2019) (footnote 28).

Catalonia (Spain

Consell Assessor del Parlament sobre Ciència i Tecnologia (CAPCIT), with contributions from the Catalan Studies Institute, IEC and the Catalan Government

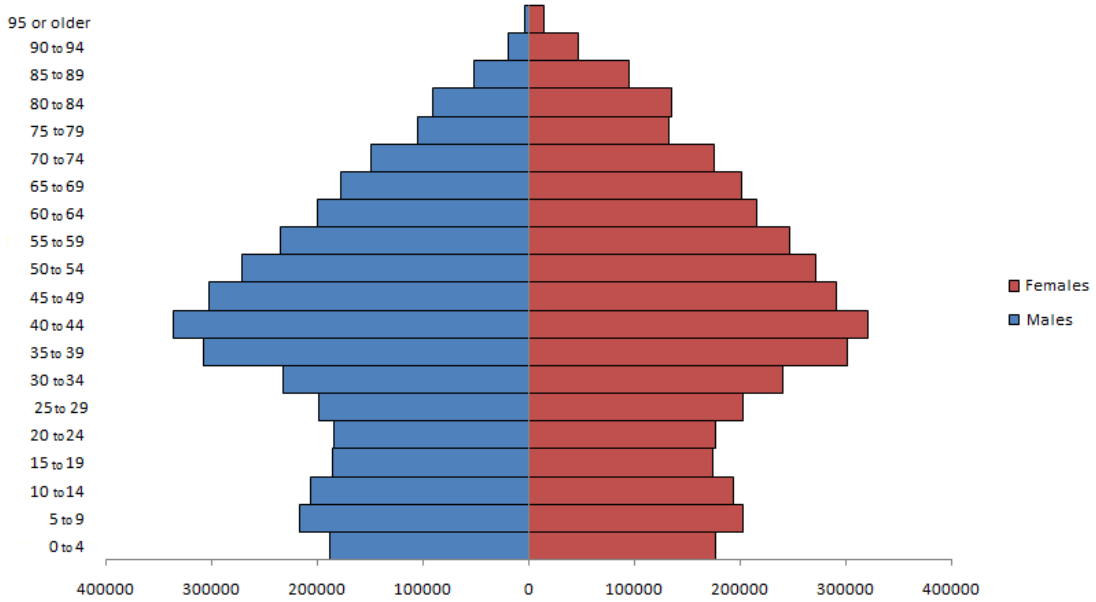
Elderly population

Facts and figures

In Catalonia today, there are two problems in the area of technology for elderly care, namely poverty and the digital divide, which are layered upon the problems stemming from ageing, primarily the lack of autonomy and the dearth of sufficient resources to use all the technological means available to achieve better wellbeing.

The baseline fact in Catalonia is that 24% of the population is currently age 60 or older (see Table 1), However, there has also been a steep decrease in the birth rate since the 1970s, which has led to a narrowing of the base of the age pyramid. Therefore, if we extrapolate this to 20 years from now, the population of persons age 60 or over may reach 40%.

Table 1.- Age pyramid in Catalonia (figures from 2017)



Source: Idescat (Statistical Institute of Catalonia)

We should bear in mind that around 30% of the population age 65 and older has some kind of moderate or severe limitation, and 9.1% of the total population has difficulty performing basic activities. With regard to the problem of poverty, in late 2018, the At Risk of Poverty and/or

Exclusion (AROPE) rate in Catalonia was 41% before counting all kinds of social transfers. Once all the social transfers are counted, this percentage was only lowered to 20.6%, revealing that the current social measures to mitigate poverty leave one out of every five people in highly precarious situations.[1]

Digital maturity

With regard to the issue of the digital divide, namely the problem of the increasing socioeconomic difference and the gap in opportunities arising from being «connected» or «not connected» to the outside world via the information and communication technologies (ICT), it is worth noting that the existing inequality is increasing and leading to a gradual rise in the number of elderly persons at risk of poverty or exclusion because they miss out on opportunities.

Digital illiteracy affects a major swath of the population, especially individuals born before the 1960s. According to a survey by the INE (National Statistical Institute, a state-wide organisation in Spain) on information technologies equipment and use, in the period 2010 to 2018, elderly persons' access to the ICT in the most recent three months increased from 13.8% to 49.1%, which is the steepest growth in all the age groups for Spain as a whole.[2] Mobile Internet has heavily penetrated Spain is a fact, even though smartphones and complex devices are used by the elderly in a more limited fashion.

The Punt TIC network is comprised of a wide variety of centres and spaces, both publicly and privately owned, which make available to citizens the equipment and personnel needed to provide them with access to ICT and thus to the Knowledge Society. The vast majority of centres offer digital literacy aimed particularly at the elderly in an effort to close the digital divide. Of all the centres which are open to the public at large, the general public at more than 50 is primarily comprised of elderly persons, and they therefore provide specialised training targeted at this population segment.[3]

Current status of the use of technology and social innovations in elderly care

At the level of both the institutions of Catalonia and most of the Catalan town halls, all administrative procedures have been streamlined so they can be done without being personally present, in terms of both municipal administrative services and especially the «e-salut» healthcare service, which is one of the services used the most widely by the elderly.[4] Catalonia has made a major effort to generate and incorporate new technologies into its healthcare services, such as electrical wheelchairs and remote assistance buttons, which have increased the security and autonomy of many elderly persons. Despite these advances, the e-services that technology

[1] You can check the figures on the AROPE rate by sex and age for 2018 at: https://www.idescat.cat/pub/?id=ecv&n=7705.

[2] See: http://www.ine.es/jaxi/Datos.htm?path=/t25/p450/base_2011/a2018/l0/&file=02002.px.

[3] See the Punt TIC website, which reports on important news for the elderly, projects, events, calendar, etc.: http://punttic.gencat.cat/en/taxonomy/term/56.

[4] In order to encourage research and transfer in the e-health sector, the government of Catalonia has created the Fundació TIC Salut i Social (ICT Health and Social Foundation), which operates out of the Department of Health and works to promote the development and use of ICT and networking in the sphere of health. Its mission is to facilitate a transformation of the social assistance and healthcare model via ICT. It also promotes research and development geared at fostering industrial development with technology meant for this sector. See: https://ticsalutsocial.cat/.

currently allows do not yield all the desired results, first because of elderly persons' difficulty accessing IT tools, but also because of the rejection that public service IT applications cause; the fact that they are not very intuitive or are excessively complex can demotivate people from using them.

As a technology centre, we should mention the Eurecat programme, which has different divisions and several working lines in the field of health, such as the development of implants, orthosis, technical assistance systems, remote assistance services and remote medicine based on new devices or sensors or systems to support decision-making for diagnosing and classifying patients. In the sphere of healthcare, a personal assistance robot is being developed which consists in an autonomous mobile platform which communicates with the user via a screen.[5]

Catalonia is participating in some of the 25 most influential European projects on technologies applied to active, healthy ageing. The study by the European Commission entitled *Impact of EU-Funded Research and Innovation on ICT for Active and Health Ageing - The Top 25 Most Influential Projects*[6] analyses the results of the projects financed by the EU within the seventh Framework Programme on Research and Innovation 2007-2013, the Innovation and Competitiveness Framework Programme 2007-2013 and the current Horizon 2020 programme. Catalonia's most prominent participation is the following:

- Badalona Serveis Assistencials (BSA) is part of the Beyond Silos project, which develops integrated services in seven European regions.
- Ateknea Solutions, the Universitat Politècnica de Catalunya (UPC), the Fundació Tic Salut, the Hospital Clínic de Barcelona, the Sistema d'Emergències Mèdiques and Flowlab are partners in the FATE (Fall Detector for the Elderly) programme, which has validated a digital solution to detect when elderly persons fall.
- The company Pal Robotics is a participating partner in the «Grow Me Up» programme, which has developed a smart learning robot.
- The Fundació Hospital Asil in Granollers and the Universitat Politècnica de Catalunya (UPC) are participating in the «I Don't Fall» project, which provides solutions to prevent falls.
- The Fundació Hospital Asil in Granollers and the company Sensing & Control Systems are participating in the «Radio» (Robots in Assisted Living Environments) project, which is working on caregiving robots.
- The Agència de Qualitat i Avaluació Sanitàries de Catalunya (AQuAS) and the Hospital de la Santa Creu i de Sant Pau of Barcelona are participating in the «Stop and Go» programme, which seeks to pilot an innovative shopping process to improve the life of the elderly.

Other examples in which Catalonia has recently participated include:

- The CREB (Biomedical Engineering Research Centre) at the UPC and the company Sensing & Control Systems are developing a system, currently in the pilot phase, based on gas sensors and artificial intelligence to monitor the elderly, along with a

[5] See: https://eurecat.org/sectors/salut/.

[6] You can see the report at: http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=50441. You may also check the information at: https://ec.europa.eu/digital-single-market/en/news/top-25-influential-ict-active-and-healthy-ageing-projects.

device that detects risky situations, such as if the gas is left on, if the ventilation is poor or if there is spoiled food in a room.[7]

- The Eurecat technology centre and AST (Aquitaine Science Transfert), a company specialising in technology transfer, are unveiling a smart sock prototype that monitors movement while walking with the goal of checking balance and helping prevent falls.[8]
- A team at the Terrassa Campus of the UPC can objectively determine the thermal comfort of homes for the elderly.[9]

Within the city of Barcelona, in 2019 the Barcelona Town Hall announced a call for applications to care for elderly persons in situations of dependence using technological solutions. Also in 2019, Mobile World Capital Barcelona, the Barcelona Town Hall and 5G Barcelona launched a new call for applications through the d-LAB programme to provide innovative technological solutions to improve the quality of life of the elderly.[10]

Implications for elderly, staff and workplaces

If we analyse the regulations approved in Catalonia, we first and foremost find societal awareness of protection of the elderly, yet we also notice the scant influence of all the tech-based considerations. Therefore, it seems recommendable to once again update the legislative texts bearing in mind the possibilities afforded by current and future technological resources.

The importance of the healthcare sector, both from the social standpoint and because of the size of its market, makes it a field of interest for the industrial and services sectors. There are many companies in Catalonia that offer services ranging from providing personnel for cleaning and domestic tasks or escorts, to comprehensive services, remote assistance services, physiotherapy services or special services.

Catalonia also has its own tech providers of not only services but also products. The industry supplying these products can respond to local initiatives, or they can supply international companies which have moved to Catalonia because of the competitive advantages they garner from its rich industrial and knowledge environment. This industry comprises everything from the development of special apps for mobile phones to simple devices that make the homes of individuals with physical or sensorial disabilities safer and more functional, such as sound indicators on the level of liquid in glasses for individuals with visual impairments and pictographic communicators, along with more complex equipment like the autonomous caregiving humanoid robots produced by Pal Robotics, a company from the United Arab Emirates mentioned above which operates out of the city of Badalona, very close to Barcelona.

[7] See: http://www.accio.gencat.cat/ca/accio/premsa-comunicacio/cercador-premsa-actualitat/article/20190407_ASIVI.
[8] See: https://eurecat.org/presenten-mitjo-intelligent-objectiu-ajudar-preveure-caigudes/.
[9] See: https://gric.upc.edu/ca/projectes.
[10] See: http://ajuntament.barcelona.cat/premsa/2019/05/24/53-projectes-de-5g-opten-al-repte-tecnologic-de-barcelona-per-millorar-lautonomia-de-la-gent-gran-a-casa-seva/.

Future prospects and reflections – societal and political debates and TA-perspectives

In the forthcoming decades, it is obvious that the sciences and technologies will provide important tools to diagnose illnesses better, more quickly and earlier, or to better track therapies or physical conditions, based on all kinds of highly sensitive, non-invasive, wearable and connected sensors. Less obvious yet perhaps even more important in the middle term, and with more profound effects, are the advances in direct action on the nervous system and the brain through optogenetic techniques, one of whose prime motivations is to treat the neurodegenerative diseases that affect the elderly.

The use of the new technologies is a huge opportunity to extend the number of years people can live healthily and independently, provide access to training and entertainment opportunities at all ages, and offer the chance to fully participate in society, yet it also entails formidable challenges in relation to the preservation of privacy, a subject of in-depth ethical debates. These challenges cannot just be left in the hands of committees of scholars or experts, who must obviously participate, but instead should be tackled by society as a whole. It is very important for citizens of all ages and social statuses to be informed of the latest scientific and technological advances, as well as their practical applications and implications.

As Carl Sagan said, «Who is running the science and technology in a democracy if the people don't know about it?» It is very important for concerned institutions to work not only to divulge the existing knowledge but also to promote public debates which enable citizens to be informed about the latest advances and their implications.

In the forthcoming years, this technology will be complemented by the addition of other technological gadgets which are just emerging now (electrical devices with one, two, three or four wheels; drones, personal robots; etc.), and by the implementation of cyberneural systems which will provide new solutions to caregiving, mobility and autonomy. The fact that the cost of these gadgets keeps going down should allow their use within universal social benefits to be normalised, provided there is political will. To achieve this, more resources must be allocated for this purpose, and this entails reconsidering the priorities regionally, state-wide and throughout the entire European Union.

Clearly, a new balance should be found between spending invested in infrastructures and the military industry and spending which should ensure the wellbeing of the elderly and environmental preservation.

European Parliament

Panel for the Future of Science and Technology (STOA), European Parliament, Gianluca Quaglio and Philip Boucher, Scientific Foresight Unit (STOA), European Parliamentary Research Service (EPRS)

This report has two main sections: The first sets out key trends, opportunities and challenges linked to the deployment of e-health in the EU, before presenting insights on the possible difficulties in implementing technology-based interventions for elderly people at the EU level. The second section presents ideas relevant to elderly care derived from a STOA study on assistive technologies.

E-Health in Europe

Information and Communication Technologies (ICT) in healthcare play a key role in expanding access to diagnostic services, improving their quality, increasing coordination between providers, improving patient management, and helping to overcome physical distances between patients and healthcare professionals. This is particularly important in elderly care.

Key trends of e-health in Europe

Many EU Member States have invested substantially in the development of ICT in healthcare. E-health and m-health are gaining wider acceptance and are increasingly deployed across the EU. They are also becoming more important in the delivery of top-quality care to European citizens. However, they still face barriers. For example, patient access to online medical records was recommended as a key action within the Digital Agenda for Europe but, according to a World Health Organization report from 2016, most Member States still do not have legislation to support such access.

The first EU e-health Action Plan was adopted in 2004. Since then, the European Commission (EC) has developed several policy initiatives aimed at fostering the implementation of e-health throughout the EU. The adoption in 2011 of the Directive on the Application of Patients' Rights in Cross-Border Healthcare, establishing the e-health network, marked a further step towards formal cooperation on e-health through interoperability and the implementation of e-health systems. The new e-health Action Plan describes the actions that will need to be implemented in the coming years in order to address well-known barriers. It focuses on the interoperability of e-health services, and e-health deployment and uptake. Finally, it also addresses the need to strengthen international cooperation among EU Member States, and to increase e-health research and innovation.

Challenges for the deployment of e-health in the EU

Despite the proliferation of ICT in the EU, healthcare systems face fundamental challenges in taking advantage of the full potential of e-health solutions. Several research projects have investigated these problems, which are attributed to such factors as the healthcare environment and providers.

The Impact project was one of the first projects that systematically investigated critical success factors and published recommendations based on their findings, highlighting the importance of multi-disciplinary teams in supporting the process of change. The EHR Impact study recommended that policy-makers create an enabling organisational and legal framework, and highlighted that interoperability and engagement are central for the success of e-health implementation.

Moen *et al.* identified a number of challenges attributed to e-health in Europe belonging to four categories: policy, technology, organisation and professionals. According to this study, the most prominent challenges are: (i) a missing legal framework and national strategy with sufficient funding; (ii) the need to establish a sound e-health platform (with an effort to harmonise standards, ensure interoperability, optimise integration of new and existing ICT solutions etc.); (iii) the need to balance the interests between the private and the public sector; and (iv) the complexity and variety of clinical practice across Europe. A more comprehensive review by Hoerbst *et al.* of barriers and critical success factors for clinical information systems in integrated care settings, arrived at similar results.

From the United4Health project, it emerged that the resistance of healthcare providers to the use of e-health is related to the lack of strong evidence supporting its clinical benefits. The increased time that clinicians spend on documentation due to new systems has been identified as a major barrier. Moreover, even when the clinicians are willing to get involved, they are not sufficiently supported by clear guidelines. The study suggested that, in order to convince the 'non-believers', a transparent reimbursement model, appropriate training, a clear legal and regulatory framework, and carefully redesigned ICT-supported care pathways should be implemented.

Within the EU, healthcare systems are highly differentiated by funding levels, access to healthcare services and quality of care. As EU Member States aspire to improve their healthcare systems, the need for increased healthcare spending and ICT infrastructure/e-health capacity in less developed countries will continue to pose a challenge. An important objective of the EU is to create a level playing field by extending access and availability of health services to all citizens. Policies to reduce health inequality include promoting cross-border healthcare, creating a digital single market and empowering patients. The EU will not be able to afford the cost of illness unless it recruits citizens to be partners in the campaign to prevent disease and disability, to promote good physical and mental health, and to manage their own diseases. All these actions are particularly relevant in elderly care.

ICT in healthcare plays a key role in expanding access to diagnostic services, improving their quality, increasing coordination between providers, and helping to overcome physical distances between patients and health workers. At present, several barriers hamper the wider uptake of e-health solutions in Europe. They include: (i) a lack of confidence in e-health among patients and healthcare professionals; (ii) limited interoperability between e-health solutions; (iii) limited evidence of the cost-effectiveness of e-health tools and services; (iv) a lack of legal clarity, e.g. for mobile health applications; (v) a lack of transparency regarding the utilisation of data collected by

such applications; (vi) a lack of reimbursement schemes for e-health services; (vii) high costs involved in setting up e-health systems; and (viii) EU national and regional differences in accessing ICT services.

STOA study on assistive technologies

In 2016, STOA conducted a study on assistive technologies (ATs) for the inclusion of people with disabilities in society, education and employment. It focussed on ATs for people with visual impairments, hearing impairments and autism, and had three phases: The first reviewed the current regulatory environment, the three disabilities, and their associated ATs, including the state of the art and anticipated future developments. The second phase included a survey, several interviews and two workshops with producers and users of ATs, as well as other relevant actors, such as carers and policy- makers. Finally, the third phase identified and explored the implications of possible future trends.

While the project focussed more upon lifelong disabilities than age-related disabilities, two of the disabilities and related ATs that were considered – visual and hearing impairments – are particularly relevant to elderly care, with the occurrence of both anticipated to increase in the coming decades with the ageing global population. The present report draws upon and develops these aspects of the project, first in exploring the range of current and possible future ATs for visual and hearing impairments, and then in examining several issues and ideas related to their effective deployment.

It is important to recognise some key differences between age-related and lifelong impairments. First, gradual age-related impairment of hearing or vision differs from sudden or lifelong impairment in terms of the strategy and ability to adjust, with or without ATs. It is also significant that older individuals are more likely to have multiple impairments – such as visual and hearing impairment, perhaps accompanied by other impairments such as reduced mobility – which could affect the suitability of some ATs. Social inclusion of elderly people with impairments is a crucial topic, while there are differences regarding their inclusion in employment and education. Contextual differences are also important, for example between the experience of stigma and prejudice associated with disability and old age, as well as between perspectives on and familiarity with some technologies.

Assistive and mainstream technologies

It is worth noting that all technologies are, to an extent, assistive, in the sense that they help people to achieve things quicker, easier or more effectively than they would otherwise be able to do. While ATs refer to technologies that are designed specifically for those with impairments, people with and without impairments use daily all kinds of technologies to augment their personal abilities. As such, many of the insights on ATs are relevant for all technologies. Furthermore, some technologies may be disabling. For example, interfaces increasingly use touchscreens instead of physical buttons that, if implemented without sensitivity to all users' needs, can have a disabling effect on people that are not at ease with touchscreen technologies, including those with visual impairments.

Assistive technologies for visual impairments

There are several types of ATs currently available to assist the blind and visually impaired. Many are designed to convey information via touch or sound that would more often be received visually. Some of the best-known ATs for the blind and visually impaired are 'haptic aids', based upon the sensation of touch. These include traditional low-tech devices such as white canes and Braille texts, as well as embossed or tactile maps and textured surfaces to support navigation. There are also more high-tech equivalents of these haptic aids, such as advanced Braille applications, smart/advanced canes and haptic computer devices. Another way of categorising ATs for the blind and deaf depends upon the level of independence achieved by the individual. Primary aids provide sufficient information for blind or visually impaired travellers to achieve tasks safely and independently. Secondary aids, on the other hand, are not sufficient alone and must be used along with a primary aid or a helper, which could include wearable orientation devices. Some systems may blend these modalities in different ways. Several ATs are also available to support the blind and visually impaired in accessing ICT such as televisions, computers, the internet, telephones and smartphones. These may be designed for specific purposes – e.g. education, employment or recreation – and can adapt to a user's needs by, for example, magnifying or intensifying a display, or translating visual information into other sensory modalities – e.g. sound and touch. There are also several technologies available to assist with the independent performance of daily tasks such as personal care, timekeeping, food preparation and consumption, environmental control and household appliances, and payments and shopping.

ATs for the blind and visually impaired that are not commercially available but under development include so called 'bionic eyes', which are essentially devices designed to replace functions of the optic system, e.g. by converting light to electrical impulses. Augmented reality spectacles may help users by magnifying images, filtering colours and providing object and facial recognition assistance by audio. The study also identified some key trends in the development of future ATs for the blind and visually impaired that are enabled by wider mainstream technology developments. For example, user-led 'democratised' design and production is made possible by the emergence of accessible 3D printers, improved wearability and portability is driven by miniaturisation and efficiency gains for power sources, and innovative displays and interface devices making use of improved touch screens and haptic feedback systems can also benefit ATs for the blind and visually impaired.

Assistive technologies for hearing impairments

ATs currently available for the deaf and hearing impaired can be categorised into three main categories: hearing, alerting and communicating. ATs can augment people's hearing ability by adapting the volume and other qualities of sound in a way that is useful for the individual. These technologies include hearing aids, assistive listening devices and personal sound amplification products, which increase sound levels within targeted frequency ranges. Cochlear implants also fit into this category, as surgically-implanted sensors that convert sound inputs into electrical signals that are directed to the auditory nerve. These are often given to deaf children to support them in developing speaking and listening skills and, ultimately, to facilitate social integration. However, the technology has raised some ethical debate, including criticism that it makes life easier for the hearing, rather than the deaf. Other ATs for the deaf and hearing impaired are

designed to alert the user, via light, vibration or a combination of the two, about specific events that would usually be announced audibly. The third category is communication technologies, which deploy a range of keyboards, touchscreens and video technologies, as well as tools to translate between speech, text and sign to facilitate communication. These can be used for face-to-face or telecommunication interactions.

Advanced versions of many of these technologies are under development, including advanced auditory brainstem implants that can bypass the inner ear and acoustic nerve to stimulate brainstem neurons directly. These are intended for those that cannot receive a cochlear implant. There are also many combinations of existing technologies, such as the integration of sign language into translation tools, which might be effectively combined with new interfaces, such as augmented reality glasses.

The following sections outline several insights from the study that are relevant to the elderly:

Future ATs are promising, but current ATs are not used to their full potential

ATs of the future may be extremely valuable for all citizens, not only the elderly and citizens with impairments. The development of future ATs, in parallel with mainstream technologies, should be supported in ways that maximise their value. This could involve encouraging the inclusion of people with disabilities from the earliest stages of development. However, a great deal more could be achieved with ATs and other technologies that are already available. A more active promotion of the distribution and use of current ATs could provide more immediate benefits than future ATs.

One size does not fit all

Everyone has different abilities and individual circumstances. Many people have multiple disabilities, while further differences appear in their social and economic resources, as well as in their personal needs, desires and preferences. Others are subjected to multiple forms of stigma or discrimination, as highlighted in a recent report on the problems facing women with disabilities in the workplace. Each individual's circumstances can be as important as their impairments or the capabilities of the AT in shaping the extent to which the AT can respond to their impairment. The sheer range of individual circumstances raises several problems for 'one-size-fits-all' approaches to elderly care.

Social and regulatory action may be more important than technological development

While ATs offer significant support for some aspects of people's lives, it is also important to consider social and regulatory action for social inclusion. For example, while ATs may ensure elderly citizens' functional capability to remain in employment for longer, social change may also be required in order to counteract stigma, as well as organisational changes such as flexitime and working from home.

Effective change should target all social groups, not only the elderly

It is important that action to achieve inclusivity does not target elderly people only. For example, the problems of discrimination and stigma require attitudinal and organisational change that permeates society. Wider actions are also required in the specific area of ATs. For example, many people will increasingly encounter ATs in their professional and personal lives, perhaps in the form of tools for facilitating communication with citizens with multiple impairments. Understanding how to engage with others effectively through these means will be particularly important for health professionals and other public services, as well as for the designers of digital services and other infrastructures.

Independence and inclusion

Our society values independence, and ATs are often conceived and designed to enable people – elderly or otherwise – to live more independent lives, or to maintain their independence for as long as possible. However, some citizens, such as retirees with reduced mobility, may have limited opportunities for human-to-human contact. ATs that enable them to live longer and with less intervention from human carers and other individuals could contribute to feelings of isolation. As such, while devising care options that include the use of ATs, it is worth reflecting on whether gains in independence could negatively affect levels of social inclusion or human interaction.

The establishment of 'AT professionals' may help on many fronts

The establishment of a defined profession of experts in the application of ATs could play an important role in addressing several of these issues. As well as providing support for individuals in the adoption of ATs that respond to their specific needs and individual circumstances – including old age – they could also help individuals without impairments to interact more effectively and inclusively with people using ATs. Their experience would also be valuable in informing the development of new ATs, as well as mainstream technologies, that will be used by people with and without impairments.

Finland

Committee for the Future, Maria Höyssä and Markus Rahkola

Elderly population

Facts and Figures

Of the 5,5 million people in Finland in 2018, 1.2 million people were older than 65 years (appr. 20 % of total population). In the current scenarios, there will be 1.5 million people, i.e. every fourth of the Finns, over 65 in 2030 and every third by 2050 (assuming steady net immigration of 15 000 people/ year)[1]. At the moment, Finland's share of population over 65 years is among the top six largest among the EU28 countries. About 400 000 elderly people are living alone and around half of persons aged over 75 live in single households.[2] The quantity of elderly will raise the most in large cities. Compared to the previous generations, the baby boom generation and people who soon turn 65 live more often in cities and in the car-dependent outskirts of cities. This will affect the future spatial distribution of the elderly. In turn, the percentage of elderly will raise the most in municipalities nearby large cities.[3] However, by 2040, the share of people aged over 84 years will rise especially in the remote municipalities.[4] According to a recent study, most municipalities have not yet made decisions regarding how to adjust for the increasing need for living and housing solutions suitable and appropriate for the elderly.[5]

Some 56 000 people aged over 75 were receiving home care services in 2018, and of those, 35% was visited by caregivers at least 60 times in a month[6]. Yet, research has found that even 86% of those receiving home care services were undernourished or were at risk of being so.[7] In 2017, about 44 000 elderly people were living in enhanced service housing, while some 11 000 were using some other form of 24h/ day care.[8] The share of people aged over 75 who feel lonely has decreased from the 13% of 2013 to 7,7% of 2018, and nearly 50% of people over 75 reported being happy. In 2018, 35% of people over 75 years reported significant difficulties in coping with everyday life, however, and 22,9% faced significant challenges to walk over 500 meters.[9]

[1] https://www.stat.fi/til/vaenn/2018/vaenn_2018_2018-11-16_tie_001_fi.html
[2] Robotics in care services: A Finnish roadmap (http://roseproject.aalto.fi/images/publications/Roadmap-final02062017.pdf).
[3] Helminen et al. (2017) Ikääntyneiden asuinpaikat nyt ja tulevaisuudessa. Suomen ympäristökeskuksen raportteja 20:2017.
[4] https://www.ym.fi/download/noname/%7B0A152E73-C122-49C6-910E-DFA2ACA2C33E%7D/120641
[5] THL (2018) Päätökset ikäasumisen ratkaisuista puuttuvat vielä kunnista. Tutkimuksesta tiiviisti 25/ Syyskuu 2018.
[6] https://thl.fi/fi/tilastot-ja-data/tilastot-aiheittain/ikaantyneet/kotihoidon-asiakkaat
[7] https://yle.fi/uutiset/3-10582346
[8] https://thl.fi/fi/tilastot-ja-data/tilastot-aiheittain/ikaantyneet/sosiaalihuollon-laitos-ja-asumispalvelut
[9] Sotanet.fi.

Digital competence among elderly

Some 60% of the population aged over 75 years has never used internet, while 19% uses it several times per day[10]. More than 70% of people over 75 years old (350 000 – 400 000 persons) does not have access to internet banking.[11] Most elderly people (84%) have access to help in using digital devices, when needed. Around third of those aged over 75 years did not use digital devices and of those, a narrow majority was not anxious about that, while the situation caused insecurity for nearly half of the group.

An example of a developing service that is helpful for those of reduced mobility, but which requires digital competence, is the Kanta.fi portal. There, Finns can browse their own medical records and prescriptions and order repeat prescriptions. Another one is the Virtual Hospital Initiative's[12] portal[13] for citizens, patients and professionals. From the patient point of view, the portal is built to help monitoring and living with various symptoms, chronic conditions and modes of life. It provides virtual spaces with chats, chatbots, symptom navigators, and with a doctor's prescription, access to digital treatment paths.

Current status of the use of technology and social innovations in elderly care

Policy initiatives

Finland has a very strong political will to increase digital inclusiveness. Prime Minister Juha Sipilä's government (2015 – 2019) started a committee to promote digitalisation in everyday life.[14] The committee includes representatives from various stakeholders. One initiative stemming from the government programme was the Hyteairo (wellness AI & robotics) programme, whose focus was to explore the possibilities of AI and robotics to help elderly people to live at their homes longer. Other contexts of application were hospital environments, pharmaceutical treatment and training for wellbeing & rehabilitation.[15]

Prime Minister Antti Rinne's governmental programme (2019) continues the theme of digital inclusiveness with an emphasis on eldery people point of view. The governmental programme highlights the use of new technologies and methodologies to help elderly people to live longer at their homes and increase the quality of social and healthcare services. This includes the use of robotics, AI and different digital services including remote surveillance services.

[10] https://www.stat.fi/til/sutivi/2018/sutivi_2018_2018-12-04_tie_001_fi.html
[11] Robotics in care services: A Finnish roadmap (http://roseproject.aalto.fi/images/publications/Roadmap-final02062017.pdf).
[12] https://www.virtuaalisairaala2.fi/en/home
[13] https://www.terveyskylä.fi
[14] https://vm.fi/digi-arkeen-neuvottelukunta
[15] http://airoisland.fi/hyteairo/

Best practices - the use of different technologies and innovations

VTT Technical Research Centre of Finland has researched and developed various technological solutions around aging, summarized in Aging and technology (2017) report.[16] These include solutions for living at home: ambient monitoring of cognitive functionality, securing thermal comfort, enhancing the feeling of security of the memory-ill and adjusting lightning. Development has also focused on technologies such as hearing device, navigation service, smart rollator[17], and tailored food products and packages. The report also introduces VTT's work on activities that go beyond specific solutions, such as coaching companies for aging-related markets; developing roadmaps for healthy aging and ICT for aging employees; designing a future shop for older people, and notions on responsible research and ethical and social evolution of gerontechnology.

The pre-study (2016) for above-mentioned Hyteairo (wellness AI & robotics) programme found that in Finland there are several regional testbeds and living labs to enable longer living at home that are organized around the university hospitals. Examples are Oulu WelfareLab, KuopioHealth and Eksote. These involve extensive piloting, commercialization and/or collaboration with business and other stakeholders. The pre-study found that there are also other living labs that may include long-term development and activities, but involvement of university hospital, the city, or other large institutional actor seems to provide better access to home care, service housing and end users. There is a national test bed working group consisting of representatives of Ministry of Social Affairs and Health, Ministry of Economic Affairs and Employment, Sitra and Business Finland. The testbeds collaborate internationally with Nordic Proof and Nordic Innovation networks.[18]

Hyteairo has gathered a network of about 150 related actors sharing information on best practices. In the Hyteairo program many pilots and experiments were conducted to help elderly people care and to live independently at their homes. The results of these experiments are both methodological and technological. One of the results is a concept "technology-supported living at home", done in co-operation of Ministry of Social Affairs and Health and the VTT Technical Research Centre of Finland LTD, where new services to everyday life are produced by processing sensor-based monitoring information through AI. Other examples are different robots for social communication, distant communication, walker robot and its analytics for surveillance purposes, medicine robots to remind and help elderly people to take their medicines in time and right dose.[19]

New initiatives in the area

As an example of municipal initiative, the city of Helsinki started a living lab in one district (Kalasatama) at the same time the district is build. The aim is to create the district a lasting innovation and experimental area to promote "Smart city" –concept, where the city and companies can introduce projects to be experimented together with the inhabitants. The projects are not exclusively aging-related but aim at enhancing the smart use of resources and the quality

[16] Ikääntyminen ja teknologia. Aging and technology (2017). VTT Research Highlights 14 (VTT 2017). (https://www.vtt.fi/inf/pdf/researchhighlights/2017/R14.pdf).
[17] https://www.vttresearch.com/services/digital-society/data-driven-solutions/digital-transformation/co-creative-prototyping
[18] Niemelä & Sachinopoulou (2019) Hyvinvoinnin tekoäly ja robotiikka kotona – pilotointiympäristöjen kehittäminen. VTT Technology 355. https://www.vtt.fi/inf/pdf/technology/2019/T355.pdf
[19] https://www.slideshare.net/airoisland/hyteairo-20182019-raportti

of urban life with, for example, shared communal spaces and distant digital control of home appliances. Rapid (3-6 months) experiments include mobile food diary, home delivery service for meal ingredients, distant therapy chatbot, smart finger ring and virtual reality travel service. The companies can have small funding for such experiments.[20] Laurea University of Applied Sciences functions as the R&D partner for the projects. Laurea also collaborates with the municipality of Sipoo in developing services for elderly people. One of the research areas has been interaction between robots and people: experiment have involved the social robot Pepper reading aloud news and playing music for the inhabitants of supported service home for five weeks in 2018. Pepper has also assisted in physiotherapy and functioned as a bingo host. In addition to Laurea's "robolab", more than ten other university units experiment with various applications of Pepper.[21]

A living lab of Tampere University of Applied Sciences has among its focus areas the development of home care as well as wellness by culture, nature, nutrition and physical activity. People of the "third age" as well as memory-impaired people create new service needs that are also business opportunities. The living lab seeks to enhance collaboration between customers, business and the municipality by creating new service and technology innovations for supporting living at home.[22]

A different approach for supporting longer life at home are the co-operative housing projects by/for elderly who participate to the design of the physical and social form of their apartments and communal space. Such housing co-operatives are, for example, Senioritalo Aikalisä[23] ("Senior House Timeout") for people aged over 55 in Jätkäsaari, Helsinki, and As Oy Helsingin Loppukiri[24] ("Final Spurt of Helsinki") for people over 48 years in Arabianranta, Helsinki. The latter is a self-service house where some work tasks, such as the cleaning of communal spaces and optionally the cooking of dinners too, are divided jointly. Such housing solutions require, however, some wealth and functionality from the customers. A lighter social innovation to support longer living at home is, for example, connecting voluntary (peer) companions to senior people in need, coordinated through website www.vapaaehtoiseksi.fi.

Autonomous traffic and new mobility services are a part of future living at home for the elderly. The Ministry of Transport and Communications and Traffic Lab[25] are jointly supporting various mobility projects, such as Jätkäsaari Smart Mobility in Helsinki, where urban mobility services and technologies are tested. Future legislation is expected to support the development of autonomous traffic, and the combining of transport of people, services and cargo.[26] (However, there naturally already exists various municipal mobility solutions for elderly and other groups of reduced mobility, realized with conventional buses and taxis and their combinations as specifically designed service lines or on-demand services.)

[20] Niemelä & Sachinopoulou (2019) Hyvinvoinnin tekoäly ja robotiikka kotona – pilotointiympäristöjen kehittäminen. VTT Technology 355. https://www.vtt.fi/inf/pdf/technology/2019/T355.pdf

[21] https://www.tekniikkatalous.fi/blogit/sosiaalinen-robotti-edistaa-palvelun-inhimillisyytta-pepperia-tulee-ikava-sanoivat-vanhustenkodin-asukkaat/09f7bb9c-917a-32bd-91d5-e09892b636ff

[22] Niemelä & Sachinopoulou (2019) Hyvinvoinnin tekoäly ja robotiikka kotona – pilotointiympäristöjen kehittäminen. VTT Technology 355. https://www.vtt.fi/inf/pdf/technology/2019/T355.pdf

[23] http://www.senioritaloaikalisa.fi

[24] https://www.loppukiri.com/

[25] https://www.trafficlab.fi/

[26] Niemelä & Sachinopoulou (2019) Hyvinvoinnin tekoäly ja robotiikka kotona – pilotointiympäristöjen kehittäminen. VTT Technology 355. https://www.vtt.fi/inf/pdf/technology/2019/T355.pdf

Implications for elderly, staff and working places

Prime Minister Antti Rinne's governmental program (2019) highlights the need to strengthen the working conditions and skills of home care staff, including technological skills. The programme includes a plan to establish multi-disciplinary social service & health care centers that extend the utilization of digital technologies to distribute work in new and more efficient ways, as well as to increase the use of distant and mobile services.

Education and further training

Valli - The Finnish Union for Senior Services[27] coordinates Technology for Eldery Care Centre[28]. The Centre assembles information, shares experiences, organizes seminars and promotes collaboration in the field. Also some guidebooks around aging and technology have been published for the elderly, their families, health care and social work professionals, technology developers and decision-makers.[29]

Much of the learning by business actors takes place through funding programs, such as the Business Finland's Smart Life (2019–2022), which offers innovation funding and useful networks as well as internationalization and export services for the digital transformation of the health and wellbeing sector.[30]

Education for elderly (e.g. digital alienation

VTKL - The Finnish Association for the Welfare of Older People has established SeniorSurf[31] for the national coordination of senior citizen IT peer tuition, material production, and advocacy. Another peer support network, Digiklubi[32], is coordinated by Technology for Elderly Care Centre. The Population Register Centre's Digituki (digital support) initiative is currently spreading from the five pilot regions to combine various local initiatives to a national program.[33]

Conflict of interests (integrity, ethical and economical

Societal and political debates

In the aftermath of a series of revealed deficiencies in certain enhanced service homes[34], there emerged a very vivid public debate regarding the privatization and quality of elderly care in winter 2018-2019. Many of the service homes turned out to be seriously under-resourced in practise and examples of poor treatment of old people seemed to abound around the country. As one result, according to the new governmental program, the relation of the number of nurses per elderly in

[27] https://www.valli.fi/in-english/

[28] https://www.ikateknologiakeskus.fi/in-english/

[29] Anni ja Onni - Huomaamaton teknologia arjen apuna (2016), Jaana Leikas & Helena Launiainen (eds.) Miina Sillanpään Säätiön julkaisusarja B:41 (https://issuu.com/vttfinland/docs/anni_ja_onni_sisus_press?e=5313536/36647375); Arjen älykkäät välineet - opas ikääntyneiden kotona asumisen tueksi https://www.valli.fi/fileadmin/user_upload/Julkaisut__pdf/Oppaat__pdf/ITK-opas_kolmas_korjattu_painos.pdf

[30] https://www.businessfinland.fi/en/for-finnish-customers/services/programs/smart-life-finland/

[31] https://www.seniorsurf.fi/english/

[32] https://www.ikateknologiakeskus.fi/tietopankki/digiklubi-hanke/

[33] https://vrk.fi/digituki

[34] https://yle.fi/uutiset/osasto/news/watchdog_probes_up_to_15_deaths_at_senior_care_homes/10633841; https://newsnowfinland.fi/domestic/valvira-orders-esperi-care-to-fix-problems-at-residential-homes-for-elderly-people

enhanced service homes is about to be increased from 0,5 nurses to 0,7 nurses per elderly person receiving the service. However, some actors in the field have voiced doubts of the sufficiency of the number of caregivers on the labour market and the potential subsequent implications for the quality of home care services, for example. Thus, the pressure to utilize also technological means to support the living and health care of the elderly are not going to diminish in the foreseeable future.

Future perspectives and reflections

The Academy of Finland has funded a large research consortium Robots and the Future of Welfare Services (ROSE) that runs from 2015 to 2021. The project studies how advances in service robotics allow product and service innovation and renewal of welfare services, when such services are developed ethically and jointly with stakeholders. The development is studied on individual, institutional and societal levels, taking into account user needs, ethical issues, technological maturity, and the health care service system. The project[35] has published a roadmap[36] for understanding the use of robotics in care and promoting independent living with a focus on the elderly population in 5-10 years timeframe. The roadmap divides the applications on robotics in care into four areas: supporting workforce in care, rehabilitation and prosthetics, personal physical support, and personal cognitive/social support. Medical robots such as robotic surgery are excluded. The English summary of the report states that:

> "To support care workers in healthcare institutions, we foresee opportunities in well-defined tasks such as hospital logistics, patient transfer and administering medication. Telepresence (possibly robotic) will become available. Within rehabilitation and prosthetics, robot assisted therapy and rehabilitation exercises will become available. Robotic prostheses will be used for assisting upper- and lower-body mobility.
>
> In personal assistance, robotic mobility aids will become available. New single purpose domestic robots for purposes such as cleaning and personal hygiene will appear. Social and cognitive assistant robots will support communication between humans and provide information services such as reminders. Robots will also be able to provide some forms of cognitive therapy for example to treat early dementia. General purpose assistive robots are not foreseen in the next 10 years due to immaturity of the technology.
>
> The Finnish business and innovation ecosystem around robotics in care is immature. There is no credible, skilled national operator that could connect care technologies, related services and service users. At present, the business ecosystem is still largely at the birth stage, and the wider innovation ecosystem is immature and essential stakeholders are missing. However, Finland appears to possess good opportunities to build a functioning innovation ecosystem around care robotics, as the well-established Finnish technological and welfare systems form a synergic platform for actors and stakeholders to co-operate, allowing both public and private institutions as well as developers and users to participate in planning of robotic services. In order to reach a cutting edge position in using and producing robotic systems in care services, a systematic and multidisciplinary research, innovation and education program is needed."

The ROSE project has also organized a citizen panel for the acceptability of robots as caregivers for voluntary people over 65 of age (N=26). As a result of various forms of group work, the panel produced a statement recognizing the central values to be followed when implementing robotized

[35] http://roseproject.aalto.fi/en/

[36] Robotics in care services: A Finnish roadmap (http://roseproject.aalto.fi/images/publications/Roadmap-final02062017.pdf).

care: autonomy of the elderly, informing and education, matters of responsibility and justice, as well as the importance of and entitlement to human interaction.[37]

[37] https://www.bioetiikka.fi/wp-content/uploads/2018/01/Rose-raportti.pdf

France

The secretariat of OPECST

Elderly population – Facts and Figures

The number of persons, 65 years and older, are 13,1 million (2018 figures) which is 19,5% of France's population. The number is projected to increase to 16,5 million in 2030 (23,5% of population) and 18,9 million in 2040 (26,1% of population). From 2020 to 2030, the number of persons 85 years and over will grow by 420 000; from 2030 to 2040 it should again increase by 1,4 million and in 2060 5 million persons will be 85 years and over[1].

Life expectancy is 78,4 years for men and 84,8 years for women. Various projections show that it will increase to 86 years for men and 91,1 years for women in 2060. The majority of older people is ageing in rather good conditions and can sustain their autonomy. 8% of 60 years and over are dependent. Over 85 years, it is 1 out of 5. The average age for elderly dependency is 83 years. The average duration of elderly dependency is four years; it is expected to be five years in 2040.

85% of persons 60 years and over live in private homes and 85% of them are owners of their homes. But even as owners, more than 10% of them live under the poverty level which means that they need financial help to adapt their houses to progressive loss of autonomy. Among the dependent population, 60% are living at home and 40% in special housing. 4,3 million people are helping the elderly, of which 2,8 million are assisting the daily life of old people living at home[2]. The persons with Parkinson's disease is projected to double by 2030 as well as those with dementia, depression, diabetes, cancer or arthritis - main illnesses among the elderly.

One specificity for France is the high level of residential mobility within the elderly population towards the coastal regions and the South of France. It already has, and will have increasingly, a significant impact for local governments. In 2050 the persons 65 years and over are projected to be 22% of the population in Paris region but 30% in the Côte d'Azur. Even though people chose to move when they are retired, only 6% of the houses are adapted to the daily life of the elderly[3]. The paradox is that 90% of French people say they agree to the need of adjusting their homes to old age and health deterioration.

The contribution of old people to society is strong: more than 5 million are taking part in local associations and many are active support to family solidarity (more than two-thirds of grand-parents take regular care of their grand-children).

[1] Rapport du Haut Conseil de la famille, de l'enfance et de l'âge – Le soutien à l'autonomie des personnes âgées à l'horizon 2030, 7 novembre 2018

[2] DREES – Etude handicap-santé aidants informels

[3] This very low rate explains why so many household accidents involve the elderly. 450 000 falls are registered every year of which 62% are at home and more than two-thirds affect people over 74 years; almost 10 000 people die from their injuries.

Digital competence among elderly

A recent study shows that 27% of the 60 years and over never use the internet. The figure is 59% for the people 85 years and over. Digital exclusion is an aggravating factor for social isolation of old people. On the other hand, elderly with digital knowledge spend a large amount of time on the internet. They usually say that it provides a window to the world and a good means of communication, especially with young people (grand-children). More and more retirement homes have become web-friendly with Wifi access to everyone and training workshops for their residents.

Some old people clearly do not want to deal with digital technologies and feel that this choice is not well respected by society especially when it implies a more difficult access to their rights. For instance declaration of income only through e-administration services is considered a step backwards.

Current status of the use of technology and social innovations in elderly care

Policy initiatives

In line with the World Health Organisation (WHO) approach[4], the main objective in France is to increase the well-being and the quality of life of the elderly in order to prevent the loss of autonomy. It is the principal objective of the Law adapting society to ageing[5]. It means helping elderly people do what they consider the most important, even with less functional capabilities. These capabilities depend on the physical and moral condition but also on the environment. Therefore policy initiatives strive to take into account the different environments in which the elderly live: urban, suburban, periurban or rural areas, family support, finances. It implies different types of answers regarding mobility, housing, etc.

Ageing in the underprivileged neighborhoods is a focal point. It is being addressed through the general urban policy but with a special attention to the specificities of the elderly in these areas: overrepresentation of women, large proportion of very isolated people, people with low or very low income.

Prevention policies aim at promoting health education and educational therapy of the elderly. It is more and more perceived as a life-long action: promoting good health and environment for the elderly has to begin when the persons are still in good condition and should continue all along the loss of capabilities. Encouraging a healthy lifestyle seems necessary at all stages. Making the elderly participate in the policy design is also a new requisite of national and local programmes.

Best practices – the use of different technologies and innovations

The potential of technological or organisational innovations is linked to a strong analytical effort. Four directions must be examined and defined:

[4] WHO – Age-friendly Environments Programme, 2012, 2018

[5] Loi du 28 décembre 2015 relative à l'adaptation de la société au vieillissement

- typology of interventions/actions/ways of acting (incentive, constraint…);
- typology of stakeholders : from individuals to institutions;
- institutional and financial organisation;
- identification of best policies to prevent elderly dependency.

The main areas for these innovations are:

- urban design: walkways, benches, lifts, visual and sound devices;
- adaptation of transport: assistance personnel, taxi services, social carsharing, securing of pedestrian, cycling, motorcar routes;
- adaptation of personal housing[6]: telecare, home automation, smart home, e-health; experimental residences, apartment-sharing with other seniors, intergenerational cohabitation; access to financial support;
- fight against social isolation[7]: cultural, physical, social activities; attractive proposals and incentives; improving detection and care of sensory deficits[8]; digital platforms creating links between the elderly, their family and professionals;
- local action : better coordination of old-age services especially health services; better information of the elderly; supporting municipalities trying to deal with old age cognitive impairments and creating « dementia friendly communities »[9];
- promotion of good health: physical activity for old and very old persons; improvement of nutrition; memory workshops; development of new medical techniques[10]; better tracking of situations of vulnerability[11]; better organisation of the health system for the elderly[12]; improvement of the medical prescription[13].
  All these fields designed for innovation can be enhanced by new technologies, robots, artificial intelligence, better and more intensive use of data, etc.

The Silver Economy sector is getting larger and stronger each day with many start-ups inventing new solutions for the elderly and the people accompanying them. This new industrial cluster was launched in 2013 and has a turnover of 92 billion euros[14]. GDP annual growth coming from it is 0,25%.

Implications for elderly, staff and working places

Services to individuals is a quick rising economic sector. The total workforce is increasing by 4 or 5% every year which means there is a recruitment challenge particularly in some rural areas. Many new jobs are emerging and a strong need for training and qualification will have to be addressed during the years to come. It is import to develop attractiveness of the jobs and enhance a high level quality strategy. Traditional jobs will have to adapt to the situation of elderly with less

[6] Persons 80 years and over spend 80% of their time at home.
[7] 27% of persons 75 years and over are considered socially isolated versus 12% for the whole population : étude CSA pour Les Petits frères des pauvres
[8] Several studies show the direct link between hearing problems, depression, disability, dementia and death.
[9] The city of Rennes aspires to be the first French dementia fiendly town.
[10] Cataract surgery assisted by a robot is less traumatic and very effective to prevent falls and their comordibity.
[11] In the Oise département, an experiment started in 2017 to detect vulnerability by the way of connected objects.
[12] A systematic evaluation of individual geriatric state has shown good results.
[13] 20% of the hospitalisation of 80 years and over is due to medication
[14] https://www.silvereco.fr

autonomy. Dentists, opticians, audioprothesists will have to visit patients at home or in the special housing. Connected objects, teleassistance, domotics, e-health will enrich some of the services provided. More than 70 diplomas or degrees exist in the field of services to individuals. They aim at professionalizing the workforce and making more attractive a number of professions.

Family caregivers are also increasing in numbers. 12% of French people take care on a regular basis of someone from their close circle during 14 hours a week on average. Studies focusing on people (very often the family) accompanying the elderly with dementia of major cognitive impairments show the necessity to help family caregivers. New programmes are designed to offer medical, psychological and social help.

Education for elderly including measures against digital alienation

The priority in the education for the elderly is the education for a healthy life. It includes physical training in order to prevent the loss of autonomy. Associations, municipalities, special programmes for the elderly offer a very large choice of activities. The elderly are better informed about them, the medical professionals encourage their patients to participate in these programmes, teachers and animators are trained to deal with old age. It is not yet accessible to everyone but the dynamic is strong.

Measures against digital alienation are also being taken to make the digital equipment more user-friendly, facilitate e-services, online formalities, promote digital assistance personnel, show the elderly the internet resources according to their areas of interest, etc.

Societal and political debates

Autonomy is the major cause for concern for 42% of the French people (48% of the 65 years and over)[15]. Ageing well means staying in good physical shape for one person out of two. Young people (25 years and less) are more worried than seniors. The priority of the elderly is to stay at home.

The development of smart homes will offer many new and interesting opportunities for the elderly such as house surveillance, motion detectors, alarms, cameras, automation of household appliances, internet of things, connections with family and caregivers, etc. It will give them more autonomy, greater independence and a better quality of life. On the other hand, it will register the behaviour, the habits, the way of life of many and intrude on people's privacy. Too much automation can also lead to less social interaction and paradoxically isolation problems.

Future perspectives and reflections

All recent studies show that the intergenerational link is considered as a major value for the future of society. Within families, people 65 years and over are believed to be a strong asset especially to pass the family history and traditions to the younger generations and to give financial help. At the same time, old people want to play an active role in the society and take part in the shaping of the future.

Therefore, the anticipation of the difficulties and the needs of the elderly is the main challenge in order to prepare the increase in the proportion of 65 years and over, 75 years and over, 85 years

[15] Baromètre annuel réalisé par l'IFOP

and over during the next twenty or thirty years. It has become a political priority. Another challenge which has become a political priority is to ensure equality in the access to services for older people, particularly to health services.

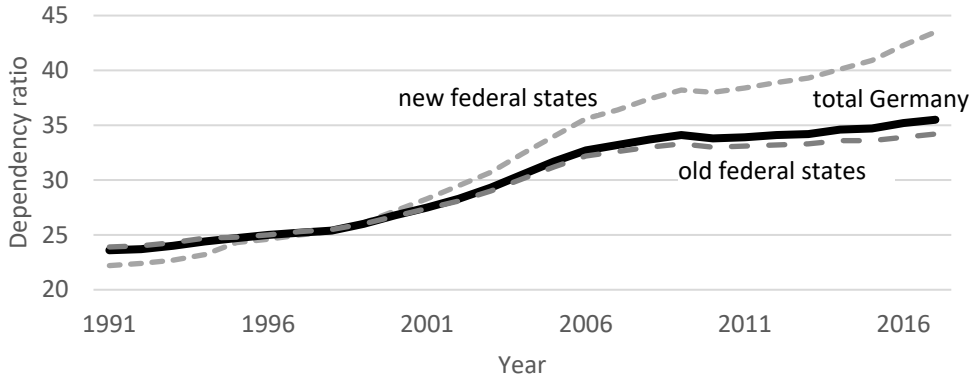
Germany

Office of Technology Assessment at the German Parliament (TAB), Katrin Gerlinger, Christoph Kehl and Reinhard Grünwald

Elderly population

Facts and Figures

Germany has one of the lowest birth rates among industrialised countries and is thus particularly affected by demographic change. The proportion of the age group 80 years and older is projected to increase from a mere 5 % of the population (in 2013) to 13 % in 2060.[1] In the same period the share of people of working age (here: 20-64) will fall from 61% today to 51%. This development is particularly pronounced in the new federal states (i.e. East Germany), because in the post-reunification period 1.8 million persons - mainly young, qualified and female – moved away and left an additional demographic gap. Already today, in the new federal states there is an average dependency ratio[2] of 44 (see Fig. 1)[3]. This is one of the highest figures in the world second only to Japan.[4]



Dependency ratio: persons 65 years and older per 100 persons 20 to 64
Data origin: GeroStat - DOI 10.5156/GEROSTAT

Not to be misleading: The ageing society does not only pose challenges, it also has a number of opportunities associated with it since elderly people contribute a multitude of experiences, time and possibly also financial and other resources to the community. However, in the context of

[1] Federal Statistical Office of Germany (2015): Germany's population by 2060 - Results of the 13th coordinated population projection, page 19.
[2] this is an indicator for the number of retired persons per 100 persons of working age
[3] GeroStat - Deutsches Zentrum für Altersfragen, Berlin. DOI 10.5156/GEROSTAT
[4] https://data.worldbank.org/indicator/SP.POP.DPND.OL?locations=JP

health care and long-term care this demographic development is well known to cause issues: there is a strong statistical correlation of chronic diseases and the need for care with increasing age. According to official statistics, one third of all persons with severe disabilities is 70 or older. In 2017, the official number of people needing long-term care in Germany was 3.4 Mio. One in four is cared for full-time in nursing homes, about 75% at home, most of them by family members (who often do not live in the same house, however) with or without the support of outpatient nurses.[5] Despite the strong family commitment, the pressure on the national care and health system is growing in the course of demographic change.

Digital competence among elderly people

The opportunities for social participation of people of old age are often impeded by physical, mental and/or cognitive limitations. At the same time, many chances that digital technologies offer for participation remain untapped, because this age group often has only very limited digital skills: half of the people with age 70 or older do not use the internet. A high number of them are women, people in rural areas or people with a low level of education. Those who do use the internet mostly use e-mails for communication and browse webpages to find information. But they are very cautious about other tools like social networking, video and internet telephony or the use of online learning materials.

Use of technology and social innovations in elderly care

Current status and policy initiatives

For years, experts have pointed to emerging funding gaps and significant difficulties in ensuring adequate coverage of the demand for nursing care and - particularly in structurally weak rural regions - also of medical care. The shortage of general practitioners in rural areas is becoming increasingly obvious and the number of employees in elderly care cannot keep up with the growing need for care. There is already talk of a national crisis in care (»Pflegenotstand«). According to the Federal Employment Agency, about 40,000 positions in the nursing sector are currently unoccupied, of which about 24,000 are in elderly care.[6] This situation threatens to worsen in the coming years. For elderly people, who need long-term care as well as medical care, travel and waiting times are increasing, especially in rural areas, and care time may decrease, severely impairing well-being and quality of life of those affected. Politics and government have reacted with a concerted effort on many levels, which includes initiatives for schooling and training of personnel, salary improvements and cross-border recruitment of skilled nursing and medical professionals.

In addition, there is hope that new (digital) technologies and assistance systems can disburden professional and family caretakers and also directly support elderly people to live self-determined

[5] http://www.demografie-portal.de/SharedDocs/Informieren/DE/ZahlenFakten/Pflegebeduerftige_Versorgung.html

[6] https://www.aerztezeitung.de/politik_gesellschaft/pflege/article/979191/neue-zahlen-bundesagentur-viele-pflegestellen-unbesetzt.html

and autonomously at home. Three areas are of particular interest here: Ambient Assisted Living (AAL) – i.e. intelligent smart home solutions (e.g. fall detectors, communication aids and services) –, care robotics and telecare/telemedicine. Digitisation and the utilisation of technology aim at facilitating workflows and making processes more efficient.

Since 2008, the Federal Ministry of Education and Research (BMBF) has set up various national funding programmes to develop age-appropriate assistance systems. By 2015 a total of 54 R&D projects were financially supported. Digitisation in care for the elderly and nursing is another focus of federal government funding. Currently a total of 74 projects are supported with € 89 Mio.[7] Approximately € 8-10 Mio of this is spent on research projects on care robotics. Telemedicine has a broad and varied R&D funding base, with several hundred projects at different levels of application maturity. However, cross-sectoral approaches in which nursing and medical care are integrated are rather rare.

Best practices – the use of different technologies and innovations

Only few products or services based on digital technologies, which can support the care of older people, have permeated in everyday practice, the emergency call button being a noted exception. There are several obstacles for an increased use of digital care technologies in the future:

low everyday usability and maturity of the technology,

administrative and financial hurdles: new technological applications have to go through an arduous and time-consuming process of CE-certification under EU medical device regulation, admission onto official lists of assistive technologies and formal evaluation of medical and/or cost benefits before statutory health or long-term care insurances bear the costs or operators of nursing homes or hospitals invest in such technologies;

lack of an adequate digital infrastructure in the medical and care sector in Germany: compared to other sectors and other countries there are significant backlogs. In addition, there are major deficits in digital network coverage in structurally weak regions.

As a result, telecare and telemedicine applications, despite their promising potential, are only slowly finding their way into the long-term care and health sector covered by statutory insurances in Germany. Front runners often can be found in the self-pay market, medical consultations via video services being one example.

One of the few robotic systems already routinely used in a few German nursing homes, is the therapeutic seal »Paro«[8]. Most of the innovative technologies (AAL, robotics, telemedicine) are still in an experimental stage and several extensive field trials are currently underway (for example in Garmisch-Partenkirchen[9] or in the BMBF-funded Nursing Practice Centre Berlin[10]). However, nursing home and care professionals expect a significant boost in innovation in care and also in telemedicine over the next few years. This includes both the introduction of new technologies (sensors, robotics, etc.) and the establishment of new home-based monitoring, care and housing concepts.

[7] https://dipbt.bundestag.de/doc/btd/19/063/1906321.pdf
[8] www.parorobots.com
[9] https://www.dlr.de/dlr/desktopdefault.aspx/tabid-10989/1769_read-27306/
[10] https://www.ppz-berlin.de/

Implications for elderly, staff and working places

There is a broad societal consensus in Germany that innovative technical solutions play an important role in shaping future care and medical service. However, there is also agreement that good nursing and medical care are fundamentally based on interpersonal interaction and that technology should never substitute or impede it. Concern about machines dehumanizing nursing and medical care is noticeable in Germany and also has implications for the acceptance of innovative nursing and medical technologies. As population surveys show, technical assistance systems for medical treatment and independent living tend to appear more acceptable than the use of autonomous robots in personal care. However, the opinion towards these technologies seems to be strongly influenced by emotions and personal attitudes (both curiosity and reservations). There is not yet a consolidated public opinion, mainly because practical experiences are insufficient.

Of central importance for the acceptance of a technological solution in elderly care is the actual added value for those affected and their relatives, as well as the usefulness for nurses and physicians. However, knowledge about the impact of new technologies on elderly care is still very limited. In general, innovative assistive technology for elderly care can only realise their potential in a complex interaction with medical and nursing professionals, relatives and people in need of care. The design of the living environment also plays an important role. In order to meet the complexity of human-machine interaction in nursing and medical care, BMBF-funded projects have to follow an approach called »Integrated Research«. This means that R&D-programmes put the people and their needs at centre stage. Ethical, social and legal aspects are integrated from the beginning and persons concerned are involved in a participatory manner.

In order to support the optimal integration of AAL, telemedicine and care robotic technologies into the care and health system, important fields of action are the respective competences of all involved as well as questions of access and financing. Application design should be strongly geared to the needs of the user group and not just be based on technological feasibility. Since digital skills of older people are often below average, as are those of many care professionals, suitable educational offers should be developed and provided. A relevant obstacle is that statutory long-term care and health insurances remunerate the qualification of the elderly concerned - but not the training of caring relatives or professional caretakers. Another obstacle which is difficult to tackle is that the concept of lifelong learning has no strong foundation in routine practice yet.

In order to prevent the formation of a two-tier care and health system, the solidarity-based financing of innovative aids that have proven their benefits would be key. Today the German healthcare insurance system can fulfil this requirement only to a degree, because of a multitude of regulations and restrictions. For example, smart phones or tablet computers are defined as everyday commodities, which are excluded from the official lists for assistive technologies that are covered by the statutory insurances. By the same argument technical components in the smart home area are by definition excluded from coverage.

Also, investments by out- and inpatient care institutions in innovative technologies are generally not covered by statutory long-term care and health insurances. Since most of these facilities have very limited investment resources, new financing models for innovative care technologies are needed. Compared to digital pioneering countries, Germany has for years invested considerably less in the IT equipment of nursing homes and medical institutions. As a

result, many processes are hardly digitised at all, especially since there are no obligations to manage electronic patient records, and the specialised network infrastructure with which all healthcare facilities will be connected in future is still in a build-up phase.[11]

Future perspectives and reflections

In view of the ageing population, the future of healthcare has been an important political issue in Germany for many years. However, a debate of the question whether and how innovative technology solutions can and should contribute to coping with the respective challenges is only beginning. Examining these questions requires not only a preoccupation with the possibilities and limitations of the increasing automatisation in the healthcare sector, but above all an understanding of what constitutes a »good« nursing and healthcare in a modern digital society. TA can inform this debate, thus making an important contribution to the societal shaping of socio-technical innovation processes in the context of demographic change.

With this overarching aim in mind, a number of TAB-projects deal with these issues:

- Innovation Analysis on Health Apps« (http://www.tab-beim-bundestag.de/en/research/u30000.html)
- Robotics and assistive neurotechnologies in the care sector – challenges for society (http://www.tab-beim-bundestag.de/en/research/u106002.html)
- Status quo and perspectives of telemedicine (ongoing, http://www.tab-beim-bundestag.de/en/research/u40600.html)
- Potentials of mobile Internet and digital technologies for a better participation of persons with disabilities in society (ongoing, http://www.tab-beim-bundestag.de/en/research/u30800.html)

[11] Currently new legislation is being prepared to accelerate the digitisation of the healthcare sector (Cabinet resolution adopted on July 10, https://www.bundesgesundheitsministerium.de/fileadmin/Dateien/3_Downloads/Gesetze_und_Verordnungen/GuV/D/Digitale-Versorgung-Gesetz_DVG_Kabinett.pdf).

Greece

Greek Permanent Committee on Research and Technology (GPCRT), Costas Papadimitriou

Elderly population

Facts and Figures

According to the 2011 census, the population of Greece aged 65 years or over amounts 1,873,243, ie 17.08% of the total population (for 2008: 18.1%, 2,029,695) with a life expectancy for the general population equal to 79.78 years, 78.2 years for men and 81.9 years for women.

Thus, to one hundred children under the age of 15 correspond 71 adults over the age of 65. In 2020, according to a survey conducted by the National Centre for Social Research, the number of the elderly will be as much as the number of young people. In 1853, the proportion of the elderly was 3.2% and the young under 15 years was 41.2% of the general population.

The regions of the country, where more elderly people live, are the central and southern Peloponnese and the islands of the eastern Aegean. The regions with the highest percentage of mature citizens are Lefkada (22%), Samos (21%), Kefalonia (21%). Arcadia, Lesvos and Fokida, where the respective rates range from 20-21%.

Digital maturity

Surveys show that among the elderly population, more than half of the respondents have never used a computer (56.13%) or the internet (58.17%). From the remaining percentage, 9.68% use the computer about once a month, 24.52% about once a week, while 9.68% more than 2 times a week. Accordingly, 7.10% of respondents use the internet around once a month, 23.87% around once a week and 9.68% more than twice a week. It is evident that computer and internet usage rates are almost identical, indicating that adults do not make a distinction between using a computer and using the internet.

People aged 60-64 use computers and the internet more than older age groups. Also, a strong correlation was found with respect to the level of computer use and the level of education. The frequency of computer and internet usage increases according to the educational level of individuals. Computer ownership and the ability to connect to the internet are important factors that enable the use of tools and technology in the health care sector. Although the percentage of women who do not use computers and the internet is higher than that of men, these differences were not statistically significant.

The reasons that elderly people use computer and internet are for being informed about the news (78.06%), for the acquisition of new knowledge and skills (72.26%), for communication with family and friends (61.29%), for dealing with loneliness(60.00%), for entertainment (56,13%), for monitoring of the modern way of life (45,16%) and, lastly, for the maintenance of individual autonomy (36,77%).

The reasons, for which elderly adults do not use computers and the internet are: the feeling that they are not ready to handle these technologies without the help of a specialist (84.78%), the cost of purchasing a computer and of internet connection (13%), the thought of computers' inevitability (60.87%) in their household, the lack of confidence for the security of personal data (58.70%), the physical discomfort caused by their use (46.74%), the lack of time (45.65%), the feeling that advanced age is incompatible with new media (45.65%), as well as, the anxiety caused by the use of the computer and the internet s (36.96%).

Concerning the intention to participate in computer and internet educational programs, 57.14% of the respondents noted that they wanted to participate in such programs against 42.86% who responded negatively to the question. Adult people who have indicated their intention to participate in computer and internet education programs consider (90.36%) that acquiring digital skills will help them keep up with the developments at time, that participation in such programs is an interesting challenge (89.02%) and that it helps to keep their mental capabilities alert (88.89%).

Also, ICT education is seen, even among the elderly, as an opportunity for education that adults did not have when they were younger (90.48%), and as a form of entertainment (83.13%) or an opportunity to broaden their social contact cycle (67.90%). On the other hand, older people who were negative about their participation in computer and internet training programs said that they did not have time to deal with them (60.66%), that it is not worth it (52.54%) and that they consider they will experience difficulties in educational activities (63.93%).

Current status of the use of technology and social innovations in elderly care

Policy initiatives

In Greece, the research and development of these technologies is mainly financed by European Funding and the state.

An important action in this direction is performed by the Sotiria Public Hospital's electronic healthcare unit, located in Athens, which provides electronic home monitoring and rehabilitation and home care services to patients suffering from chronic illnesses.

In addition, National Telemedicine Network operates with 43 units. Among them, 30 telemedicine stations, where patients address to, are located in remote locations in the island country, in health centres and in multipurpose regional clinics and 13 stations, where doctors consult and / or examine patients remotely, are located in large hospitals of both the islands and the mainland. This system functions for regular appointments for patients and for e-learning for doctors and nurses who are practicing medicine on the islands. More telemedicine units gradually enter the system in a way that ensures stability and duration of the system's operation. Emergencies are expected to be set to operate shortly.

Best practices

Many important developments have been made in the past years in the areas of medical care and health, such as telemedicine support, that was mentioned above. The application of ICT in

combination with various intelligent systems and devices can make it possible to extend independent living. For example, an elderly person with health problems may receive medical care without leaving his / her home.

The importance of technical support is particularly great, especially in the aspects of everyday life that families or third parties cannot contribute. However, the initiatives and the laws regulating the use of ICTs in health care provision are at an early stage and the biggest problem rises from low funding for relative research and innovative applications.

Implications for elderly, staff and working places

Education and further training

The Youth and Lifelong Learning Foundation of the General Secretariat for Lifelong Learning of the Ministry of Education is implementing a counselling program for senior citizens on "Evolvement in the Third Age". Thematics that can be developed in the program are:

- Structure and Function of the Greek Family
- Third Age and Family: Relationships in the Family
- Nutrition issues
- Leisure Time Management
- Psychological support
- Loneliness in the Third Age
- Dealing with Loss in the Third Age
- Health Education
- Education for elderly (e.g. digital alienation)
- Conflict of interests (integrity, ethical and economical)

Future perspectives and reflections

The main research institutes in Greece involved in the development of ICTs for the elderly and disabled are:

- The Institute of Computer Science of the Foundation of Research and Technology (FORTH).
- The Department of Electrical and Computer Engineering of the National Technical University of Athens.
- The Department of Informatics and Telecommunications of the University of Athens
- The Department of Product and Systems Design Engineering of the University of the Aegean
- The Department of Computer Engineering and Informatics of the University of Patras
- The Institute for Language and Speech Processing (ILSP)
- The National Centre for Social Research (EKKE), which created the Hellenic Bank for Social Data in order to support empirical social research in the country and the dissemination of its results.

Japan

Research and Legislative Reference Bureau (RLRB), National Diet Library (NDL), Chifuyu Hiyama and Tomoyuki Suzuki

Elderly population

Facts and Figures

What Japan is facing today is a rapid aging of its population that is unprecedented in the world. In 2007, Japan's aging rate (the proportion of the total population over 65 years of age) exceeded 21%, and became the first super-aging society in the world. In January 2019, out of the total Japanese population of 126,317,000, the number of people 65 years or over was 35,624,000, meaning the aging rate reached 28.2%[1].

The healthy life expectancy of the elderly continues to increase, and was 72.14 years for males and 74.79 years for females as of 2016[2]. In addition, the decline in the younger population due to the decreasing birth rate and increasing aging rate is expected to continue increasing. The population of Japan will fall below 100 million in 2053 and 90 million in 2063, with the aging rate anticipated to exceed 38.4% in 2065. Furthermore, it is predicted that the population aged over 75 will be larger than one fourth of the total population in 2055[3].

Along with the progress of aging, the working-age population continues to decline, and the shortage of workers in labor-intensive industries and of people to support local communities has been recognized as a most serious problem. At the same time, the number of older people being certified as requiring long-term care/support is increasing, reaching 6.32 million (18% of all people 65 years old or over) as of March 2017[4]. People leaving their jobs to provide nursing care for family members and a shortage of nursing staff are considered major problems in the aging society of Japan.

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[1] Jinko Suikei (population projection), June 2016. <https://www.stat.go.jp/data/jinsui/pdf/201906.pdf>

[2] Shuji Hashimoto, "Kenko jumyo no zenkoku suii no santei hyoka ni kansuru kenkyu: zenkoku to todofuken no suii" (Research on the calculation and evaluation of the national transition of healthy life expectancy – figures of whole country and 47 prefectures) <http://toukei.umin.jp/kenkoujyumyou/houkoku/H29.pdf>

[3] National Institute of Population and Social Security Research, Nihon no shorai suikei jinko (Heisei29nen suikei)(Population projection of Japan, 2017), <http://www.ipss.go.jp/pp-zenkoku/j/zenkoku2017/pp29_Report3.pdf>

[4] Ministry of Health, Labour and Welfare, Kaigo hoken jigyo hokoku(nempo) no pointo (points of annual report of national nursing care insurance as of 2016) <https://www.mhlw.go.jp/topics/kaigo/osirase/jigyo/16/dl/h28_point.pdf>

Current status of the use of technology and social innovations in elderly care

Policy initiatives

The Basic Act Measures for Aging Society was enacted in 1995 in order to respond to the increasingly aging population. In 2012, "The Guideline of Measures for Ageing Society" was formulated based on the act as the guideline for the country's basic and comprehensive measures for aging society.

This guideline was revised in February 2018[5], establishing "new measures to counter the aging society enabled by the achievements of technological innovation" as one of its basic concepts as well as indicating a variety of measures in each field.

The measures are diverse:

- improvement of employment environment for the elderly through promotion of telework;
- provision of learning opportunities to the elderly and promotion of social participation through ICT;
- realization of traffic systems contributing to safe and comfortable movement, and promotion of research and development of welfare equipment, daily goods, information and communication equipment, etc.;
- development of care robots based on the practical demands of nursing care, solving problems such as dementia and frailty using advanced science and technology, and development and introduction of innovative medical technologies and devices.

In addition, specific numerical targets for these measures were also given: to expand the market scale of nursing care robots from 24.4 billion yen in 2015 to about 500 billion yen in 2020, to make unmanned automated driving transport services available across the country by 2025, and to make more than 5 sorts of innovative medical devices available for use by 2020.

This policy direction of solving problems through technological innovation truly reflects the ideas of "Growth Strategy 2017" (later revised as "Investments for the Future Strategy 2018")[6], which was adopted in advance of the Guideline. The "Growth Strategy" is aimed at realizing "Society 5.0" to solve social problems by putting the fruits of technological innovation into the industries and daily life. As one of the strategic areas of Society 5.0 is the creation of a health care system for the next generation, the policy goal is to build a health, medical and long-term care system for the benefit of individuals and patients to further extend healthy life expectancy.

Some examples of current efforts under these policies by national and local governments and other entities follow.

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[5] The Guidelines of measures for aging society. <https://www8.cao.go.jp/kourei/measure/taikou/pdf/p_honbun_h29e.pdf>

[6] *Growth Strategy 2018.* <https://www.kantei.go.jp/jp/singi/keizaisaisei/pdf/miraitousi2018_en.pdf><https://www.kantei.go.jp/jp/singi/keizaisaisei/pdf/miraitousi2018_en2.pdf

Utilization of ICT in community-based integrated care systems

Before the year 2025 when the baby boomers (about 8 million) become older than 75, local governments, as the insurers of the national health insurance and nursing care insurance system, are obliged to build a "community-based integrated care system" in preparation for an explosion in demand for medical and long-term care. This system should be a seamless system, which provides services related to housing, medical and nursing care, sickness prevention and support of daily life for residents to keep living in familiar places even when they require nursing care.

In this system, doctors, nurses, pharmacists, caregivers, care managers and local government officials should cooperate with each other to offer seamless health and long-term care services. The relevant information can be closely shared between those concerned by taking advantage of ICT and efficient and cross-sectional use of data enables optimal policy making in municipalities. One example is the system of Sado City, Niigata Prefecture, operating from 2013, and another is that of Kashiwa City, Chiba Prefecture, operating from 2014[7].

Construction of health care data platform

In January 2017, the Ministry of Health, Labour and Welfare initiated a "data health reform". The ministry is currently constructing a database called a "health and medical data platform" to launch in 2020, which will connect the health, medical care and long-term nursing data owned by local governments/insurers and medical institutions. Personal data from when healthy, to when sick, to requiring long-term care will be integrated into the platform to be utilized personally and by medical and nursing care staff to provide services properly. Such data will be anonymized for secondary use by various actors such as researchers, for example, to establish scientifically proven nursing-care methods and develop efficient therapeutics for dementia. It is expected to enable "data health": promoting health and preventing sickness as well as reducing medical expenses[8].

Development and practical use of nursing care robots

The Ministry of Health, Labour and Welfare and the Ministry of Economy, Trade and Industry support the development and adoption of nursing care robots in six priority fields: transfer assistance, mobility assistance, excretion support, watching and communication, bathing assistance, and long-term care support. The Ministry of Health, Labour and Welfare set up a "needs and seeds" council to discuss the direction of development of robots so they will reflect the needs and demand from the long-term care field[9].

Recent achievements of development have been put to practical use in welfare facilities for the elderly: transfer support equipment to reduce the physical burden of the care staff by artificial muscle, electric power assisted walking support equipment with automatic brakes, monitoring devices to prevent falling by detecting motions before the care recipient leaves bed, and a

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[7] Takashi Igari et al., "Chiiki hokatsu kea shisutemu kochiku ni muketa chiiki iryo joho nettowaku sisutemu donyu ni kansuru ichikosatsu" (a study of introduction of regional medical information cooperative network system toward construction of health care data platform), FPU Journal of Nursing Research, (15) , 2018, pp. 83-90. <https://fukuoka-pu.repo.nii.ac.jp/?action=repository_uri&item_id=396&file_id=22&file_no = 1>

[8] Kusuhiro Okabayashi, "Utilizing Big Medical Data: Initiatives by the Japanese Government to Promote Secondary Use of Medical Information"(in Japanese) *Issue Brief* 1005 <http://dl.ndl.go.jp/info:ndljp/pid/11092417>, "Data Health kaikaku toha" *Nikkei Digital Health* 2017.7.4 <https://tech.nikkeibp.co.jp/dm/atcl/word/15/327920/070400027/?ST=health>

[9] <https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/0000209634.html>

communication device for a bedridden person to transmit messages by looking at a screen through detection of eye movement with image analysis technology[10].

Kitakyushu City's approach is well known as a practical example by a local government. The city has been collaborating with local companies, universities and nursing care facilities on development and practical implementation of nursing care robots since 2016. In the development process, the details of work required for nursing care are analyzed in advance, and the functions to be implemented are determined after exchanging opinions with the nursing staff. The robots will be tested in nursing care facilities and be on the market after being improved based on feedback from caregivers[11].

Approach to telemedicine

It is expected that the burden of moving elderly people will be reduced and the efficiency of medical services will be improved by promoting telemedicine or online medicine, such as telemedicine where doctors examine patients at home or in welfare facilities, and remote monitoring where a patient's vital data is grasped through the Internet.

Fukuoka City started a project to enhance family doctors' role through ICT in 2017: telemedicine through online monitoring, online interviews, and online medical examinations have been tested. The number of patients who need home health care in Fukuoka City is estimated to increase 2.5 times between 2013 and 2025, and there is a concern about the shortage of family doctors engaged in home care. The main aim of Fukuoka City in introducing telemedicine is to make medical treatment more efficient and to increase the number of patients that can be examined by one doctor.

In online monitoring, changes in a patient's blood glucose level or blood pressure are displayed as a graph, and the doctor checks the patient's condition online. In online interviews, a patient can check off the scored interview items before the examination, and the doctor can objectively grasp the patient's main complaint in advance. For diagnosis, the first medical examination is carried out by a face-to-face meeting, then follow-up examinations will be done online by video chat after making the treatment plan with the patient's consent[12]. Telemedicine was positively reviewed by doctors involved in the experiment[13], however, it has been consistently considered to be complementary to conventional medicine from doctors' perspectives[14].

Providing services for watching over the elderly by using ICT

Various kinds of services for watching over elderly people's daily living activities have been provided by private companies and others using ICT. The market scale is anticipated to expand

[10] *Kaigo robotto donyu katsuyo jireishu* (examples of introduction and practical use of nursing care robots) as of 2017<http://www.techno-aids.or.jp/robot/file29/jirei2017.pdf>, as of 2018 <http://www.techno-aids.or.jp/robot/file30/jirei2018.pdf>

[11] *Annual Report on the Aging Society*, 2018 (in Japanese) <https://www8.cao.go.jp/kourei/whitepaper/w-2018/html/zenbun/s1_3_topics6. html>

[12] *Nihon Iji Simpo* (4879), 2017.10.28, pp.18-20.

[13] *Nikkei Digital Health* 2019.2.28. <https://tech.nikkeibp.co.jp/dm/atcl/feature/15/327441/022700345/>

[14] *Nikkei Digital Health* 2019.3.7. <https://tech.nikkeibp.co.jp/dm/atcl/feature/15/327441/022300339/?ST=health&P=1>

with the increase of elderly persons living alone. Examples of such services, some of which are in experimental stages, are[15]:

- personal monitoring and emergency call service: monitoring living activities and environment such as temperature and humidity of a solitary elderly person through sensors and cameras installed in the house. Reports will be sent to relatives in case of an extraordinary event. The status of use of electricity, gas and water by an elderly person can be notified by email.
- monitoring elderly people living in nursing homes during nighttime by sensors and cameras to lighten the burden on staff members
- monitoring service for elderly patients with dementia: collecting location information of patients by using a wearable GPS device and making emergency calls. Many local municipalities lend such devices to prevent people from going missing. Some municipalities have introduced systems to transmit location information of patients wearing IC tags automatically whenever they encounter any volunteers carrying smartphones installed with a dedicated application.
- collecting information of living habits and physical data by wearable devices useful for prevention and early detection of dementia along with other information for diagnosis such as the accumulated amount of causative agents

Promotion of social participation of elderly people

Improving ICT Literacy of the Elderly

Although the Internet usage rate of elderly people has increased significantly over the past decade, generational differences still exist. According to a survey conducted by the Ministry of Internal Affairs and Communications in 2018, the proportion of those who used the Internet in the last year was 75.7 % for people in their 60s, 51.0 % for people in their 70s, and 21.5% for people in their 80s or older; the older the users are, the lower their utilization rate[16].

In addition, according to another survey conducted by the Ministry of Internal Affairs and Communications in 2015, Internet use by people aged over 60 in Japan is still at a low level when compared to those in the USA, Sweden and Germany[17].

On the other hand, many of the elderly are active and healthy "active seniors". According to a survey by the Cabinet Office, 71.9 % of people 60 to 69 years old and 47.5% of people over 70 have certain kind of social activities[18]. As the labor population continues to decline, it is expected that the elderly's opportunities for activities that make use of their abilities and experiences will

[15] Junko Kishimoto, "Sentan gijutsu katuyo ni yoru koreisha sisetsu no nyukyosha no anzen kakuho to romu kankyo kaizen no hokosei" (direction of securing the safety of residents of facilities for the elderly and improvement of working environment by using advanced technology) *Senior Business Market,* 2016.11, pp.60-63.

[16] Ministry of Internal Affairs and Communication, *Tsushin riyo doko chosa* (*Communication Usage Trend Survey*), 2018. <http://www.soumu.go.jp/johotsusintokei/statistics/data/190531_1.pdf>

[17] Ministry of Internal Affairs and Communication, *Dai hachi kai koreisha no seikatsu to ishiki ni kansuru kokusai hikaku chosa* (The result of 8th survey on international comparison of senior citizen's living and awareness), pp.133-134. <https://www8.cao.go.jp/kourei/ishiki/h27/zentai/pdf/kourei_h27_3-7.pdf>

[18] "Heisei 28 -year National Health and Nutrition Survey Report," the Ministry of Health, Labour and Welfare , 2017.12. <Https://www.mhlw.go.jp/bunya/kenkou/eiyou/dl/h28-houkoku.pdf>

be increased if these people acquire skills to utilize ICT[19]. Under these circumstances, non-profit corporations/organizations and local governments are more frequently working to foster ICT literacy of the elderly and to support other kinds of learning by the elderly through ICT skills. There are courses of lectures on the usage of PCs, smartphones and tablets taught for the elderly at places such as the Silver Human Resource Center (in 95 municipalities), Saga Prefecture, NPOs in Nagoya City, Miyazaki City, Setagaya City in Tokyo, etc.

Future perspectives and reflections

The super-aging in Japan is a situation the world has never before experienced. Japan is seeking effective measures to deal with such unprecedented circumstances[20].

To make advanced technology a real driving force in overcoming the problems arising from a super-aging society, it is essential to identify needs and reflect them in development processes. The ethical aspects of such technology should also be considered. It is necessary to revise the existing relevant systems and/or review their adequacy to introduce new technology.

[19] Hiroya Masuda " Aging and Life of Elderly People in the Local Community and ICT Utilization " 2009.9.10. The University of Tokyo Policy Vision Research Center Website < https://pari.ifi.u-tokyo.ac.jp/unit /event_report/cocn_masuda_090910.pdf>

[20] Akira Kawamura, "Koreika de sekai toppu no nihon: shisaku no seiko taiken de sekai wo rido dekiruka? (Japan is at the top of aging on the globe: can Japan lead the world with any successful experience?) *Waseda Weekly*, 2018. 10.26. <https://www.waseda.jp/inst/weekly/academics/2018/10/26/40830/>

Mexico

Office for Information of Science and Technology (INCyTU), for the Mexican Congress, Liliana Estrada

Elderly population

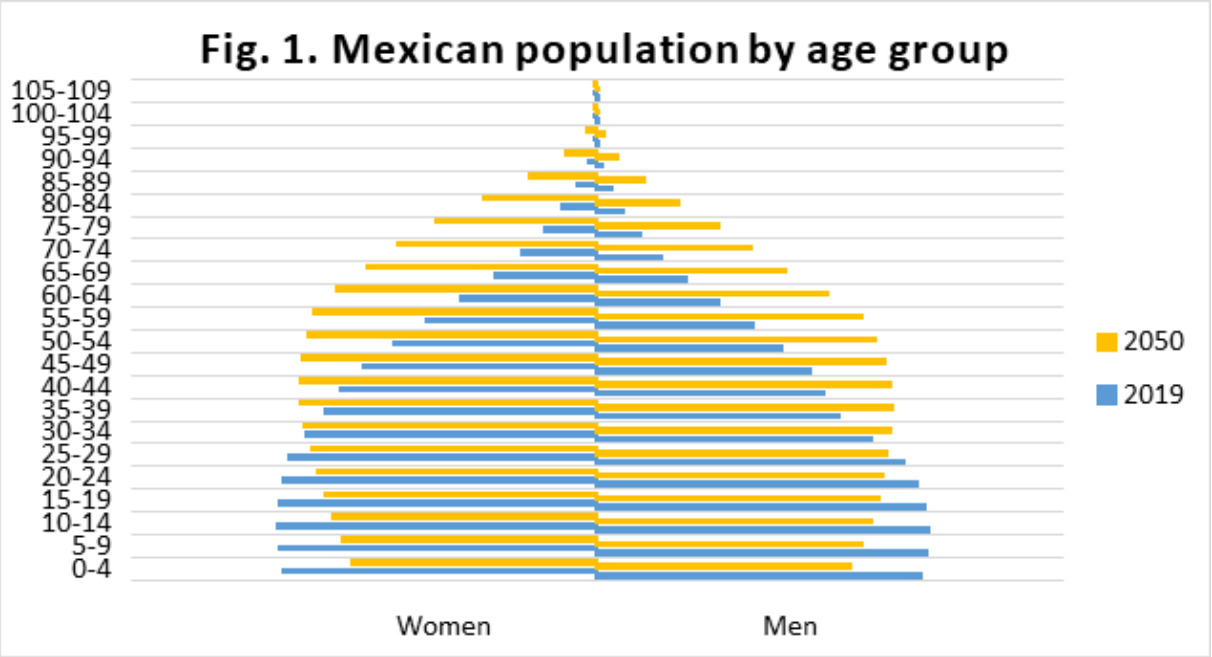
Facts and Figures

With a population above 120 million people, Mexico is the 11th largest country. Contrary to most European countries, Mexico's population is relatively young. It has a mean age of 28.4 years, below the world average of 30.4.[1]

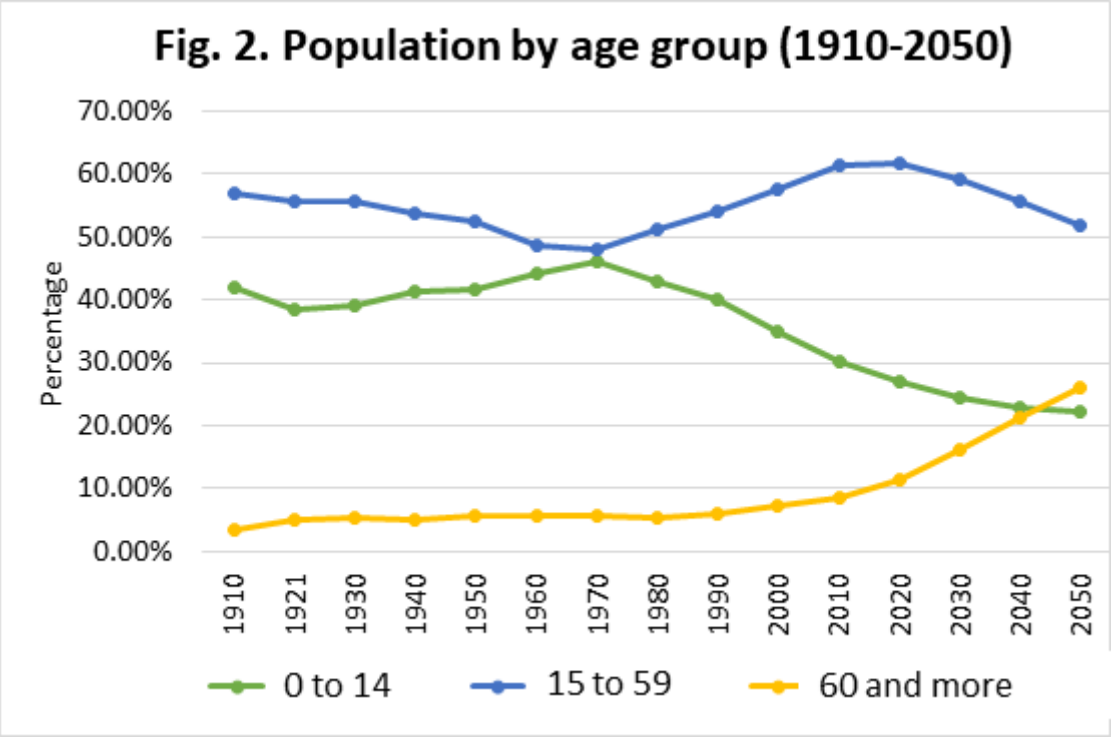
Mexican life expectancy at birth is 76.3 years, one of the largest in Latin America. It increased greatly from 1950 where it was 47.3 years to 75.2 years in 2005. However, since 2005 it has not increased in part due to the ageing of population and due to the elevated number of violent deaths of young people that the country has endured in the last decades.[2]

In Mexico a person is considered elderly starting at 60 years, however, the retirement age is at and many public policies are aimed at population over 65. In 2016, 7.8% of the total population were above 65 years. From this group, 41.1% is living in poverty and more than half (57.1%) did not finish secondary school (US: junior high school). In comparison, the percentage of adult population below 65 years that did not finish secondary school is much lower, being 14%. Remarkably, people over 65 years has much better access to social security and health services than the rest of the population.[3]

Decreasing natality rates and increasing mortality rates predict an ageing Mexican population as shown in Fig. 1.[4] By 2050, the percentage of elderly people is expected to rise to 23%, representing approximately 34.5 million out of a total 150 million people. The mean age will rise to approximately 47 years, from current 28.4 years.[5]



This depicts a scenario where the Mexican population pyramid will suffer a transformation similar to what has happened to some European countries, but it will be much faster, happening in a lapse of 30 years. This steep increase in the proportion of elderly people can be observed in Fig 2.



Digital maturity

According to the National Institute of Statistics and Geography (INEGI) a low percentage of the population above 55 years make use of the internet (32.3%), computers (17.9%), but almost two thirds make use of mobile phones (65.1%). When asked how did they learn to use these technologies the three most popular answers were, in order of popularity, by themselves, thanks to a friend or relative, and at work. The least popular answers were those related to taking a course regardless if they were free or paid.[6]

Current status of the use of technology and social innovations in elderly care

Policy initiatives

The current bills in Mexico presented in the two ordinary sessions of the LXIV Legislature from September 1, 2018 to April 30, 2019, regarding care for the elderly, include two by the Chamber of Senators and six by the Chamber of Deputies, from which only two of them were sent to the reviewing Chamber. These two bills deal with the respect of human rights of the elderly in prison and the other one ensures that the requirements and guidelines of social programmes for vulnerable people and social groups can be easily met. The rest of the bills are aimed to guarantee the elderly: medical assistance; old-age pension; participation in public policies and government programmes; and the promotion and encouragement of teleworking between social, private and public entities, in order to facilitate their inclusion in this kind of work.[7]

On the other hand, one of the largest social programs for the current Government of México is "The Elderly Wellness Program", in which an amount of one hundred billion pesos (4.7 bn EUR) has been assigned this year. The programme have national coverage and provides financial support of $1,275 MXN (60 EUR) per month to indigenous people over 65 years old and people over 68 years old in the rest of the country. However, no bills or substantial programs have been discussed in the Congress of the Union or in the Federal Government of Mexico related to specific technologies for the elderly care.[8]

Best practices and new initiatives

The National Institute for the Elderly (INAPAM, by its acronym in Spanish) is responsible for the national public policy in favour of the elderly. Through an official INAPAM identification, seniors are entitled to certain benefits including discounts in property taxes and food, cultural, educational, tourist, recreational, health and transport services. Although this Institute offers programs, workshops or services related to health care; multidisciplinary education; linkage with the productive sector; training for work or legal advice, it does not contemplate training or promotion of the use of different technologies.[9]

Currently, Mexico has not implemented a national comprehensive strategy to include new technologies in elderly care, however, there are few examples of technology developed and best practices. Some health institutions such as the Ministry of Health, the Mexican Social Security Institute (IMSS, by its acronym in Spanish) or the Institute for Security and Social Services for

State Workers (ISSSTE, by its acronym in Spanish) have developed electronic medical appointment systems and telemedicine programs.[10,11] The IMSS has a program specialized in Geriatrics that aims to implement the best practices in this area and an advance oftalmologic unit able to perform up to 3,000 optical surgeries a year.[12] Another example is the Mërcher Industrias Médicas, a mexican company which has developed a telemedicine module with biometric sensors and a medicine dispenser.[13] There are also many other projects such as the development of a social work robot, which interacts with people by verbal communication, body language, recognition and expression of emotions. This innovation is being developed by one of the National Research Centers of CONACyT, the Ensenada Center for Scientific Research and Higher Education (CISECE, by its acronym in Spanish).[14] Another example is ORTMED S.A. de C.V., a society that leads a free program of therapeutic gymnasiums in outdoor spaces for the elderly. The program aims to prevent, restore or delay the effects of aging in health by building exercise circuits in public parks with equipment similar to those used in rehabilitation centers and physical therapy, but with the possibility of practicing them safely outdoors.[15]

Implications for elderly, staff and working places

Caregiving and human resource formation

Care for the elderly is mainly done by informal caregivers (ICs). Most commonly, the ICs are usually female members, with little male participation. Access to Assistive Ambient Technologies AALs is restricted to the affluent or middle-high income families who can afford them. In the specific case of ICs working with people with dementia, the most common use of AAL technologies are cameras, and families are not usually concerned with privacy issues regarding monitoring the person with dementia.[16]

Regarding human resources formation in Elderly Care, Mexico is lagging behind other countries. It is not well prepared to face its incoming population transformation as can be seen in the following example. Despite the fact that there is more population above 60 years than below 5 years, in 2015 there were more than ten times more positions for medical students to specialize in child care rather than elderly care.[17]

Future perspectives and reflections

The process of population ageing involves ethical, political and economic actions, problems, risks and opportunities for a nation. In order to prolong people's lives in a dignified manner and enhanced people's quality of life, it is necessary to create and implement knowledge and technology, public policies and innovation.

Future plans include the five-year work programme 2017 - 2022 of the National Institute of Geriatrics, which has established an integral strategy for GeroScience in Mexico constituted by 5 governing actions: training of specialized graduate students, which will involve new programs in universities and national research centers; increase of infrastructure to serve the elderly, that is, specialized hospitals and research centers; a strong public-private partnership under the law to obtain new funding schemes, development of technologies and efficient knowledge transfer

mechanisms; multidisciplinary alliances between federal government institutions, universities and scientists; and mobility of different people working for the elderly and inter-institutional dissemination of results. [18] Independently to this plan, a new research center on Geriatrics is being developed in the capital city. This new center is a collaboration between the City Ministry of Science (SECTEI), the National Council on Science and Technology (CONACyT) and the Centre for Research and Advanced Studies (CINVESTAV). Furthermore, it will have close links to the three Max Planck Institutes that encompass research on Geriatrics. [19]

In Mexico there is a prevalence of digital alienation of the elderly, and lacks specialized human resources and education for the elderly, a multi-sectoral approach is needed to overcome these difficulties. Boundary organisations such as Technology Assessment offices shall play a cornerstone role in bringing together different actors for building adequate public policies.

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18. http://www.geriatria.salud.gob.mx/descargas/planeacion/Programa-Quinquenal-17-22.pdf
19. La CDMX contará con un nuevo centro de investigación sobre el envejecimiento — ciencias. [citado 24/07/2019]. http://ciencias.jornada.com.mx/2018/01/21/la-cdmx-contara-con-un-nuevo-centro-de-investigacion-sobre-el-envejecimiento-6669.html

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Socio-technological innovations for Dutch elderly care

The number of Dutch elderly people is increasing, and with it the need for care and support, while the ratio of (informal) caregivers per elderly person is dropping. Where in 1980 approximately 63% of the over-80's lived in nursing homes, nowadays this is approximately 11%. Moreover, it is expected that the number of community-dwelling elderly people will increase because of population ageing and a national policy to stimulate elderly people to live longer at home. In order to anticipate the growing demand for healthcare by elderly people, Dutch government has put in place various policy regimes aiming to empower older adults to stay active and improve their quality of life, to enable them to keep residing in their own homes, or experience a good quality of life in a nursing home. In the near future, it is thought that various technological solutions will play a leading role in (home) care, leading to changes in the (working) environment of (informal) care providers, and the elderly people themselves. In this report we will provide an overview of the various socio-technological innovations that are introduced in the setting of Dutch community-dwelling older adults and nursing homes.

Dutch elderly population – 2018 - 2030

Facts and Figures

A number of trends can be elicited that have stimulated the increased attention for social and technological innovations for community-dwelling elderly people in the Netherlands. These trends are:

- The number of elderly people is increasing
- The number of care providers is decreasing
- Rural shrinking requires more care at a distance

Current Dutch population consists of 17 million people, of which 1.4 million people are aged 75- and older (approximately 8%). Of these 1.4 million over-75s, 1.2 million live at home[1] independently. The percentage of community-dwelling elderly decreases with age, 98% of the 75-79-year olds compared to 71% of the over-90s. More than 90% of the over-75s has a chronic illness, of which almost two third has three or more illnesses.[2] In 3020, it is expected that the total

[1] De Klerk, M., Verbeek-Oudijk, D., Plaisier, I. & M. den Draak (2019) Zorgen voor thuiswonende ouderen. Kennissynthese over de zorg voor zelfstandig wonende 75-plussers, knelpunten en toekomstige ontwikkelingen. Den Haag: Sociaal en Cultureel Planbureau.

[2] RIVM (2019) Volksgezondheidenzorg.info. Cijfers en achtergronden. (Facts and Backgrounds) Accessed July 8th 2019 via www.volksgezondheidenzorg.info

population of elderly persons (over-75s) will have increased to 2.1 million, approximately 12% of the total population. Hence, the absolute number of elderly people that require care will increase.

Simultaneously, the labor market is increasingly strained – the number of health professionals is decreasing, especially the number of nurses. Currently, about 1.2 million people work in healthcare (around 13% of the employed working population), of which more than a third (35%) work in nursing, care, and home care.[3] Reorganizations in home care have led to health care professionals leaving the sector and less young people starting education to work in the health domain. Health care professionals, especially in the home and elderly care, indicate to experience a high regulatory burden that comes at the expense of their job satisfaction in healthcare.[4] However, there are still over 25.000 existing vacancies, and with the relatively new legal requirement for Quality monitoring in nursing homes an additional 70.000 people are necessary. What is more, it is expected that the number of needed employees in the care sector will rise to 200.000 in 2022.[5] Increasingly, informal care givers are required to take care of their loved ones. Yet, due to the ageing society the ratio of care givers per elderly person is decreasing. In 2019, for every 85-year- old and over, there were 13 potential informal caregivers in the age of 45-64. In 2040 this ratio is expected to be 1:4.

A third trend affecting the organization of Dutch elderly care is rural-shrinking. Older adults living in rural regions often live at a larger distance from their children than older adults living in other regions. Young people have moved towards cities to deploy career opportunities there, while their parents have stayed in the rural community. In 2030, it is expected that the percentage of over-75s in the population will be especially high in rural areas (≥ 12,5%), requiring a larger proportion of the potential working population to work within the domain of elderly care.[6]

Digital maturity

In 2019, Statistics Netherlands (CBS) established that digital skills of older adults are increasing, though still 32% of the over-75s has never used the internet before. The group of over-75s who have never been online has decreased from 66% in 2012, to 50% in 2015, and 32% in 2018.[7] With respect to the use of e-health, Statistics Netherlands reports that 85% of the Dutch population sometimes looks for information about health problems on the internet, of which 14% always searches the internet if they have complaints. Young people use the internet to look forhealth information more often than elderly people. 37% of the group over-75s states never to use the internet to look for health information. Nevertheless, older adults, aged 55-75, do use eHealth applications, such as online requests for recipes more often than youngsters. Yet, the group over-75s use these applications less than all the other age-groups.[8] Elderly people are less inclined to measure their own health values at home than young people. When they do want to perform these measurements, they almost always want to share these data online as well.[9] Since the age-group 65-74 is using the internet and eHealth applications more often than the over-75s, it is expected

[3] Aalst, Mechelien van der (2018). Zorg. Factsheet arbeidsmarkt. Accessed July 8th 2019 via https://www.uwv.nl/overuwv/Images/Factsheet_Zorg.pdf.
[4] idem
[5] Daalhuizen, F., Groot, C. de en H. van Amsterdam (2018). Zorg om banen in de ouderenzorg. Accessed July 8th 2019 via https://themasites.pbl.nl/zorg-om-banen-in-de-ouderenzorg/.
[6] idem
[7] https://www.cbs.nl/nl-nl/nieuws/2019/01/zes-procent-nooit-op-internet, accessed 20190704
[8] Van Beuningen, J. (2019) eHealth. Mogelijkheden, gebruik en opvattingen. Den Haag: Centraal Bureau voor de Statistiek
[9] idem

that eHealth usage and the acceptance of technological innovations in the elderly care will increase in due time.

Current status of the use of socio-technological innovations in elderly care

Policy initiatives

As of 2018, the Ministry of Health has stimulated various parties to collaborate in improving Dutch elderly care. With the so-called '*Pact for care for the elderly people',* the various stakeholders, from governmental bodies, insurers, tech-developers to care providers, come into action together to:

- identify and break through loneliness,[10]
- organize good care and support at home,[11] and
- improve the quality of nursing home care.[12]

The underlying motivation is the belief in a society in which elderly people feel valued and in which they can - if necessary - make use of good quality care and support.[13] Hence, Dutch government has initiated three main action programs, each targeting one of the three themes.
Policy and financial incentives are put in place for each of those themes. These financial investments are spread over the three programs, with each program having its own points of attention. For example, within the program *Longer at Home,* investments are made in learning networks. These networks aim to stimulate the collaboration between health insurers, municipalities, health care providers, VWS and a delegation of client representatives so that they can tackle the problems in elderly care and promote innovation and upscaling thereof. The *Longer At Home-program* also entails specifically earmarked investments in innovation via the so-called innovation schemes (€270.000, 2019-2021). These innovation schemes aim to stimulate living at home longer through e-health applications and accessing medical data, and the development of new initiatives for residential care arrangements[14].

Best practices

The three identified themes of loneliness, organizing good care and support at home, and improving the quality of nursing home care, are problems that are hard to solve by existing institutions, networks, and markets, yet require collaboration and understanding of the circumstances that allow the problems to manifest themselves.[15] Policy focuses on solutions for these problems through policy, management, and financing, including stimulating innovation. Policy makers and care providers expect that because of technological advancements people will be able to receive more (medical) care at home.

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[10] https://www.rijksoverheid.nl/onderwerpen/eenzaamheid/aanpak-eenzaamheid, accessed 20190612
[11] https://www.rijksoverheid.nl/onderwerpen/zorg-en-ondersteuning-thuis/langer-zelfstandig-wonen, accessed 20190612
[12] https://www.rijksoverheid.nl/onderwerpen/verpleeghuizen-en-zorginstellingen/zorg-ouderen-verpleeghuizen-verbeteren, , accessed 20190612
[13] https://www.rijksoverheid.nl/onderwerpen/ouderenzorg/documenten/publicaties/2018/03/08/pact-voor-de-ouderenzorg, accessed 20190612
[14] Ministerie van Volksgezondheid, Welzijn en Sport (2018) Programma Langer Thuis. Den Haag
[15] Scheffelaar & Kuiper (2017 Wat werkt bij sociale innovatie. Utrecht:Movisie

Indeed, innovations made possible by technological developments can contribute to solving these problems, yet they cannot be solved by technology alone. "*Innovation is not only driven by technological possibilities but also by social, economic and societal factors. Innovative applications become successful if they manage to connect with their environment; that is to say, if they become integrated into existing systems and technologies, are permissible and fit within regulatory frameworks, and are accepted by users and society at large*".[16] Experts confirm that technological developments focussing on the social embedding of their solutions, whether low- or high-tech, are likely to have a higher acceptance rate by older adults.[17] Moreover, they claim that it is not always technology that should offer a solution.

Best or good practices are often socio-technical innovations. Hence, in this overview report we will focus on socio-technical innovations for older adults who grow old independently in a familiar environment, and for older adults for whom it is no longer possible to live at home and who reside in a nursing home.

New initiatives for active and healthy elderly people

Various types of technologies are used to improve the quality of life and activity for the elderly in the Netherlands, such as (social) robotics for (physical, social, cognitive) assistance, lifestyle monitoring for prevention, telecare to allow care at a distance, personal alarm systems for safety, health apps to coach healthy behaviour,[18] and medicine dispensers for therapeutic adherence. These technologies often have a digital or ICT component in them, aiming to improve communication or stimulate daily activity and health. Many of these technologies have been developed during the nineties and '00's, and since then have undergone merely incremental changes, e.g. medicine dispensers or lifestyle monitoring. A Dutch study demonstrates that other technologies also help elderly people to live independently, such as consumer equipment, home adaptations, and personal alarm buttons.[19] Stakeholders thus should have a broad view with regards to technology that could support ageing-in-place.[20] Though, scientific evidence for the (cost-)effectiveness of these technologies remains limited.

In recent years, the focus of technology developers and researchers has shifted towards the social component of innovations and its societal embedding; having an eye for technological, commercial, regulatory, and societal aspects that play a role in the acceptance of innovations in general.[21] The same transition can be witnessed within the development of technological solutions, or better said, socio-technical innovations for elderly people. Below, we provide some examples that are identified as 'good practices' in policy documents and / or by the three interviewed Dutch experts on technologies for elderly people.

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[16] Maclaine Pont, P., van Est, R., & Deuten, J. (2016). Shaping socio-technical innovation through policy: Essay commissioned by the Department of Knowledge, Innovation and Strategy of the Dutch Ministry of Infrastructure and the Environment

[17] In order to verify findings of the desk research study we interviewed three Dutch experts with respect to assistive technologies for elderly people in the Netherlands. We gratefully thank Sebastiaan Peek, Henk Herman Nap and Louis Neven for their input. Any misrepresentation or errors are the mistake of the authors of this brief report.

[18] Kool, L., Timmer, J., & van Est, Q. C. (2013). Keuzes voor de e-coach: maatschappelijke vragen bij de automatisering van de coachingspraktijk. Den Haag: Rathenau Instituut

[19] Peek, S. T. M. (2017). Understanding technology acceptance by older adults who are aging in place: A dynamic perspective. Doctoral dissertation, Tilburg University.

[20] Peek, S.T.M. et al. (2016). What it takes to successfully implement technology for aging in place: focus groups with stakeholders. *Journal of medical Internet research*, *18*(5), e98.

[21] Sikma, T. Verhoef, P., J. Deuten (2019) Voorbereid op de praktijk. Anticiperen op de maatschappelijke inbedding van innovatie bij onderzoeks- en ontwikkelprogramma's. Den Haag: Rathenau Instituut.

According to some of the experts, technologies appear to have a higher degree of acceptance when they have limited functionality but are fully developed. Examples are **CRDL**, **Paro** and the **Magic table** (in Dutch: Tovertafel), all three technologies aim to enhance social interaction of elderly people. *"CRDL (cradle) is an interactive care instrument that translates physical contact between people into sound". This makes new contact possible for people with dementia who struggle with communicating and social interaction and those in their environment.*[22] Paro, a robot in the form of a baby seal, is a social robot initially designed to stimulate group activities within nursing homes. Increasingly, Paro is used in therapy for elderly people who haveproblems with emotional contact and sleeping.[23,24] The Magic table "*connects older people in the late stage of their dementia journey with each other and with their surroundings, all the while stimulating movement*".[25] The evaluation of these technologies occurs in terms of effectiveness (influence on the disease process or otherwise 'medical' effects),[26] or in more qualitative observational terms of positive experience in connection with bystanders (partner, family or healthcare professionals).[27]

In The Hague the *Living Healthy & Longer at home* (in Dutch: gezond lang thuis) -project has enabled residents of the **iZi-Living Lab** to experience and experiment with various technologies that can make their lives more pleasant and easier. Every resident receives a personalized mix of technologies via a so-called matchings consultation; what technology fits the context, the network, abilities, and needs of the elderly person living in the iZi-apartment. Based upon this consultation, the resident can experience several of the 90 smart solutions embedded in their home, varying from sensors that measure their way of life, to social and care robots, to senior tablets, or to personal alarms. This Living Lab contributes to the knowledge of the residents, suppliers, care and welfare organizations, municipality, housing associations, and knowledge institutions on the development, validation and implementation of innovative care technology. Whereas this is not the only Living Lab for elderly care in the Netherlands,[28] according to experts the attention for embedding these technologies in the personal context of the resident is quite unique.

The integration of separate technologies in the personal context of community dwelling elderly people is the current challenge. Integrating various technologies, from social robotics to lifestyle monitoring, allows, for example, **tinybot Tessa** to increase in context awareness.[29] An example of such an integration project is **i-evAALution**, which "*offers elderly people support in various areas of their daily life. The system improves comfort and safety at home, thus making it possible for the end-user to remain living independently and comfortably at home. Moreover, interoperability on the platform promotes autonomy and makes it possible for elderly to take care of themselves and others*".[30] Similarly, **FreeWalker** aims to integrate various technologies in order to develop a system that determines dynamic lifecycles (i.e. the 'allowed' travel behaviour) for elderly people with dementia and is currently being fine-tuned in co-creation with the nursing home. Thereby providing elderly people with dementia with accurate personal alarm systems in-

[22] https://crdlt.com/?lang=EN, Accessed July 8th 2019
[23] PARO Therapeutic Robot. Accessed July 8th 2019 via http://www.parorobots.com/
[24] Robinson H., Broadbent E. & Macdonald B. (2015). Group sessions with Paro in a nursing home: Structure, observations and interviews. *Australasian journal on ageing*, *35*(2), 106-112.
[25] https://tovertafel.co.uk/ Accessed July 8th 2019
[26] See for example footnote 21, 22 and Anderiesen, H. (2017). Playful Design for Activation: Co-designing serious games for people with moderate to severe dementia to reduce apathy. Doctoral dissertation, TU Delft
[27] https://crdlt.com/static/docs/CRDLpresentation01.pdf Accessed July 11th 2019
[28] See for example: https://livinglabamersfoort.nl/
[29] HAN Univeristy of Applied Sciences is investigiating the effects of the tinybot Tessa in a testing-ground.
[30] https://www.vilans.org/project/i-evaalution-integrated-supportsystem-for-elderly-people/ Accessed July 8th 2019

and outside their living situation. A system that adjusts the allowed travel behaviour according to the agenda of the user and their personal situation.

Individual technological solutions are not necessarily the first stepping stone for all innovations. Another example, **Embrace** ("SamenOud" in Dutch), a best practice according to the policy program *Longer at Home*, is a population-based integrated care model based on the Chronic Care Model and the Kaiser Permanente Triangle. The essence of Embrace is the integration of the various policies, approaches, and resources present in the care for elderly people. Based on screening and triage, over-75s receive care and support according to their risk profile (robust, frail, or complex care needs). A multi-disciplinary Elderly Care Team offers appropriate personalized, pro-active, and preventive care and support.[31]

Co-creation and research

Dutch studies and current trends in socio-technical innovation thus demonstrate that with respect to healthy ageing and independently living of elderly people, attention is neededfor both the technologies and the system within which they are used. What all the provided examples have in common, is that they combine technological solutions with an eye for social context and the systems in which the solutions are embedded. They provide networks and aim for co-creation between suppliers, research institutes, care providers, and elderly people. The existence of six **Academic Collaborative Centres on elderly care**, collaborations between universities, care and other organization to develop scientific knowledge, and to initiate innovation in elderly care contributes to these developments. These collaborations are based on a long-term research program, jointly established by the universities and the care and wellbeing organizations, and aim to improve elderly care in nursing homes and at home.[32] Similarly, Dutch universities of applied sciences have developed various networks and collaborations with respect to elderly care, such as the expertise centre Caring Society 3.0 that includes the **GET-lab** (Health and Technology laboratory) by Avans and Fontys' **Sense of Home Fieldlab**. These laboratories allow for (future) care professionals to develop into care providers who deliver customized care using technology. Likewise, knowledge institutes, such as **Vilans** focus on the connection between existing research and implementation of good practices in long-term care. Accordingly, in the Netherlands, research and the field of innovations in the elderly and home care are intertwined, focusing on the use of socio-technical innovations for excellent elderly care.

Implications for elderly, staff and working places

The focus on socio-technical innovations implies that it is necessary to pay attention to the education of care professionals, the education of elderly people, and the evaluation of the implementation of technologies used by elderly people.

Education and further training

Future healthcare professionals are more likely to have grown up in a digitized environment and thus to make more use of care technology. Nevertheless, continued learning and education will remain necessary, as technological advancements will continue as well. This means that

[31] https://www.samenoud.nl/over-samenoud/english-information/ Accessed July 8th 2019
[32] https://publicaties.zonmw.nl/academische-werkplaatsen-ouderenzorg/

employees in elderly care not only require an overall knowledge of current digital technologies, they are also bound to life-long learning.

Above, we briefly touched upon the Academic Collaborative Centers and Universities of Applied sciences' laboratories stimulating socio-technical innovations within the elderly care. These centers and laboratories spend considerable thought and attention to training current and future healthcare professionals as well. They have adapted their health education programs to contemporary and future skills necessary for healthcare professionals in order to increase acceptance of technology usage within elderly care. As such, healthcare professionals become part of a learning system in which elderly people, their loved ones, and the professionals themselves increasingly understand what technologies fit the elderly.

Both the **GET-LAB** and **Sense of Home Fieldlab** aim to train future healthcare professionals in their understanding of how they can and cannot support elderly people with the use of (new) technology. GET-LAB has considerable attention for the ethical aspects of the use of such technologies and for example trains students to ask themselves whether the use of Paro in a particular case is indeed good care? Fontys has, for example, developed additional training for healthcare professionals in the form of films, lesson cards and personas on how healthcare professionals can support older clients with the use of (new) technology. The education programs acknowledge that technological possibilities can make it easier for the elderly to live independently at home for longer, but at the same time sometimes are difficult for the elderly to use and have further (ethical) implications.[33]

In order for healthcare professionals to understand how they can support elderly people the Dutch **Participation Clinic** offers healthcare professionals a real-life experience of what it is like to actually be 'older', what elderly people would like to do and actually can do and what their needs are. The Participation Clinic is a vacant care location converted into a "clinic" where (informal) care providers can be admitted for 24 hours in the role of residents and as such receive care. In this way a 'learning system' is created in which care professionals, loved ones and elderly people themselves increasingly understand what is best suited for elderly people.

The coalition '**Digital skills in healthcare**' (in Dutch: Digivaardig in de zorg) is working for several years to improve digital skills of healthcare providers. In this coalition various parties work together, supported by Platform for the Information Society (ECP). The website 'Digivaardigindezorg.nl' (digital skills in healthcare) offers Dutch healthcare professionals an opportunity to improve their digital skills. The website offers the option to select the sector of Nursing care and home care and urges professionals to start today: "*The more digitally skilled you are, the more time you have for your client and the more pleasant you work*". In 2018 ECP, 's Heeren Loo and the Ministry of Health took the initiative for this national digital skills in healthcare knowledge site.

Education for elderly

Dutch government acknowledges that not all people have the digital skills to allow for a good contact between citizens and governments, or between patients and healthcare professionals. Therefore, as of January 1st 2018 Dutch **municipalities can offer computer courses to residents** who need it.[34] In this way, people who cannot work with a computer or other digital applications

[33] See for example: https://fontys.nl/Over-Fontys/Fontys-Paramedische-Hogeschool/Onderzoek-en-innovatie/Technologie-in-de-zorg/Langer-thuis-wat-haal-je-in-huis.htm (in Dutch) accessed July 20th 2019

[34] https://www.rijksoverheid.nl/onderwerpen/taal-rekenen-digitale-vaardigheden/digitale-vaardigheden

can learn these skills, and thus the risk of digital alienation is diminished. However, more attention for this by policy makers is needed, according to one of the experts.

In addition, organisations such as **Pharos**, a national expertise centre, focus on reducing major health differences amongst others due to digital alienation. Pharos aims to collect, enrich and share national and international knowledge, be it scientific knowledge, practical knowledge of care providers, policy makers and other professionals or experiential knowledge of people who ultimately matter. Pharos indicates that: "*Understanding, finding and using eHealth applications is a major challenge for many of these people. Many eHealth applications are therefore not used. While these people in particular can benefit from the use of eHealth. Because eHealth offers benefits such as image use, icons, reading functions, interactivity and use at your own pace and possibly together with others*".[35] Especially the program eHealth4all focuses on improving eHealth applications in such way that (digitally) illiterate and people with low health skills can benefit from eHealth usage.

Conflict of interests (integrity, ethical and economical)

In 2017, the Rathenau Instituut researched human rights in the robot age by investigating the challenges arising from the use of robotics, artificial intelligence, and virtual and augmented reality. One of the case studies was the use of care robots. Based upon this case, the Rathenau Instituut recommended the Committee on Culture, Science, Education and Media of the Parliamentary Assembly of the Council of Europe (PACE) to introduce to new potential human rights in order to keep the robot age human-friendly: 1) the right to not be measured, analysed or coached, and 2) the right to meaningful human contact.[36] Especially since care robots are designed to provide care to vulnerable groups, such as the elderly. When using technologies to aid the elderly, this should be done carefully since (vulnerable) elderly persons are protected by several legal sources that emphasize the importance of independent living and full participation in society for the elderly.[37]

The study demonstrates how robots can be applied both for the benefit and to the detriment of someone's autonomy and self-determination. Robots can improve the autonomy of elderly persons, for example by assisting them when they change their clothes or take a bath, but they may also restrain an elderly person when their developers have programmed them to do so, even if this is unintentionally. When robot technology forces users to take a particular course of action because developers believe they know what is best for these users, the possibility of unwanted paternalism occurs.[38] Ylimaula (2010) argues that technologies, or rather the actors behind them, should refrain from taking control over someone's life and should remain 'assistive' with respect to someone's autonomy[39] and ensure that users are *not being controlled* (respect for one's privacy).[40] Moreover, some researchers believe that contact with care robots cannot compensate

[35] https://www.pharos.nl/over-pharos/programmas-pharos/ehealth4all/

[36] Van Est, R., Gerritsen, J. B. A., & Kool, L. (2017). *Human rights in the robot age: Challenges arising from the use of robotics, artificial intelligence, and virtual and augmented reality*–Expert report written for the Committee on Culture, Science, Education and Media of the Parliamentary Assembly of the Council of Europe (PACE). Den Haag, Rathenau instituut.

[37] As stated in article 23 of the Council of Europe's Revised Social Charter.

[38] Van de Poel, I.R. & L.M.M. Royakkers (2011) Ethics, technology, and engineering: An introduction. Oxford, UK: Wiley-Blackwell

[39] Ylimaula, A., Roelofsma, P.H.M.P., Versteeg, L. (2010) Ambient Assisted Living - Deliverable 3.2 Ethical and legal requirements.

[40] Zuiderveen Borgesius, F. (2014) *Improving privacy protection in the area of behavioural targeting*, Alphen aan den Rijn: Kluwer Law International p.93

for the lack of human contact.[41] Coeckelberg (2010) claims that robots should only be used instrumentally for routine care jobs, and that care-giving tasks that require emotional, intimate, and personal involvement should be done by people.[42] From a societal point of view, it is argued that caring for other people is a key characteristic and responsibility of human beings and our human culture and should not be outsourced to robots or other technologies.

Similar ethical and societal implications to the ones related to robotics in elderly care, can also be found in other usages of technologies. The interviewed experts highlight the importance of not labelling or stigmatizing all elderly people as frail or vulnerable. Elderly people should be seen as a heterogeneous group. Unfortunately, the experts claim, many technologies still embed stigmatizing notions such as 'frail' or 'limited ability'. As a consequence, many older adults do not recognize themselves in these technologies' scripts, or to put it in other words, in the image the technologies convey about elderly people. The potential users see the technologies as interesting and worthwhile, though not for themselves but another elderly person who's in need or ill, hence the acceptance is low. The experts all argue for developing technologies in a better relation to elderly people's capabilities and desires.

Future perspectives and reflections

Societal and political debates

The debate about the future of elderly care centres around coping with the three trends earlier identified, the increasing number of elderly people in need of care, the decreasing number of (informal) care providers and rural shrinking which leaves the elderly at a distance of care facilities. Dutch government has identified three major themes (loneliness, living longer at home and good quality of nursing home care) that require various stakeholders, from governmental bodies including municipalities, to insurers, to tech-developers to care providers, to join efforts to solve the underlying issues. This debate, however, should also be seen in the light of the decentralization and subsequent transformation of the Dutch care-system.

As of 2015, Dutch national government has transferred its responsibilities for Youth Care, Social support and labor participation to municipal authorities. Care that had been arranged centrally by Dutch government, now became spread over municipalities and health insurers. Consequently, new challenges and issues arose in the organization of care, including the organization of care for the elderly and the different forms of social support, such as domestic assistance, for both municipal authorities and the (care) professionals and organizations involved.[43] In the Rathenau Instituut's report *Gezond Verstand* (2017), it is demonstrated that this systemic transition even included a repositioning of Dutch knowledge institutes for the long-term care in their role of providing knowledge for national and local government.[44] Accordingly, the implemented system changes required a substantive renewal of the organization of care, for example involving a new way of working for care organizations and different approaches to clients

[41] Sharkey, A. & N. Sharkey (2012) Granny and the robots: Ethical issues in robot care for elderly. *Ethics and Information Technology* 14 (1) 27-40.
[42] Coeckelbergh, M. (2010). Health care, capabilities, and AI assistive technologies. *Ethical Theory and Moral Practice*, 13(2), 181-190
[43] Faasse, P., & Koens, L. (2017). Gezond verstand: publieke kennisorganisaties in de gezondheidszorg. Den Haag, Rathenau Instituut
[44] Idem

and volunteers by both municipalities and care organizations.[45] In order to support this transformation Dutch government made 2.1 milliard euros available for the elderly care.

In recent years, the self-reliance of Dutch citizens has been paramount, also in health care. Giving Dutch elderly more control over their own health and situation, fits the new concept of health known as '*Positive health*', in which "own control" and "resilience" are central. Within this concept, health is described as: "*The ability of people to adapt and to direct their own, in light of the physical, emotional and social challenges of life.*"[46] This concept is embraced by municipalities, care institutions or care education institutions in the Netherlands and fits the current spirit of the times. It seems as if health awareness is greater than ever. On average, we live longer and we prefer to do that in good health. However, with such focus on self-reliance for one's own health comes great responsibility. Not everybody, especially vulnerable elderly people, have the ability to take upon this responsibility. This is also confirmed by a recent study by the Rathenau Instituut of several digital services that enable patients and healthy people to share data with a view to improving their health.[47]

In the light of these developments (decentralization, transformation, and positive health), sociotechnical innovations have started to play a leading role in home and nursing care. Only recently, digital solutions such as robotics and telecare were regularly mentioned as a way to replace personnel and make healthcare cheaper. Lately, this understanding is replaced by the need for better societal alignment of these technologies and a better fit within the context they are supposed to be used. Governments, care providers, insurers and other stakeholders realize that the use of these technologies also requires changes in the (working) environment of (informal) care providers, in the culture of care organizations, and the behaviour of elderly people themselves.

TA-perspectives

Applications that will be accepted and used by many elderly people and care organizations (in a large scale) are hard to find. Moreover, developments within the field of humanoid robotics, integrated systems, and AI are still in its infancy, and information on the cost-effectiveness of the various technologies used within elderly care is still limited. Nevertheless, within the Netherlands a transition is visible in which developers, governments, insurers, researchers, care providers and elderly people and their loved ones have a keen interest in (co)developing technologies that are increasingly integrated within the social context of their usage. Due to the increased experience with such socio-technical innovations, it becomes possible to identify several preconditions for developing new solutions targeting community-dwelling elderly and elderly people in nursing homes in order for them to live actively and healthy.

Co-creation is an important asset of a technology, the intended users (both elderly people and care providers) should be involved from invention, development to implementation of a technology. Whenever there is an indication to start using technologies in care-settings, the individual motivation by elderly people and their support should be warranted for. This also means that developers should start from elderly people's abilities and not their disabilities or frailness. Innovation can also mean that one should break down previous processes or technology

[45] https://www.thieme-connect.com/products/ejournals/html/10.1055/s-0035-1564251 Accessed July 11th 2019
[46] https://www.rathenau.nl/nl/digitale-samenleving/gezondheid-grenzen-aan-de-eigen-regie
[47] Niezen, M.G.H., Edelenbosch, R., Van Bodegom, L. & Verhoef, P. (2019). Health at the centre – Responsible data sharing in the digital society. The Hague: Rathenau Instituut

usage first, before implementing new innovations. An accumulation of technologies on top of existing processes and technologies might not solve, but just increase the felt pressure by healthcare professionals to change their practice and behaviour. Moreover, throughout the development of an innovation and its daily usage in care practices, one should keep an eye on how they fit within the various stages of becoming older and on the (potential) risks of using the technologies. For example, a person in a later stage of dementia may benefit from the FreeWalker and feel empowered to freely move around, but a person in an early stage of dementia might feel paternalized if the usage is not based upon personal indication and/or motivation. Similarly, digital inclusion should be a key concern for technology developers. Developers should not only focus on a safe and secure design, but also on how the interface remains accessible and develop applications that also groups that lack digital skills are able to use in order to warrant for equal access. Care organizations are advised to focus on technologies that have proven to contribute to a more pleasant and independent life. This also means that governments, care organizations, care providers, insurers et cetera are required to develop learning abilities, constant feedback loops and follow-up on the implemented technologies to allow for a reflexive approach to digital solutions in elderly care.

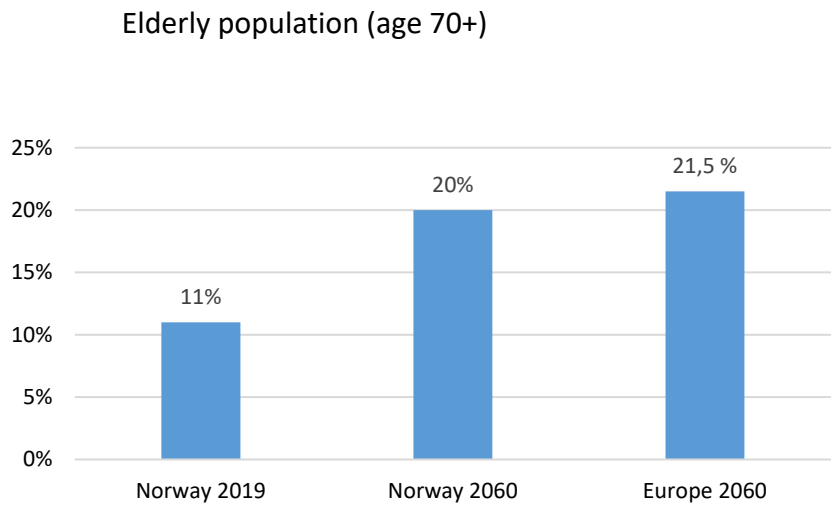
Norway

The Norwegian Board of Technology (NBT), Tore Tennøe and Adele Flakke Johannessen

Elderly population

Facts and Figures

Today, every ninth Norwegian is 70 years of age or older, in 2060 this number will be every fifth.[1] Hence, relatively fewer people will have to look after relatively more people. Without a re-organisation of the health and care services, Norway will need to double the number employees in the health sector over the next 40 years.[2] The use of technology is therefore seen as essential.



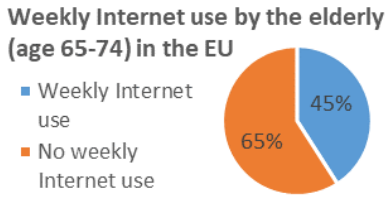
Digital maturity

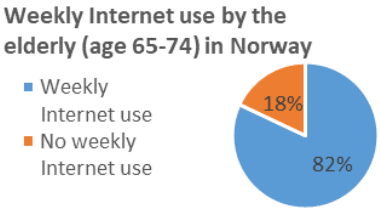
Norway is ranked among the top European countries both when it comes to the use of digital technologies, and online public services.[3] 91 percent of citizens own a smartphone and 90 percent use the Internet daily.[4] 96 percent of those between 80-100 years have a PC, tablet,smartphone or phone without internet.[5]

[1] https://www.ssb.no/befolkning/statistikker/folkfram/aar
[2] https://www.ssb.no/arbeid-og-lonn/artikler-og-publikasjoner/fremskrivninger-av-ettersporselen-etter-arbeidskraft-i-helse-og-omsorg-mot-2060
[3] https://ec.europa.eu/digital-single-market/node/66889
[4] https://www.ssb.no/en/teknologi-og-innovasjon/artikler-og-publikasjoner/nine-in-ten-use-internet-every-day
[5] https://bufdir.no/Statistikk_og_analyse/Nedsatt_funksjonsevne/ikt/#heading18962

Current status of care technology and political ambitions

The use of technology in elderly care has been on the policy agenda in Norway for at least a decade. In 2009, the Norwegian Board of Technology (NBT) published the report "the Future of ageing"[6], which was followed by a government green paper in 2011[7] and a white paper on future care in 2013.[8] Policy makers have focused on safer homes, a national care program, a new technology hub and a national program for an age friendly society.





Safety care packages

To enable people to live at home as long as possible the government proposed a right to a *safety care package* (fall sensor, smoke detector, electronic door opener, mobile phone, tracking solution (GPS) etc.) for elderly. The package received broad political support, but also lead to a debate about GPS tracking people with dementia. GPS tracking entails surveillance but can also provide safety and freedom of movement for the person with dementia.

In 2013 new legislation allowed the use of location technologies, including GPS to improve and facilitate the municipal health and care for people with dementia[9]. The number of people with dementia who have been offered a GPS alarm at home, has increased from 65 in 2015 to 1,141 in 2018. However, this is still a low number compared with the 77 000 people with dementia.

The care technology programme

With a total budget of around € 1 billion,[10] the goal is for care technology to be an integral part of the municipalities' care services by 2020. User-friendly care technology, training for both users, next-of kin and employees, and innovation have been the top priorities.

[6] https://teknologiradet.no/en/more-care-with-better-technology/
[7] http://www.regjeringen.no/en/dep/hod/documents/nouer/2011/nou-2011-11.html?id=646812
[8] http://www.regjeringen.no/nb/dep/hod/dok/regpubl/stmeld/2012-2013/meld-st-29-20122013.html?id=723252
[9] http://www.regjeringen.no/nb/dep/hod/dok/regpubl/prop/2012-2013/prop-90-l-20122013.html?id=719104
[10] https://innovativeanskaffelser.no/wp-content/uploads/2018/11/181101-kristin-standal-velferdsteknologiprogrammet.pdf

The first part of the programme has focused on implementing current safety and care technologies, such as safety alarms, electronic door locks and tools for better scheduling of home nursing services. In total, projects have been funded in 320 municipalities. The government provides guidance, tools and networks to encourage and support these projects.

The programme is now focusing on innovations, particularly medical remote monitoring. One of the major projects funded is the VIS project (Welfare technology in the city) which has tested four solutions on 822 patients:

- Automatic pill dispenser
- Mobile safety alarm
- Remote Chronic obstructive pulmonary disease (COPD) monitoring
- Personalized health check-ups

The evaluation showed a 34% reduction of visits from home care services, 19% reduction in hospitalizations, and overnight hospital admissions were reduced by 33%. Both users and their next of kin reported feeling safer and with a higher sense of mastery.[11]

These results have been questioned due to the lack of a control group. A new, randomized control trial is therefore under way and is focusing on the role of the GP and how to establish continuity in patient care.[12]

Care technology hub

Results from the first care technology projects in the municipalities, showed that there was a need for better data flow between the welfare technology solutions and the municipalities' electronic patient records. Following the Governments ambition “One citizen – One health record” a care technology hub has been established in order to enable exchange of data.[13]

An age friendly society

Currently, more attention is directed towards the growing number of older people in good health. In 2018 Norway got its first minister for the Elderly and a new Council for an age-friendly society.

[11] https://www.helsedirektoratet.no/tema/velferdsteknologi/rapporter-og-utredninger/Velferdsteksnologi%20i%20sentrum_delleveranse%202%20av%202.pdf?download=true

[12] The new trial has 600 participants with 300 of them in a control group.

[13] https://ehelse.no/prosjekt/nasjonalt-velferdsteknologiprogram-arkitektur-og-infrastruktur

The reform "Live Your Whole Life" published in 2018[14] deals with what matters the most in life: community, activity, good food and healthcare services. The reform also initiated a "national programme for an age-friendly Norway" that focuses on how demographic change affects all areas of society, markets and sectors; Encouraging organisations and businesses to create more age friendly institutions and companies, see older persons as a resource for the local communities and encourage seniors to adapt their home.

Implications for the elderly, staff and work places

The ABC training programme for employees

In order to provide a better understanding of the challenges ahead, including *why* changes should happen now, and *what* roles the employees should play in the various change processes, an interdisciplinary training programme for employees in municipal health- and care services was developed by the authorities.[15]

The training programme covers different topics such as legislation and ethics, methods for mapping user needs, and introductions to technological solutions that are being used in municipalities today.

Including seniors in a digital world

The Directorate of Health, in collaboration with different NGOs, organized courses and training for older technology users. The results show that the participants experienced better mastery of relevant technological tools. At the same time, the training strengthened and maintained the participants' social networks and reduced loneliness.[16]

Seniornett is a voluntary, politically neutral member organization and has worked to include seniors in the digital world since 1997. The organization has around 9000 members and is continuously updating and supporting seniors through its 235 Senior Network Associations. These serve as meeting places, where anyone can come and try out internet for free, get guidance, exchange experiences and keep each other updated. Seniornett also has a telephone service providing help for seniors with IT problems.

Gaming and VR for better physical and mental health

Physical activity is a key component for healthy ageing and in treating numerous diseases and chronic conditions. However, physical activity levels among the elderly are generally low, and rehabilitation typically requires supervision from health care personnel.

The city of Bergen is now testing virtual reality glasses in several nursing homes to make the everyday lives of people with dementia and other residents better. Using VR, the elderly can return to the neighbourhood they grew up in and relive memories they otherwise would have trouble remembering or visit an art exhibition without the supervision from the personnel. Another

[14] https://www.regjeringen.no/contentassets/196f99e63aa14f849c4e4b9b9906a3f8/en-gb/pdfs/stm201720180015000engpdfs.pdf
[15] https://www.ks.no/fagomrader/helse-og-omsorg/velferdsteknologi3/velferdsteknologiens-abc---opplaringspakke-til-kommunene/
[16] https://ehealthresearch.no/prosjektrapporter/sosial-digital-kontakt-opplaering-av-eldre-erfaringer-fra-2016

example is the project Senior Gamer, where seniors are invited for bowling using the Wii game console. According to an evaluation of the project, "computer games not only contribute to increased physical and mental activity, but also to creating good moments, good meetings and much joy".[17]

Future perspectives and reflections

Artificial intelligence (AI) has made a powerful leap forward in recent years. Machines can now learn to interpret text, speech and images, and do advanced tasks that so far have been reserved for humans. This technology might profoundly impact the nature of elderly care in the years to come.

A prominent example is dementia, which is considered one of the greatest challenges for health and care in the 21st century. Around 50 million people worldwide have dementia today, a number that is predicted to triple by 2050.[18]

While the cognitive abilities of people with dementia are decreasing in the course of the illness, the cognitive faculties of care technologies are steadily increasing with machine learning. Tools that use artificial intelligence (e.g. digital assistants) can help people with dementia to remember, reason and organise their daily lives. Furthermore, health workers and next of kin can get access to decision support, medical advice, and predictions for the development of the condition.

However, the introduction of AI in care also calls for a wider ethical assessment and public debate. A number of aspects needs to be considered:

Privacy: Machines learn from huge amounts of data, from patient journals as well as from sensors in our environment and on our bodies. This can reveal very personal and intimate knowledge about individuals, while at the same time enabling personalised assistance and decision support.

Power: The health and care sector is beginning to resemble the Internet economy. Data has enormous value and platforms, such as Apple's App Store, Google Play, Amazon and Facebook, will be used by many care technology providers as channels of distribution. The platform companies also have access to a huge variety and volume of data from their own services, and thus have significant insight into the condition of individual citizens as well as different populations. Needless to say, internet companies will have significant power when they decide to enter the market for care.

Responsibility: As the condition of people with dementia varies constantly, it becomes important to continually fine-tune the tools so that they are always in harmony with the patient. AI tools can learn to adapt to the condition of the patient, so can nurses and next of kin. What kind of decisions should be left to the AI system, different health professionals, next of kin, and the patient respectively, and who is ultimately responsible? Moreover, the algorithms may be slightly opaque and difficult to understand, which makes it difficult both to anchor responsibility for decisions and to appeal the decisions.

[17] https://sykepleien.no/2016/09/dataspill-helsas-skyld
[18] https://www.thelancet.com/commissions/dementia2017

Autonomy and integrity: Machine learning can make predictions of the individual's behaviour and preferences more accurately and inexpensively than before and it becomes possible to influence and manipulate actions and attitudes as well. An AI-assistant can, in theory, be so clever that people trust its advice more than their own judgement, and the boundaries between person and machine might be blurred. This also involves the person's relationship with others: Does it matter if the patient knows whether she is in contact with a machine or a human?

Participation: To further autonomy, integrity and safety for the patients, care technology should be developed and used *with* and *for* the potential users, and not *on* them. Thus, there is a need to develop methods that include the elderly in the development of technologies. An example is the Assisted Living Project, which aims at engaging persons with mild cognitive impairment and dementia (MCI/D) in developing technological solutions. In five dialogue cafes, the participants have addressed their challenges, discussed solutions, tested alternative assistive technologies, and given their feedback.[19]

[19] https://www.researchgate.net/publication/317060347_Responsible_Development_of_Self-learning_Assisted_Living_Technology_for_Older_Adults_with_Mild_Cognitive_Impairment_or_Dementia

Poland

Bureau of Research (BAS) of the Polish Sejm, Wojciech Zgliczyński

Elderly population

Facts and Figures

According to the demographic forecasts, Poland's population, currently amounting to 38.5 million people, will decrease to around 34 million by 2050. This reduction in the number of people will be accompanied by an increase in the number and share of persons in older age groups. The share of persons aged 65+ will increase from the current amount of around 15% to approximately 30% in 2050. Thus, Poland, being one of the youngest societies in the EU, will become one of the oldest ones[1]. In relation to the population ageing, old age characteristics such as feminisation, singularisation and longevity will be revealed (in 2050, the share of people aged 80+ will increase from approximately 4% to 10%).

Overall, the elderly's health in Poland is poor. On average, a person aged 65+ can expect to live 17.9 more years (15.7 years for men and 20.1 years for women), including 8 healthy life years (7.6 years for men and 8.4 years for women). Only 16.6% of people aged 65+ declare they are in good or very good health, while 34.9% report certain limitations in their day-to-day functioning[2]. A vast majority of the elderly in Poland (around 90%) declares chronic diseases or conditions. Furthermore, the frequency of serious depression symptoms is relatively high among the elderly[3]. Poor health of elderly people in Poland results largely from the weak healthcare system (both healthcare and prevention as well as promotion of health). Relatively low urbanization level (approximately 60%) combined with a significant dispersal of buildings and limited access to elevators in multi-apartment buildings make it difficult to arrange social and health services, while encouraging to search for modern technological solutions which limit the need for movement. The elderly population in Poland is characterised by a low level of professional activity (with retirement age of 60 and 65 years for women and men, respectively) as well as educational, cultural, sport and recreational activity[4]. Even though at present the elderly are of a relatively good financial standing, this situation will deteriorate considerably as the pay-as-you-go pension scheme will be gradually phased out and replaced with a capital-based system.

As the forecasts show that Polish population will age rapidly, we have very little time to adapt to the negative consequences of this process, e.g. for the economy and public finances (including healthcare and social security system). Taking advantage of modern technologies can surely mitigate many of these negative consequences.

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[1] *Population projection 2014–2050*, Statistics Poland, Warsaw 2014.
[2] *Health at a Glance 2017: OECD Indicators*, OECD Publishing, Paris 2017.
[3] *Health status of population in Poland in 2014*, Statistics Poland, Warsaw 2016.
[4] *Information on the situation of the elderly based on Statistics Poland surveys*, Statistics Poland, Warsaw 2018.

Digital maturity

With the growing significance of modern technologies, including in particular modern information technologies, the ability to use them often becomes a prerequisite for our full participation in the society. The inability to use these technologies often makes it impossible to fully participate in social, professional or cultural life. This, in turn, may lead to a gradual exclusion and deepen the existing divisions in the society. Apart from the wealth, education level, place of residence and the urbanisation level, one of the most important factors influencing the use of modern technologies is age[5].

In Poland, in the period 2014–2018, the share of people aged 65–74 who use computers on a regular basis, i.e. at least once a week, has been constantly on the rise (from 20.1% to 27.9%). Nonetheless, it was still significantly lower than the 70.9% share in the population aged 16–74. Similarly, there was an increase in percentage of people aged 65–74 who use the Internet on a regular basis (from 19% in 2014 to 29.8% in 2018; while for the population aged 16–74 it was 74.8%). Elderly persons had low digital literacy skills: in the group of people aged 65–74, the rate of people with basic and higher digital skills was 9.1%, and in the population aged 16–74 it was 45.9%[6]. Despite systematic improvement, the situation concerning digital skills in Poland is noticeably worse than in most EU countries[7].

Low level of digital skills may result both from internal (e.g. lack of motivation, poor health) as well as external factors (e.g. no access to training, limited access to broadband – significant disproportion between the urban and rural areas). Low digital skills level along with other weaknesses are the main obstacle to implementing modern technologies in the elderly care.

We need to underline the fact that engaging the elderly in various activities, including digital skills development, should preserve their sense of value as well as the feeling of belonging and being needed. What is more, intellectual training by means of developing digital skills, may help the elderly maintain fitness in terms of cognitive function. Thus, we could say that the development of digital skills may significantly improve the quality of life of the elderly.

Current status of the use of technology and social innovations in elderly care

Policy initiatives

The most recent strategic document is the "Social policy regarding the elderly 2030. Safety – Participation – Solidarity" Programme, adopted by the government in October 2018[8]. The programme envisages sector development comprising accessible and diverse services tailored to the needs and possibilities of the elderly, and indicates five priority objectives in the social policy concerning elderly persons, i.e.: 1. Improve architectural, digital and organisational accessibility

[5] B. Szmigielska, A. Bąk, M. Hołda, Seniorzy jako użytkownicy Internetu [Seniors as Internet users], Nauka 2012, No. 2, pp. 141–155.

[6] Information society in Poland. Results of statistical surveys in the years 2014–2018, Statistics Poland, Warsaw 2019.

[7] The Digital Economy and Society Index, DESI 2019, https://ec.europa.eu/digital-single-market/en/scoreboard/poland

[8] Resolution No. 161 of the Council of Ministers of 26 October 2018 on the adoption of "Social policy regarding the elderly 2030. Safety – Participation – Solidarity" (M.P. [Polish Monitor] 30 November 2018, item 1169): https://www.gov.pl/web/rodzina/polityka-spoleczna-wobec-osob-starszych-2030-bezpieczenstwo-uczestnictwo-solidarnosc

of public institutions, e.g. under the "Accessibility Plus" programme[9]. 2. Develop various community forms of elderly day-care, including a day-care centres network, e.g. under the "Senior+" programme[10]. 3. Improve accessibility of health and care services addressed to elderly persons and their families, e.g. by developing services available in their neighbourhood area, i.e.: „Care 75+" programme[11]. 4. Establish a comprehensive support system for dependent elderly and their guardians, e.g. by providing legal regulations of dependency risk – defining criteria and dependency levels, as well as the professionalisation of services in this area. 5. Use new technologies in care for the elderly and extensive monitoring of their health, e.g. by developing telemedicine and telecare. Previously, in 2014, the Polish government adopted the "Digital Poland" operational programme[12] which focuses on three areas, i.e.: common access to Internet, e-government and open government, and digital competences of the society. The last of these areas focuses, among other things, on digital inclusion of the elderly.

Best practices – the use of different technologies and innovations to improve the quality and activity for elderly

In recent years, the Ministry of Health has been conducting intensive works on healthcare computerisation which will contribute to improving healthcare system organisation and patients' safety. Low level of computerisation is still one of the main barriers to the implementation of modern technologies in the elderly care. It is only recently that some telemedical procedures received financing from public funds (including geriatric tele-consilium addressed to persons aged 65+ and covering remote interview as well as ECG record and diagnostic tests analysis. Other solutions will be tested under pilot programmes.

At the local level, a number of projects are implemented to address issues such as telecare (SOS band, telecentre, digital ward card), including "Małopolska Tele-Angel"[13] project financed from EU funds and covering approximately 10 thousand residents of Małopolskie Voivodeship. The aim of this project is to improve the quality of life of dependent persons by developing services which will allow them to remain safely in their environment as long as possible.

Implications for elderly, staff and working places

Education and further training

In order to introduce modern technological solutions related to elderly care it is necessary to make comprehensive arrangements for both formal (e.g. physicians and nurses) and informal guardians. To ensure that trainings have the necessary quality, programme coherence and universality, it would be beneficial to involve public authorities, organisations of employers and professional local governments.

[9] "Accessibility +" governmental programme for the 2018–2025 period: https://www.ncbr.gov.pl/fileadmin/POIR/3_1_1_1_2019/Dok_dodatkowe/16_Program_Dostepnosc_Plus.pdf
[10] "Senior +" multiannual programme for the 2015–2020 period: https://das.mpips.gov.pl/source/wigor/Uchwala%20157%20RM%20Senior.pdf
[11] "Care 75+" Programme for 2019 website: https://www.gov.pl/web/rodzina/program-opieka-75
[12] "Digital Poland" Programme website: https://www.polskacyfrowa.gov.pl/
[13] "Małopolska Tele-Angel" project website: https://www.malopolska.pl/teleaniol

Education for elderly

"Digital Poland" programme provides co-financing to projects which encourage citizens to use the Internet and improve their digital competences, including actions addressed to seniors. These activities are implemented mainly by non-governmental organisations in partnership with local governments. Currently (as at 30 June 2019), 11 such projects are being implemented[14]. Necessary actions include not only building digital competences, but also relieving potential concerns of the elderly resulting from the fact that modern forms of care are limiting personal relationships ("dehumanisation of care").

Conflict of interests

Research and analysis indicate a number of potential problems related to the introduction of modern technological solutions in the field of elderly care. Possible concerns relate to such issues as weakening of the personal links and psychological and ethical barriers. Among the problems that needs to be addressed are low level of acceptance (the elderly may not accept modern technologies and do not trust them), as well as potential technical issues (reliability of new technologies) and economical barriers[15].

Serious concerns relate in particular to the health care sector, including e.g. the (civil and criminal) liability for medical mistakes while providing remote medical services, the classification of medical applications as medical devices, patients' rights and the patents issue. Ensuring users' safety, including sensitive data safety, still poses an important challenge.

It seems it is also necessary to control the modern commercial solutions market so as to eliminate those which are inefficient and misleading to the users.

Introducing modern technologies in the area of care services for the elderly is a revolutionary change. One of the particularly important areas is the limitation of or even departure from the direct provision of services by another person, which raises concerns related to the risk of "dehumanisation of care". It should be highlighted that since the modern technologies uptake is generally low in Poland, including in the sector of elderly care, many possible problems have not yet become apparent and, therefore, have not been widely discussed.

Future perspectives and reflections

Societal and political debates

Modern technologies and their uptake in the area of care for the elderly has been the subject of discussion in scientific and political circles for a few years (including in the Committee for the Senior Policy of the Sejm). These discussions are mainly practice-oriented and concern the implementation of the already-developed solutions as well as the drafting of legal regulations. What we need, however, is to discuss the future of the society and economy at large, in view of the expected technological developments.

[14] Website: https://www.polskacyfrowa.gov.pl/strony/o-programie/projekty/lista-beneficjentow/

[15] J. Ejdys, K. Halicka, *Roboty humanoidalne w* opiece nad osobami starszymi [Case of Humanoids Used for the Care for the Senior Persons], http://ismsme.org/files/Robot_(nie)przyjaciel_czlowieka.pdf

TA-perspectives

The influence of technological developments on the support services for the elderly in Poland has not been extensively studied or analysed. In Poland, there are numerous obstacles to the possible developments in modern technologies in the area of elderly care. Poland is a country with relatively low advancement level as regards economy and digital society. Its citizens use the Internet less frequently than the average European, as Poles still have limited access to infrastructure and generally low level of digital competences. There is a large territorial disproportion in network access between urban and rural areas, as well as significant diversification of digital skills between different groups depending on age and education level. As a result, in Poland, modern technologies contribute to territorial segregation and lead to social exclusion of groups which are unable to participate in the modern society. This raises concerns that the pertaining social inequalities would increase even further. Therefore, it is necessary to take actions aimed to bridge the existing social divides by profiling the aid addressed to different groups of society.

Portugal

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Introduction

This report was produced by the Observatory of Technology Assessment (OAT) of the research centre CICS.NOVA at Nova University of Lisbon, from June to September 2019. The Observatory is an associate member of European Parliamentary Technology Assessment (EPTA) since 2018. The EPTA partners advise parliaments on the possible social, economic and environmental impact of new sciences and technologies. That is also the case for OAT in Portugal. In this summary of the national report, we first present some facts and figures about Portuguese demography and its relation to the institutional organisation of long-term care system. Second, the following chapters provides the "Implications for elderly, staff and working places" with regard to information technologies (IT) applied in the care work, or as mentioned in this report, to "welfare technologies". There we analyse the digital effects on organisation of work in long-term care system, the education problems and further training of care staff.

The final chapters are about the challenges and risks of the use of technology in care work (covering the topics of integrity, ethical and economical challenges and risks), the societal debates, regulations and best practices, and, finally, the future perspectives and reflections. The fragilities of the social and economic structures in Portugal affect the labour market in this sector of health services, as well the innovation capacities and the organisational settings that need a strong modernisation process considering integration of family care structures and institutional ones. The report was developed within a very short timeframe, and it was not possible to include all the aspects that the topic deserves, namely a more complete literature review and a complete data collection and further analysis. This should be taken into consideration. Thus, the report is a first attempt to collect information on care work and the use of ICT in the sector, which needs a systematic and further research work.

Elderly population

Facts and Figures

The current population of Portugal is 10,219,798 and the population density in Portugal is 112 per Km^2 (289 people per mi^2), corresponding the total land area of 91,590 Km^2 (35,363 sq. miles). The majority of the Portuguese population (65.9 %) is urban (6,743,854 people in 2019) and the median age is 44.3 years (United Nations Population Division, 2019).

Changes in the composition by age groups of the resident population in Portugal reveal the ageing of the population in recent years, as has indeed been the case in most developed countries. As a result of the falling birth rate and increased longevity in recent years, in Portugal there has been a fall in the young population (0 to 14) and the working age population (15 to 64), alongside an increase in the elderly population (65 and older). In 2015, 2.1 million people, almost 20% of the Portuguese population, were 65 and older. The proportion of elderly people in the population has been growing and this trend is expected to continue. According to national projections, in 2030, the elderly is expected to represent approximately 26% of the population, increasing to 29% in 2060. The number of people aged over 80 will more than double between 2015 and 2060 and is expected to rise from 614 000 to 1 421 000 people.

The number of elderly people has long exceeded the number of young people in Portugal, and the ageing index [1] reached 140 elderly for each 100 young people in 2015 (please, see Table 1). In turn, the old-age dependency ratio, which lets us gauge the ratio of elderly people compared to the number of people of working age, has been continuously rising in recent decades, with 31 elderly people for each 100 people of working age in 2015 (please, see Table 1).

Table 1. Elderly population in Portugal, 2010-15 and forecast 2030-60

	2010	2015	2030	2060
Resident population (in millions)	10.6	10.3	9.9	8.6
0-14	1.6	1.5	1.1	1.0
15-64	7.0	6.7	6.0	4.5
65 and over	2.0	2.1	2.7	3.0
Dependency ratio (65+/15-64)	28.6	31.3	45.5	67.0
Longevity index (80+/65+)	25.9	29.3	30.5	46.7
Ageing ratio (65+/0-14)	125.0	140.0	242.6	306.5
Life expectancy at 65	18.84	19.19		
H	16.94	17.32		
M	20.27	20.67		
Fertility rate	1.4	1.3	1.3	1.6
Net migration	3,815	-10,481	15,312	19,493

Source: INE, 2017

According to the National Strategy for a Healthy and Active Ageing (Estratégia Nacional para o Envelhecimento Ativo e Saudável ENEAS 2017-2025), is also noteworthy the increase in the population aged 80 and over. In 1971, this population represented 1.43% of the resident population in Portugal, representing 5.84% in 2015. (PORDATA, 2015).

Demographic projection suggests that the increase of people over 80 will reach 16% by 2060, when was 5% in 2013 (Eurostat, 2015). Public debate about the impact of longevity has been largely polarized on the issue of sustainability of social security systems [2]. Another debated topic is the status of the caregiver (July 2019) that was recently approved. It was defined a support

[1] Reflects the ratio of elderly people compared to the number of young people.

[2] On this issue, see the study of Amílcar Moreira on Financial and Social Sustainability of the Portuguese Pension System (Moreira, 2019)

allowance for caregivers and specific measures regarding the caregivers' contributory career. However, these measures, so far, have not been yet implemented in practice. According to the Survey of Health, Ageing and Retirement in Europe applied in 2015 (SHARE), 70% of informal care in Portugal is provided daily by women over 50 (OECD, 2017: 209).

Digital competence among elderly

The use of a computer and the internet has increased over time among the Portuguese population, including also the older population (Dias, 2012). Despite this general trend, clear disparities are found according to age and other factors. Starting by age, internet use decreases significantly with increasing age: in 2018, while in the age groups under 55 the proportion of internet users was always greater than 80%, in the age group 55-64, it was 55% and in the age group 65-74, it decreases significantly to 34%.

A study conducted by the Barometer of the Adoption of Telehealth and Artificial Intelligence in the Health System (*Barómetro da Adoção de Telessaúde e de Inteligência Artificial no Sistema da Saúde*) concluded that, in 2019, telehealth, as a component of the digital health care, is adopted by the majority of the institutions/organizations that provide health services. The most provided telehealth services are synchronic (in real time) medical appointments and screening appointments (BTIA, 2019).

The vast majority of the health professionals who have participated in this study agree that telehealth has an important role in remote monitoring of users with chronic diseases, in sharing clinical data that contributes to a higher level of user's compliance to prescribed therapies, and in decreasing the number of hospital readmissions. It is important to add that 47% of the respondents believe that telehealth improve the relationship between users and professionals. Finally, this study also identified the perspectives of the health professionals regarding the main obstacles to the implementation of telehealth: 1) reduced broadband internet coverage and internet access; 2) low level of users' literacy in telehealth; 3) low level of health professionals' motivation to use telehealth. The survey entitled Network Society in Portugal (*Inquérito Sociedade em Rede em Portugal*) shows that, in 2006, only 0,3% of the respondents used online medical/health services (Espanha et al., 2007).

The National Strategy for Active and Healthy Ageing (ENEAS) is a proposed strategy that meets the objectives included in the National Health Plan (Portugal. Ministry of Health. General Directorate of Health, 2015) and aims to promote health and well-being of older persons and to recognize the benefits and importance of active and healthy ageing throughout life cycle.

In the domain of e-health, the introduction of an integrated ICT system in the National Health Service (Serviço Nacional de Saúde – SNS) began to be noticed especially in the 90's with the launch of the Integrated System of Hospital Information, known by the acronym SONHO. One of the goals proposed by the National Health Plan for 2020 is to improve healthy life expectancy at age 65, that as we noted earlier there are still inequalities in healthy life years by socioeconomic and educational status at this age. In the domain of social care/long term care, Portugal also continued to implement the National Network for Continued Integrated Care (RNCCI), set up in 2006, under the joint responsibility of the Ministry of Health and the Ministry of Labour, Solidarity and Social Security, with a focus on the coordination and organisation of "long-term care", providing structured responses to people in a state of dependency, at different levels of functionality in all life stages.

The number of users of home-based care services increased considerably, from 49473 users in 2000 to 104551 in 2014. Daycare centres began to develop in an experimental way in the mid-1970s, with the aim of helping an individual to remain in his/her own socio-familial context for as long as possible and offering an alternative to institutional care (Carta Social, 2000). Between 1986 and 1995, the number of day care centres increased steadily (+55% from the previous period of 1975–85) (Joël et al., 2010) and the number of day centers rose in the beginning of 1990s as did the number of users: in 1987 there were 11370 users and in 2014 there were 64705.

In collaboration with the 24-hour health line and the General Directorate of Health, an elderly health monitoring system has been developed based on a dedicated telephone line and back office support system (Linha24). The University of Coimbra, together with the other members of the consortium "Ageing@Coimbra" supports a holistic ecosystem of stakeholders and it implements innovative practices to manage cognitive ageing, dementia, vision impairment, human kinetics and mobility.

Implications for elderly, staff and working places

Portugal has a mixed long-term care, composed of a social network of services, including care centres, home-based services and nursing homes ('residential structures for older people'), and the National Network for Integrated Continuous Care[3]. In this case the human resources are not allocated according to patients' needs as in other European countries, but by the number of weekly hours of care a patient is entitled to receive from each professional category (Lopes, Mateus and Hernández-Quevedoc, 2018: 213). Due to demographic changes, the number of people with chronic diseases has increased and the lack of long-term and palliative care is now more visible. Portugal now has new social and health needs which demand new and diverse solutions.

Whenever the residential structure accommodates elderly people in situations involving considerable dependency (dementia, cardiovascular diseases), the ratios of nursing staff, direct and care assistants are as follows: *a*) One nurse, for every 20 residents; *b*) One care assistant, for every 5 residents; *c*) One ancillary staff member for every 15 residents. The home-based care services have to be available every day of the week, also guaranteeing, whenever necessary, the support on Saturdays, Sundays and holidays (Portaria n.º 38/2013). The human resources (professional staff, manager and care workers) must have "a) an appropriate training for their work; b) communication competencies and friendly relationship that allow to adopt an attitude of listening and observation to respond the users' needs; c) be able to provide information for the assessment of the care program and services; d) to have training that allow adequate intervention in situations of dependence due to ageing and/ or disabilily" [4].

Although training is recognised as an necessary requirement for quality care practices, the care system is not focused on people, care workers job is underestimated, they don't receive adequate trainings and salary, and this has negative impact on their physical and mental health, job satisfaction, work environment and quality of service provided (Gil, 2018, 2019).

As far as profession or employment of family carers staff is concerned, there are also no specific data available. In Portugal there is no formal system for supporting family carers staff,

[3] D.R. Decree-Law 101/2006. D.R. I Serie A, 6th of July – Creation of the Portuguese National Network for Long-term Integrated Care (Rede Nacional de Cuidados Continuados Integrados) (in Portuguese) 2006: 3856–65. http://www.acss.min-saude.pt/wp-content/uploads/2016/10/Decreto-Lei101 2006-1.pdf.

[4] http://www.seg-social.pt/documents/10152/1197978/Port_38_2013

nevertheless some facilities, like day centres and home support systems constitute indirect measures that help family carers staff. When a family carer needs complementary help, it is usually another family member who fills in permanently or temporarily for the family carer in caring for the elderly.

As a conclusion, we consider that the carer staff level the education and training should strengthen the professionals' digital literacy through specific training programs. It should also sensitize practitioners to the advantages of e-care use (in terms of care and e-health in general).

The Adults Digital Literacy Project (LIDIA), aims to identify situations where adults are hindered from exercising their full citizenship, due to their lack of digital technologies knowledge. Initiated in March 2015, this is a project that involves a multidisciplinary team from the Institute of Education at the University of Lisbon. At senior level the implications must be: a) the focus on strengthening digital literacy; b) the focus on strengthening health literacy; c)the promotion access to affordable digital equipment and services.

Challenges and risks (integrity, ethical and economical

As mentioned in the article of Hülsken-Giesler and Krings, the "reflections on the use of technologies in the context of care in a society of longer living cannot be limited to pragmatic aspects of technology development, use or assessment. Instead these issues demand a constitutive discussion over the basic questions of society's development and provoke debates on the societal way of dealing with age and vulnerability as well as the relationship between effectively and efficiency and care in a modern society" (Hülsken-Giesler and Krings, 2015: 4). In addition to these broad issues, other challenges and risks are identified: i) Digital divide between older people and younger people – the use of ICTs by older people, particularly internet, is low, and the same is found in relation to the use of e-health and telecare, ii) Negligence of a user-centred approach to technology design and service delivery by industry and service providers, iii) Resistance in accepting care-oriented ICTs by staff and older people, iv) Violation of ethical and deontological guidelines by care staff – the use of care-oriented ICTs should respect the preservation of users' privacy and the principle of informed consent for the collection of information and the principle of confidentiality of the collected information.

Societal debates, regulations, best practices

The debates, regulations and best practices have already been discussed in previous sections thus, we will not repeat in this section. One of the good practices is the Senior Census program of the Ministry of Internal Affairs. This program aims to identify the elderly population living alone and/or that are isolated. It aims also to detect new cases of situations of risk and social vulnerability. Another good practice is the consortium "Ageing@Coimbra" that supports a holistic ecosystem of stakeholders implementing innovative practices to manage cognitive ageing, dementia, vision impairment, human kinetics and mobility.

Several measures have been implemented which target the main challenges for long- term care. The main one was a joint project between the Ministry of Health and the Ministry of Labour and Social Solidarity called Programme of Integrated Support to the Elderly (Programa de Apoio Integrado a Idosos), that was developed during the last years of the decade of 1990, and which has

enabled the development of initiatives in both health and social areas oriented for home care and informal caregivers as part of a job creation policy [5].

Future perspectives and reflections

The introduction of new technologies in social care could be an asset not only in terms of the administrative and social process of users, the registration, monitoring and evaluation of care provided. However, there are already some practices of recording personal care (hygiene, food, nursing care) through the use of tablets in residential structures for the elderly in Portugal, a practice still very incipient in the Portuguese landscape.

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Elderly population

Facts and Figures

In 2028, Sweden's population is expected to pass 11 million. The age group that will increase most is 80 years old and older. The projections show an increase of this group with 50% compared to 2018.

The majority of older people in Sweden live in ordinary housing. Almost half of those who have turned 100 years old still live in ordinary housing and only 4 percent of people over 65 live in special housing for older people[1].

Low social participation, often as an effect of reduced physical function, contributes to an increased risk for poor mental health within the elderly population. The public health agency of Sweden has shown that 50% of older people with walking problems responded that they had low social participation and about 20% of this group indicated impaired mental well-being. In a comparison with the group without physical restraints, the proportion of older people with low social participation was 33% and 7% of them reported reduced mental well-being[2].

Generally, older people living in special housing feel that they are more lonely than older people who can remain in an ordinary accommodation. Some studies indicate that use of computers and internet can reduce loneliness within the elderly population. The evidence are however week and more research are needed on for example how the use of internet can improve the quality of life and independency[3].

Digital competence among older people

Internet access at home is increasing most among the oldest. Among those who are 76 years of age or older, 87 percent has access to Internet at home compared to 68 percent in 2017[4]. Access to internet is not the same thing as using internet – well over half or 58% of this group uses the internet, a proportion that has increased by 8 percent from the previous year[5]. According to Statistics Sweden the largest increase in internet connection via the mobile phone has taken place among the older population. Still, almost 40 percent of women and just over 25 percent of men aged 75 to 84 live in digital exclusion (have never used the internet). Among people between 65

[1] Abrahamsson M et al. (2017) *Vem är den äldre? Äldrebilder i ett åldrande Sverige.* Rapportunderlag för nationell kvalitetsplan för vård och omsorg om äldre

[2] www.folkhälsomyndigheten.se

[3] SBU (2017) *Välfärdsteknik - Digitala verktyg som social stimulans för äldre personer med eller vid risk för psykisk ohälsa.*

[4] Internetstiftelsen (2018) *Svenskarna och internet*

[5] Folkhälsomyndigheten (2018) *Digital teknik för social delaktighet bland äldre personer: ett kunskapsstöd om möjliga insatser utifrån forskning, praktik, statistik, juridik och etik*

and 74, the figure is just over 10 percent[6]. The reason for the lack of digital competence can be an impaired knowledge, ability, motivation or access to the internet and hardware.

Current status of the use of technology and social innovations in elderly care

In a recent report[7], the challenge of providing good home care for an increasing number of inhabitants over 80 has been identified. The report highlights the potential of using existing technical solutions wisely in providing more users with good care while maintaining the quality. The solutions include changing working methods and better use of new technologies and digitization. The use of technologies in three areas: day and night surveillance, medication reminder and key management, could according to the report rationalise the home care and at the same time save up to 300 million euro.

A survey[8] shows that a rapid development in elderly care is ongoing. The municipalities have the main responsibility for elderly care in Sweden and are thus in charge for implementing new types of technical solutions. During the past two years, the number of municipalities using digital alarms has doubled. The use of passive alarms/sensors is also widespread among the municipalities. Many municipalities have also introduced new technical solutions such as electronic planning and GPS alarms. The introduction of digital locks in housing and security cameras is also becoming more common. The use of reminder for medicine has slowly become more frequent.

A recent study shows different attitudes of older patients to e-health services in primary care. The study concludes that in order to understand the factors that influence the adherence of fast developing e-health services in primary care it is important to explore the attitudes, expectations and beliefs of older people. A successful implementation of e-health interventions should be tailored to target different attitudes and needs with a strong focus on information and support for older people[9].

Policy initiatives

The Government and the Swedish Association of Local Authorities and Regions have outlined a common vision for Sweden concerning the possibilities of digitization in social services and health care. *In 2025, Sweden will be best in the world at using the opportunities offered by digitisation and eHealth to make it easier for people to achieve good and equal health and welfare, and to develop and strengthen their own resources for increased independence and participation in the life of society.* The background for such an ambitions vision is that Sweden's inhabitants are among the most digitally mature in the world, and the business and public sectors have largely digitised their activities[10].

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[6] Statistics Sweden (2017)

[7] Swedish Association of Local Authorities and Regions (2018) *Ekonomirapporten – om kommunernas och landstingens ekonomi.*

[8] Kommunal (2019) *Välfärdsteknik – för trygghet, hälsa och utveckling i arbetet*

[9] Milos Nymberg V et al (2019) *Having to learn this so late in our lives … ' Swedish elderly patients' beliefs, experiences, attitudes and expectations of e-health in primary health care.* Scandinavian Journal of Primary Health Care 37: 41-52

[10] Ministry of Health and Social affairs and Swedish Association of Local Authorities and Regions (2016) *Vision for eHealth 2025 – common starting points for digitisation of social services and health care*

An ongoing government inquiry will review and propose measures to promote the introduction of welfare technologies (digital technologies) for increased security, independence and quality of life for older people. It will also focus on unburden the staff and modernize the work with older people. The overall aim is to better utilize the potential of welfare technology. It is underlined in the directives to the inquiry that it is important to actively involve those who will use the technologies in the development process in order to ensure that the solutions will be adapted to the needs of older people. The inquiry will deliver information on potential obstacles for the implementation of technologies and analyse the support needed for the caregiver and work management to use welfare technologies in elderly care.

On the Government's initiative the Riksdag decided upon on an additional SEK 350 million for investments in welfare technology. The money was allocated to the local government sector for implementation of digital technology and mobile security alarms as well as supporting applications for mobiles and tablets[11].

Best practices - the use of different technologies and innovations

The National Board of Health and Welfare's latest survey on e-health and welfare technology shows that elderly care is the area where the municipalities have benefited most from technology, and that the development is faster than in other areas[12].

Västerås is a Swedish city with a population of 140000 inhabitants with 19% of the population being 65 years of age or older. The city has been a pioneer in both pilot projects and test beds, and was the municipality that first purchased solutions for e-home care. It was done in collaboration with key-actors and with a user-centred approach. The calculation model used in Västerås showed that each Swedish crown invested in e-home care would result in 5 crowns back. In all steps, the implementation of e-home care received support from politicians and stakeholders and a support unit for welfare technology was established along the way that had responsibility for education of staff which were key factors for the successful implementation of e-home care[13].

In the same city a model has been developed in order to decrease restraints in the living environment for older people with dementia. The model includes changes in working methods, living environment and technology use. By integrating all three aspects, the use of technology was put in a context where the needs of the individual was in focus. As a concrete example, security cameras were used in a dementia care, which contributed to a safer supervision at night based on the individual's needs. Being able to perform surveillance from a security camera created better opportunities for undisturbed night sleep. Another gain with the changed working method was that the staff's time could be liberated to give more support to the individuals who had the greatest need. Other examples are the use of a virtual technology for physical training and to successfully bring good memories to people with dementia[14].

[11] Vårändringsbudgeten (2018), prop. 2017/18:99, bet. 2017/18:FiU21

[12] Socialstyrelsen (2019) *E-hälsa och välfärdsteknik i kommunerna 2019 Uppföljning av utvecklingen inom e-hälsa och välfärdsteknik i kommunerna*

[13] *Välfärdslabbet: En förstudie om implementering av välfärdsteknologi.* (2014). Ett samverkansprojekt mellan SKL och IToTelekomföretagen. (In Swedish)

[14] Slutrapport för projekt *Välfärdsteknologi på äldreboenden* (2018) Västerås stad (In Swedish)

Results from another study show that mobile alarms are clearly profitable from a socioeconomic perspective. But the most important positive effect was the increased well-being of the user and increased security among both users and relatives[15].

The so-called intelligent shower, Poseidon, is designed to help older people or other persons with reduced mobility be able to shower themselves. An evaluation of how residents and staff experienced the new technology shows that residents feel that they can control their shower situation to a greater extent and that the staff are mainly there as a support. The staff sees the greatest values in being able to help the residents to become more independent. This in turn can have positive effects in other situations and also lead to increased well-being. In addition, it has led to a better work situation for the staff with reduced risk of injuries[16].

Robotdalen[17] is an initiative, funded by EU, Sweden's innovation Agency, academia, industry and the public sector. Their mission is to support the development of welfare technology and new technical solutions in health and medical care. One of the projects, Solutions for Independent and Active Life, has the goal to enable older people to remain independent and involved in the society as long as possible. The solutions stem from actual needs and end users are involved throughout the product development. Robotdalen also works with test beds for new solutions encouraging international companies and entrepreneurs to develop their robot innovations and set up business in Sweden.

Implications for older people, staff and working places

The Swedish Municipal Workers' Union has investigated the implementation of digital solutions and aids from an employee perspective. The report[18] concludes that even though new digital solutions have an impact on the working environment the effects for employees has not received sufficiently attention. The lack of an employee perspective implies that Sweden is lagging behind other countries in the development of products, services and processes that improve the work situation for the employees.

Education and further training

Employees in elderly care need an overall knowledge of new technologies which puts a pressure on the education system and the life-long learning. In order to obtain a shift towards more technology in the welfare sector it is necessary to adapt the health education programs.

Examples of further training for healthcare professionsals are two web based education packages that have been developed[19] with the aim to support municipalities and other actors in the implementing digital technologies. One of them "*Ethics and integrity when introducing welfare technology*" focuses on e-health solutions in elderly care and provides support in discussions and work on ethics and integrity when welfare technology is introduced. It includes subjects on ethics, integrity and independence, the need for human contact, conflicting goals and opportunities and

[15] Dahlberg Å (2013) *Nyttokostnadsanalys vid införande av välfärdsteknologi – exemplet Posifon*. Hjälpmedelsinstitutet. (In Swedish)
[16] Karlstad forskare vid CTF, Centrum för tjänsteforskning vid Karlstads universitet
[17] http://www.robotdalen.se/
[18] Kommunal (2019) Välfärdsteknik – för trygghet, hälsa och utveckling i arbetet
[19] Kunskapsguiden.se

risks in data collection. The other education program, "*E-health and welfare technology in the social services*" informs about the way in which e-services and welfare technology facilitates the administrative work and increases the benefit for the caregiver, the profession and decision makers.

Another example is a new project initiated by six municipalities with the goal of increasing digital skills within the health care sector. With financial support from the European social fund the purpose is to improve the knowledge of the digital development and digital tools within the staffs' respective sector[20].

Education for older people

Some municipalities have started courses for older people in order to reduce the digital alienation. One example is a "social surf course for older people" which at the same time offers an opportunity to socialise[21]. Another example is an intensive course "more digital" organised by a municipality together with a company and the university. An evaluation focusing on attitudes and behaviours before and after showed that the majority of the 300 participants became more digital as a direct result of the education whereas 70 percent estimated that they used IT more after the course. Less fear and more self-confidence were contributing factors. After the training, 9 out of 10 participants also stated that they had a more positive attitude towards digital technology. The benefits for the older people are both social, keeping in touch with relatives and friends through social media, and practical using e-services such as banking and health services[22].

Conflict of interests

The Swedish Medical Ethics Council (Smer) has compiled a report on ethical aspects of robots and monitoring in the care of the older people with the aim to stimulate a discussion and to provide support for decisions on the use of robots and surveillance in the health and social services' care for older people. The report lists arguments for and against robots in care of older people where arguments for are amongst others that health robots and monitoring technology in the care of the older people can promote the individual's quality of life, integrity and self-determination. They can lead to an increased quality of care in the health and medical care and social services. They can streamline the healthcare activities and social services' care so that resources can be used more effectively. They can improve the staff's working environment by, for example, avoiding tough and heavy work tasks. Monitoring with GPS can prevent older people from getting hurt in case he or she gets lost and monitoring can mean security for relatives. Arguments against are that health robots and surveillance can mean a deterioration of older people's quality of life and a disproportionate intrusion into his or her integrity. Replacing health professionals with health robots, camera and GPS transmitters may contribute to reduced social stimulus and that the need for security and human contact is not met. Health robots and surveillance can have a negative effect on the quality of care. In addition, buying robots for a business can entail great financial costs at the expense of other priorities[23].

[20] NLT (2019-01-09) Satsning ska öka digitala kompetensen
[21] Norra Skåne (2019-01-30) Social surfkurs för seniorer. Äldreomsorg "Kursen minskar det digitala utanförskapet bland äldre".
[22] www.his.se Utbildning kan minska digitalt utanförskap bland äldre (2018-03-28)
[23] SMER (2014) Robotar och övervakning i vården av äldre – etiska aspekter

Societal and political debates

The debate about the future of elderly care is focusing on two major challenges, the rapid increase in the proportion of older people while the proportion of people in working age decreases which means that besides a large financial pressure it is also a major recruitment challenge. In the light of these challenges, representatives of Swedish Association of Local Authorities and Regions conclude that elderly care must be developed in terms of new working methods together with an increasing use of the possibilities that digitisation offers. By using more technology such as alarms, cameras and telemedicine resources can be invested in those who need more help around the clock. It implies that the state takes the responsibility for a reliable broadband in the whole country so that the technology can be used everywhere. The state also has a responsibility to facilitate regulations to prevent potential obstacles for future development of elderly care.[24].

At centre of the discussion is also that strategies for implementation of technologies should address the individual's needs and conditions and how the technology can meet that need. When it comes to the concern that the technology would take over the staff's work it should be underlined that the idea is instead that the staff should be able to work as efficiently as possible and where they really are needed[25].

When it comes to introduction of technology in elderly care it is of great importance to involve the staff in the process. Starting "on the floor" could make the implementation faster and contribute to smarter solutions. It is common that technology initiatives come from the top without being controlled by the needs of older people but rather by the fact that a certain technology is available. As a result, the investments do not necessarily solve the problems that the staff think are of greatest importance[26].

Another reason for the slow introduction are large gaps in the legislation why the municipalities don't dare to invest. One concern is how to get consent from an older person who, for example, suffer from dementia. These issues are dealt with, in the governmental ongoing inquiry[27].

Future perspectives and reflections

The elderly population can gain from the development but to ensure a beneficial output older people should be included in the innovation process and the design of technology[28,29]. Equally important is to encompass older people as actors who use and modify technologies as they become part of their daily lives[30]. Technology is not neutral, they need careful consideration as to privacy, access and empowerment of older people.

A number of factors can have a negative influence on seniors' acceptance and successful implementation of new technologies. Factors such as fear of stigmatization and increasing costs

[24] SvT (2016-11-08) Äldreomsorgen har aldrig varit så bra som i dag
[25] Dagens Samhälle (2017-06-21) Digital teknik gör äldre trygga och självständiga
[26] Sunt Arbetsliv (2019-02-26) Utredare studerar ny teknik i äldreomsorgen
[27] Sveriges Radio (2019-06-19) Kritiken: Går för trögt med trygghetskameror
[28] Östlund B et al. (2015) STS-inspired design to meet the challenges of modern aging. Welfare technology as a tool to promote user driven innovations or another way to keep older users hostage? Technological Forecasting & Social Change 93:82-90.
[29] Peine A et al. (2015) Science, technology and the grand challenge of ageing – Understanding the socio-material constitution of later life. Technological Forecasting & Social Change. 93:1-9.
[30] Peine A et al. (2018) From intervention to Co-consitution: New Directions in Theorizing about Aging and Technology. The Gerontological Society of America. Doi:10.1093/geront/gny050

play an important role. Communication and perception of concrete benefits, demonstration and possibilities to try out the technology can reduce the concerns of the user. Also, familiarity with electronic technology can ease the implementation. Another important factor is to involve relatives or caregivers, people that the user has confidence in, as it can facilitate the introduction and functioning of assistive technology. Technology acceptance varies between the pre- and post-implementation phase and there are large knowledge gaps concerning factors influencing the acceptance and factors sustaining the use of technology in a post-implementation phase[31].

There is no "linear correlation" between the need for technologies and the possibility to continuing living at home. Other types of social solutions can replace technologies and the often straightforward desire to develop technologies as a mean to help older people to stay at home has been questioned. New technologies such as monitoring systems change the homes of older people, sometimes in ways not foreseen. It is important that older people have access to balanced information to be able to make the right decision of the different options available to them. A user centred approach with participation of the final users in the design and development of a new service or product is key to tailor the proper solution[32].

[31] Peek STM et al. (2014) Factors influencing acceptance of technology for aging in place: A systematic review. International Journal of Medical Informatics 83: 235-248.

[32] Nierling L & Dominguez-Rué (2016) All that Glitters is not Silver – Technologies for the Elderly in Context. Introduction. Ageing and Technology: Perspectives from the Social Sciences. Ed.: E. Dominguez-Rue

Switzerland

Swiss Foundation for Technology Assessment (TA-SWISS), Elisabeth Ehrensperger and Lucienne Rey

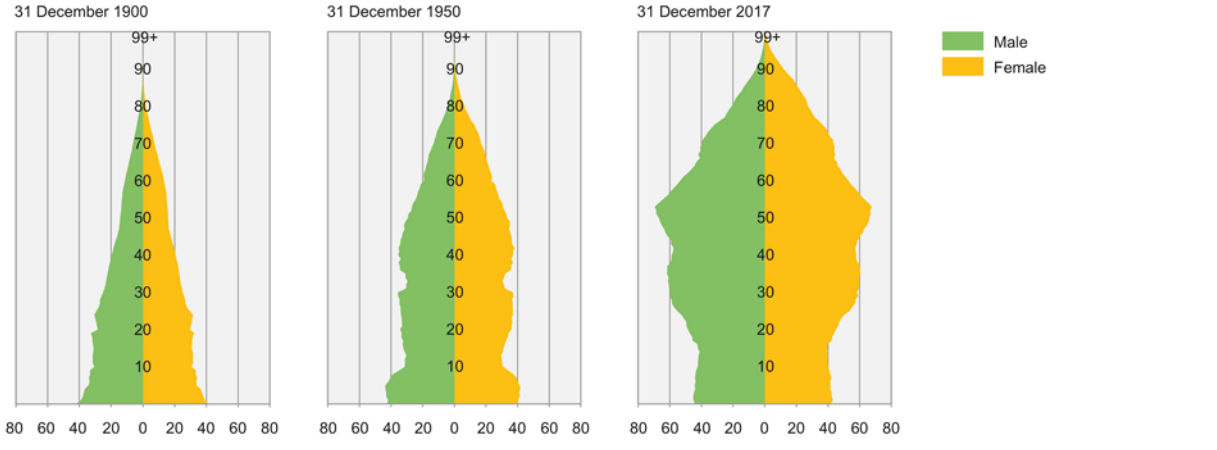
Elderly population

Facts and Figures

Since the 1960s, the percentage of the elderly in Switzerland has increased steadily. This condition is also mirrored in the country's median age, which is the age at which the population can be divided into two equal groups, with one half being older and the other younger. In 1971, the median age was 32.18 years; by 2017, it had risen to 42.45 years.

This development is equally striking when regarded over a longer period of time and in absolute numbers. In 1950, there were 247 people over the age of 95 living in Switzerland, which corresponded to just 0.06 per cent of the population at that time. In 1975, a total of 1,940 people had reached this old age (0.17 per cent of the population) while, 25 years later, the number of very elderly individuals had increased to over 8,700 (0.65 per cent). By 2010, there were over 12,600 people older than 95, which corresponds to 0.74 per cent of the entire population (Federal Statistical Office FSO).This has caused the shape of Switzerland's age pyramid to slowly evolve into something more akin to an urn, with a comparatively narrow base and a bulge in the age group of 30- to 60-year-olds. The reasons are twofold: the low birth rate on the one hand, and rising life expectancy on the other. The trend will become even more pronounced when the baby boomer generation (individuals born between 1955 and 1965) retires

Age structure of the population
Number of persons in thousands



Source: FSO – Census, STATPOP

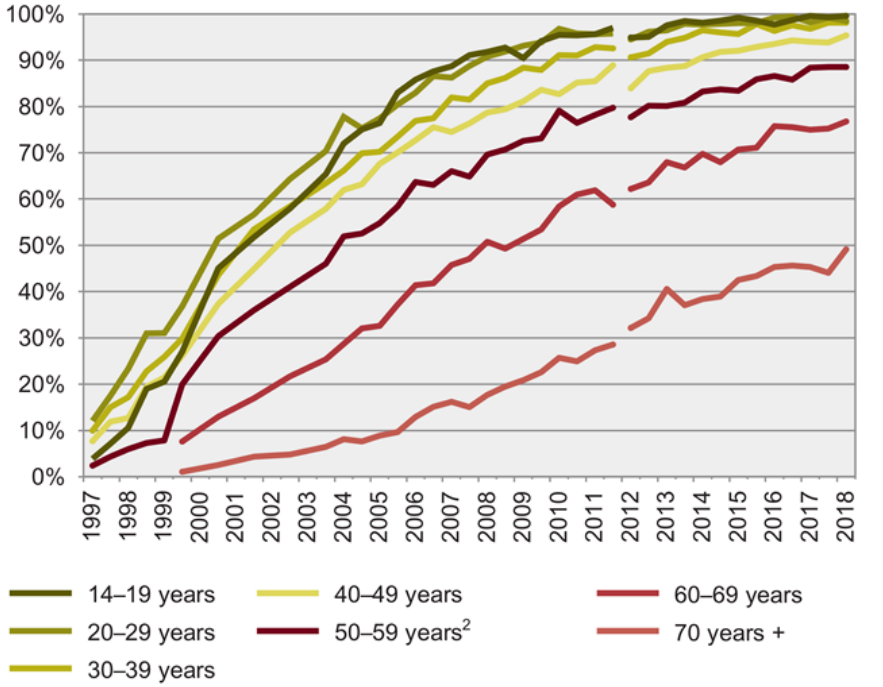
Online or left out?

One side-effect of the growing influence of digitalisation is the often-expressed fear that older generations – which grew up before the advent of computers and cell phones – will increasingly lose access to societal developments and thus be left out. It is indeed a fact that people over the age of 60 use the Internet less frequently than individuals aged 14 to 49. Data from 2018 reveal that 95 per cent of the latter age group regularly surfed the Web, and among individuals between 50 and 59 years of age, use of the Internet was a habit for 88 per cent. Just under 77 per cent of individuals in the age group 60 to 69 frequently surfed, and among people 70 and older, still half (a solid 49 per cent) regularly used the Internet.

According to the Federal Statistical Office, when Internet usage is broken down into age groups, the differences are less pronounced in Switzerland than in other countries. Because usage rises with increasing levels of education and because older generations are on average less educated than the younger population, it is possible that two separate influencing factors overlap, thus making it difficult to determine whether the decrease in Internet usage is due to an increase in age or to a lower level of education. The Federal Statistical Office has observed that differences in Internet usage are apparently less pronounced the higher the general use in a country is, which may be interpreted as an indicator of how far digitalisation has advanced in a given country.

Internet usage in Switzerland according to age, development [1]

Regular users in percentages of individuals over the age of 14



[1] Methodological factors make it impossible to compare the results after autumn 2012 to older studies. Comparisons with future years are, however, possible.

[2] Over the age of 50 in the years 1997 – 1999.

Source: MANet: Net-Metrix-Base

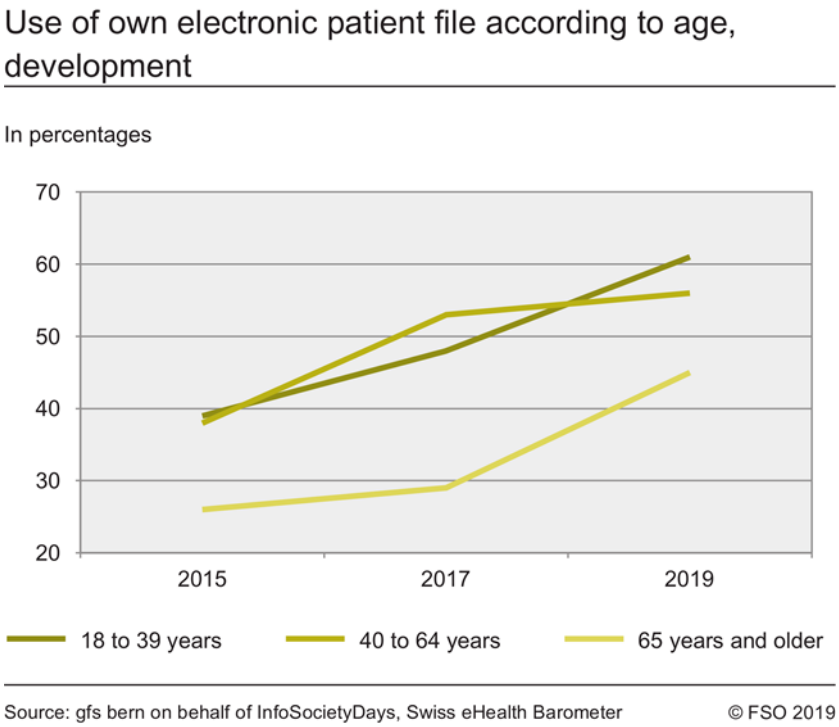
It is believed that the Internet impacts the well-being and general outlook of senior citizens. In a study conducted in 2015 at the University of Zurich Center for Gerontology, researchers came to the conclusion that "onliners" – individuals who use the Internet comparatively frequently – generally tend to deal more positively with their own ageing than offliners (Seifert und Schelling 2015, 61). In addition to public transport timetables and official information, health issues are one of the most common topics onliners search for on the Internet. (ibid., 16). Over half of surveyed onliners and a quarter of offliners either rather or completely agreed with the statement that the Internet allows them to remain independent longer in their old age (ibid., 48). That they can stay in touch with others on the Internet is apparently a key factor; indeed, more offliners than onliners (16 per cent compared to 9 per cent) agreed with the statement that they sometimes feel left out (ibid, 59).

Current status of the use of technology and social innovations in elderly care

Technology and health as the focus of various strategies

The Swiss federal government pursues various strategies that are designed to guarantee all persons living in the country equal opportunity to lead a full life. Consequently, two core objectives of the *Strategy Digital Switzerland* are "Enabling equal participation for all and strengthening solidarity" and "Further improving the digital empowerment of people". Moreover, the strategy aims to facilitate the provision of made-to-measure health care by creating networks to link the various participants in the health-care sector (OFCOM 2018, Item 4.8.2). The strategy's action plan states that, in the framework of the European programme "Active Assisted Living AAL", the Swiss government promotes the development of technical solutions that enable older individuals and persons with disabilities to be self-sufficient, to live and work independently and to improve their digital skills. Regarding networks for participants in the health-care sector, the action plan refers to the *eHealth Suisse* strategy (eHealth Suisse, 2018).

One priority of the *eHealth Suisse* strategy is to increase the use of electronic patient files. The Federal Health Insurance Act HIA prescribes that all Swiss hospitals, psychiatric clinics and rehabilitation centres must have introduced patient electronic files by April 2020; birthing centres and nursing homes have two additional years. The Swiss population takes a cautiously positive view of the files: a representative survey by the Swiss eHealth Barometer (Golder 2018) reveals that 69 per cent of residents in Switzerland think electronic patient files are a very or rather good idea. 17 per cent hold a clearly negative view of the files. Individuals over the age of 65 tend to have a more sceptical attitude than do younger generations (59 per cent of people in the 65+ age group believe patient electronic files are a rather or very good idea). As a consequence, the willingness to create one's own electronic patient file decreases with age (cf. gfs chart below).



The *eHealth Switzerland* strategy also supports the promotion of "Mobile Health" (mHealth) with a clear emphasis on developing a broad palette of measures to care for patients with chronic illnesses (e.g. via tele-monitoring) or for long-term care of aged adults (e.g. active assisted living systems).

State of technology and development

Table 1 (TA-SWISS 2014, 12) illustrates the type and nature of support programs available to support the adoption of telecare and home-based telemedicine policies. Furthermore, the type of service provider gives insight into the mix of private and public services on offer.

Name of service provider	**Date introduced**	**Objective**	**Type of service provider**
Medgate www.medgate.ch	1999	Medgate is one of the leading telemedical companies in Switzerland. It provides advice and treatment via telephone, the Internet and video chat for patients with urgent or general health queries. People with chronic illnesses benefit from telemedical care programmes.	company
Medi24 www.medi24.ch	1999	Medi24 is a Swiss pioneer in the field of telemedicine. It offers telephone assistance for medical advice or in the event of an emergency, as well as special care programmes for chronically ill and at-risk patients.	company
Swiss Red Cross www.redcross.ch	1983	Provides emergency call solutions at home (system "Casa") or mobile solutions (system "Mobil").	non-profit

Overall, Switzerland generally promotes eHealth applications, apparently an adequate measure for introducing telecare and home-based medicine. However, no explicit promotion of telecare and home-based medicine is pursued (i.e. there are no known incentives). Consequently, building up the appropriate infrastructure and implementing new technologies may take a long time.
As Switzerland is a country with a very good health care system and excellent research institutions in the high-tech domain (e.g. the Federal Institutes of Technology), there is the potential to develop and implement new technologies for health care.

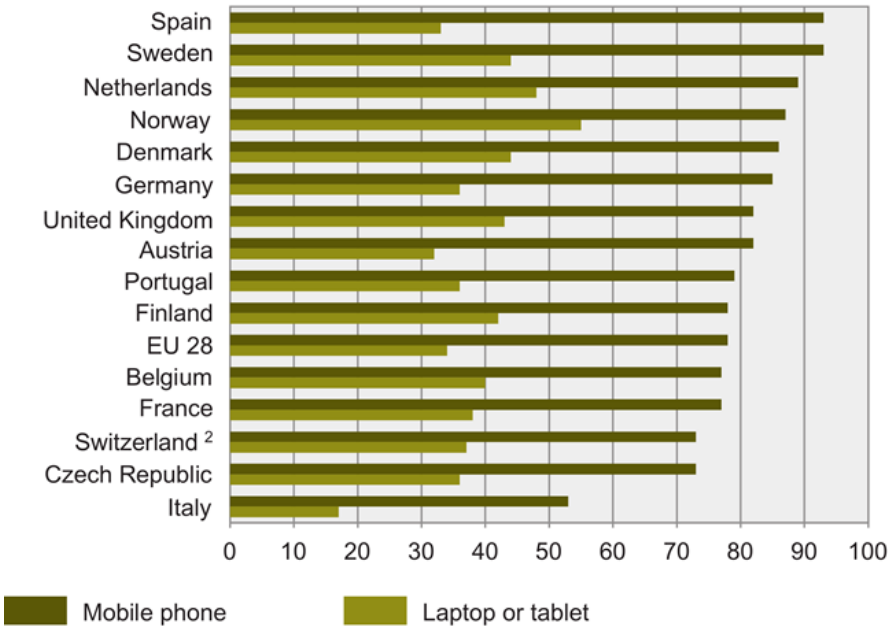
However, one difficulty in implementing new policies related to telecare and home-based medicine is posed by the federalist governance structure in Switzerland: many decisions are made on a cantonal level and the influence of national authorities is limited. The internet platform ageingsociety (www.ageingsociety.ch) provides an overview of further research and information initiatives on age and technology in Switzerland.

Potential benefits of age-appropriate health apps

In the past few years, mobile "health coaches" and health apps designed for smartphones and tablet computers have gained in significance. In 2017 in Switzerland, 73% of people between 16 and 74 years of age accessed the Internet via their mobile phones. When smartphones are equipped with sensors, they can be used to collect, store and transmit health data.

International comparison of Internet access via mobile devices, 2018

in percentages of Internet users[1]



1 Internet usage in the last three months before data was collected, population aged 16 to 74 years.
2 Data 2017

Sources: Eurostat; FSO – Omnibus IKT

The TA-SWISS study "Quantified Self" (Meidert, 2018) has also confirmed the growing significance of mobile health apps in health care. The data collected by sensors in mobile devices can help health-care professionals to make better decisions and to determine the optimal time for a medical intervention. The study, however, also notes that in comparison to younger people, senior citizens require a different kind of motivation to change their health-related behaviours in the long term; this aspect should therefore be factored in when developing apps.

In addition, aged adults find it more difficult to use modern technology in general, and mobile devices in particular. In the aforementioned study, 41 per cent of the surveyed senior citizens said they find using technical devices rather or very difficult. To alleviate this situation, the ICT Accessibility Lab at the Zurich University of Applied Sciences has created a guideline for developing age-appropriate apps. The guideline explicitly addresses problems facing an aged population – for instance impairments in vision and hearing as well as deficits in fine-motor skills and cognitive abilities – that can make using apps of all kind, including mobile health apps, difficult or even impossible.

Robots in caregiving

While the percentage of aged adults in Switzerland is on the rise, the national health-care system is confronted with a shortage of medical staff. Technical aids, especially robots, could help fill the gap. A TA-SWISS study (Becker et al., 2013) reveals that technical devices can support nursing staff in carrying out physically demanding tasks such as lifting patients. And using robots is also feasible in routine tasks, for example picking up and distributing laundry or meals. Other potential areas for the use of assistive robotic technology include "smart" walking aids and wheelchairs that could help patients to maintain greater independence. Nevertheless, the study advises caution in using robots to replace human interaction: this would increase a patient's sense of isolation, and the lack of personal contact would make the profession less attractive for many nurses and caregivers.

One aspect of a current TA-SWISS study called "Roboter, Empathie und Emotionen" (*Robots, empathy and emotions*) examines the impacts an increased use of caregiving robots has on the relationship between patients and nursing staff.

Falling and dementia: an elderly person's nightmare

Older people fear falling – and rightly so, as this is the most common cause of an abrupt loss of independence. A hip fracture leads to a hospital stay, after which the patient is often placed in a retirement or nursing home. In 2012, a quarter of the Swiss population over the age of 65 that was still living at home experienced a fall, with almost 10 per cent of these falling multiple times. Compared with data from 2002, this implies an increase in the frequency of falls (in 2002, a 20.9 per cent rate of falls in persons over the age of 65 and, in 2012, 25.2 per cent). In retirement and nursing homes, just under 39 per cent of the residents fell in the year of the study (2012); of these, nearly 21 per cent fell multiple times (Swiss Health Observatory 2015, 111).

The greatest nightmare in advanced old age is dementia – an umbrella term for several diseases marked by memory loss and accompanied by an impairment in at least one other cognitive function, for example speech, motor skills, recognition or ability to carry out plans. These symptoms make it impossible for dementia patients to manage daily life with its many

challenges on their own. It is estimated that there are some 110,000 people with dementia living in Switzerland and it is predicted that the numbers will increase to 190,000 by 2030 and to approximately 300,000 by 2060 (Swiss Health Observatory 2015, 109).

Spotlight on age-appropriate assistance systems

In Switzerland, various higher education institutions and commercial suppliers are pursuing the topic of active assisted living (AAL) systems – that is, age-appropriate assistance systems that use innovative technology to promote independent living in an elderly person's accustomed environment.

For instance, a one-year study in Bern tested whether wearable sensors and fitness trackers in combination with motion, acceleration and sleep sensors are suitable for detecting falls and for early recognition of risk of falling (Schütz et al., 2017). The collected data confirm that synchronised sensors are a viable means to detect falls early and to increase the safety of persons at risk of falling.

There are some 15,000 patients with Parkinson's living in Switzerland. A current ETH Zurich study uses sleep monitors to care for Parkinson's patients – in particular, to optimise their medications – based on various sleep markers (Buet, 2017).

The iHomeLab (http://www.ihomelab.ch) at the Lucerne University of Applied Sciences and Arts also pursues a variety of projects that research and test systems for home use. One recently concluded project, "Home4Dem" – conducted with international partners in the scope of the European AAL programme (http://www.aal-europe.eu) – focussed on individuals with dementia, their relatives and caregivers. In the project, two commercial AAL sensor systems (http://www.domo-safety.com/) were integrated with other multi-function sensors and tested in retirement homes and nursing facilities in Switzerland, Italy, Sweden and Norway. One objective of the project was to improve commercial solutions so that they can recognise unexpected situations requiring an immediate response. Another project aim was for the commercial solutions to use data gathered by the sensors as well as machine learning algorithms to track the development of a dementia case and to recognise trends in the medium term. The data gathered by the sensors are visualised in charts and graphs and sent via smartphone to nursing staff and caregivers, enabling them to identify changes in a patient's daily behaviour or sleep patterns.

Mobility and independence are greatly valued by aged adults – a finding that was further corroborated in an open panel discussion organised as part of a TA-SWISS anti-ageing project. While the participating nurses and caregivers primarily regarded cognitive fitness as the main criterion of health, the seniors participating in the discussion also highlighted the importance of physical ability (Rey 2007, 28). The development of age-appropriate assistance systems that enable independent living at home is thus likely to be welcome by many older individuals – and would meet the needs arising from the anticipated demographic developments.

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United States

The U.S. Government Accountability Office (GAO), Timothy M. Persons

Elderly population

Facts and Figures

According to the Central Intelligence Agency's World Factbook, approximately 16% of the population in the United States was 65 years and older (i.e., elderly) in 2018.[1] The elderly population is growing more rapidly than any other age group in the United States. Specifically, according to 2010 U.S. Census data, the elderly population grew 15 percent from 2000 to 2010 compared to 10 percent growth in the overall population, and by 2030 the elderly are expected to comprise about 20 percent of the overall U.S. population. 10,000 Americans turn retirement age each day and will continue to do so for the next decade. Thus the United States is in the midst of one of its greatest demographic shifts in its history.

Digital maturity

One of the challenges to elderly digital maturity is getting elderly adults access to broadband internet. According to a 2015 Pew Research Center report, only 45% of surveyed adults over 65 years old were using broadband service at home compared to over 65% for those aged 18-64. Furthermore, the Federal Communication Commission's (FCC) National Broadband Plan identified affordability, perceived relevance, lack of computer skills, and the availability of broadband service as the four principal barriers to broadband adoption. In a June 2015 report, GAO also found that affordability, lack of perceived relevance, and lack of computer skills are the principal barriers to broadband adoption.[2] In addition, stakeholders identified other barriers, although with less frequency:

- Data security concerns such as privacy and identity theft: According to AARP survey data, many older adults do not take proactive steps to protect themselves online. For example, a little over half use a passcode on their phones or tablets and only one-third use two-factor authentication.[3]
- Accessibility for people (including the elderly) with disabilities, such as those who are blind, deaf, or hard of hearing.

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[1] https://www.cia.gov/library/publications/the-world-factbook/geos/us.html, accessed Aug. 30, 2019. Total U.S. population was estimated at 329 million in 2018.

[2] GAO, *Broadband: Intended Outcomes and Effectiveness of Efforts to Address Adoption Barriers are Unclear*, GAO-15-473 (Washington, D.C.: June 2, 2015).

[3] AARP, *Technology Use and Attitudes Among Mid-Life and Older Americans*, December 2017. https://www.aarp.org/content/dam/aarp/research/surveys_statistics/technology/info-2018/atom-nov-2017-tech-module.doi.10.26419%252Fres.00210.001.pdf, accessed Aug. 30, 2019.

Current status of the use of technology and social innovations in elderly care

Policy initiatives

Since the enactment of the Health Information Technology for Economic and Clinical Health (HITECH) Act in 2009, the U.S. government has invested over $35 billion to accelerate the development and adoption of health information technology. These efforts are aimed at encouraging investment in and the use of electronic health records and related technologies that, among other things, enable patients to access their health information when they need it in a useful electronic format. In 2017, GAO interviewed patients who have accessed their information electronically, and reported numerous benefits and challenges.

Benefits

- The ability to better communicate with their health care providers, track health information over time, and share information with other providers. Multiple patients described circumstances in which they used information in their portal to improve their interactions with their provider and adhere to provider recommendations.
- Electronically accessing their health information made patients feel empowered or more proactive in managing their health, particularly over time. One patient described using the information in her portal to notice a trend in her lab results and also learned that she had a condition which her provider had not disclosed to her.
- Patient portals can be used to share information with other providers. Multiple patients described printing out medical information from their portals, such as lab results, and bringing that information to appointments with other providers. Patients noted that portals make sharing health information very convenient.

Challenges

- It wasn't clear to patients whether their information could be electronically downloaded or transmitted.
- Patients also expressed frustration with the amount of time and effort it took to set up electronic access through their providers, managing multiple passwords for their many portals, and understanding each portal's user interface.
- Many patients said that the information itself was often incorrect or not presented in helpful ways, and some patients noted that there was no simple way to correct or denote incorrect information within the portal.
- Patients could not aggregate their information from multiple providers into a single health record.

Best practices

Telemedicine: Broadband provides consumers the ability to research health issues, obtain and share their personal health information with third parties, and communicate with doctors, including specialists who may work in a different city. For example, through remote access, telemedicine[4] can allow rural patients to receive medical diagnosis or patient care, including from specialists who are located elsewhere.[5]

Selected provider, patient, and payer associations GAO interviewed reported that telehealth may improve care for Medicare[6] beneficiaries, but they also cited coverage and payment restrictions as barriers to the use of telehealth in Medicare.[7] Officials from the selected associations reported several factors that encourage the use of telehealth in Medicare, including the potential to improve or maintain quality of care, alleviate provider shortages, and increase convenience to patients. For example, officials from one provider association noted that regional medical specialty shortages can be addressed through telehealth. Officials also reported several potential barriers to the use of telehealth in Medicare, including payment, coverage restrictions, and infrastructure requirements. For example, officials from one provider association and both of the selected patient associations described access to sufficiently reliable broadband internet service as a barrier to telehealth use.

Nursing home rating systems: In 2017, GAO reported on a system used to rate nursing homes on a 5-star basis that is used by the public to help select locations for the elderly.[8]

Social communication and networking: Broadband technology provides an opportunity for older adults who may be socially isolated to participate in social dialogue about current events and issues.[9] According to AARP survey data, 91% of those with mobile and traditional computing devices say they use technology to stay in touch with family and friends. In addition, more than half of adults over age 60 reported surfing the internet, getting news and other information, messaging, and playing games on a tablet or smartphone.

Transportation: In December 2014, GAO reported that as the U.S. population ages, transportation is a service that is critical to helping older adults remain in their homes as long as possible. Technology could help with transportation issues, particularly those who cannot rely on friends and family. However, according to AARP, only 6% of adults 50 or older used mobile apps such as Uber and Lyft to arrange for transportation. This may be an area where federal training, funding, or coordination programs could assist older adults.

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[4] Telemedicine includes telehealth, which is the use of medical information exchanged from one site to another via electronic communications (such as video or email) to improve a patient's clinical health status. Telehealth can include telemental health, which is the provision of mental health services to patients living in remote locations or otherwise underserved area.

[5] GAO, *Telecommunications: FCC's Performance Management Weaknesses Could Jeopardize Proposed Reforms of the Rural Health Care Program*, GAO-11-27 (Washington, D.C.: Nov. 17, 2010).

[6] Medicare is a federally-run health insurance program in the United States for the elderly, disabled, and those with end-stage renal disease. In 2016, Medicare covered over 56 million people.

[7] GAO, *Health Information Technology: HHS Should Assess the Effectiveness of Its Efforts to Enhance Patient Access to and Use of Electronic Health Information*, GAO-17-305 (Washington, D.C.: Mar. 15, 2017).

[8] GAO, *Nursing Homes: Consumers Could Benefit from Improvements to the Nursing Home Compare Website and Five-Star Quality Rating System*, GAO-17-61 (Washington, D.C.: Nov. 18, 2016).

[9] GAO-15-473

New initiatives in the area

Some experts project the use of Internet of Medical Things (IoMT) is increasing.[10] IoMT devices, such as heart monitors and pace makers, collect and send a patient's health statistics over various networks to health care providers for monitoring, remote configuration, and interventions. The use of these devices worldwide is expanding rapidly, growing from over 300 million IoMT devices in 2017 to over 400 million devices in 2018.[11] At a personal health level, wearable IoT devices, such as smart watches and fitness trackers, can track a user's physical activities, basic vitals, and sleeping patterns. In 2017, over 40 million fitness tracker IoT were in use in the United States.[12]

Implications for elderly, staff and working places

Education and further training

In 2015, GAO reported on three primary approaches that have been used to address broadband adoption barriers:[13]

- Free or discounted equipment and broadband service: Broadband adoption efforts may provide computer equipment or broadband service at reduced or no cost. This approach addresses the barrier of affordability.
- Public outreach: Outreach campaigns seek to promote broadband adoption programs or improve awareness of broadband and its benefits. Outreach efforts may include partnering with community organizations, which representatives of some BTOP projects told us was an effective way to address issues of trust and relevance among lower-income populations that are sometimes suspicious of such outreach. This approach addresses the barrier of relevance.
- Training (computer or Internet use): Training may focus on basic computer skills such as operating a computer, using e-mail, and navigating the internet, or more advanced and specialized skills. This approach addresses the barrier of the lack of computer skills.

Future perspectives and reflections

Societal and political debates

Disconnect between new technologies and established regulatory structures: Technological convergence—which is a result of blending or integrating multiple technologies—can make

[10] Bernard Marr, "Why the Internet of Medical Things (IoMT) Will Start to Transform Healthcare in 2018," *Forbes*, https://www.forbes.com/sites/bernardmarr/2018/01/25/why-the-internet-of-medical-things-iomt-will-start-to-transform-healthcare-in-2018/, accessed Aug. 30, 2019.

[11] Statista, "Global Connected IoT Devices by Sector 2017 and 2018 | Statistic," https://www.statista.com/statistics/748737/worldwide-connected-iot-devices-by-sector/, accessed Aug. 30, 2019.

[12] Statista, "IoT Devices in Use by Category in US 2017 | Statistic," https://www.statista.com/statistics/757717/iot-consumer-product-installed-base-in-the-us-by-category/, accessed Aug. 30, 2019.

[13] This review was meant to illustrate these various approaches and is not comprehensive of all efforts to address broadband adoption barriers in the United States.

government regulation a challenge. This is because: (a) the one-to-one relationship between a converging technology and a regulatory entity is no longer clear, and (b) a converging technology may create a new sector where a regulatory entity has not been identified. In some cases, multiple agencies may need to regulate a single converged technology. This may increase the timelines for regulatory reviews and industry costs to meet standards and reporting requirements. Without a clear regulatory and oversight framework in place, new converged technologies may be left unregulated, partially regulated, or regulated under a newly developed framework. They could also be left to self-regulate by the industry; or they could be overlooked as governing bodies remain indeterminate on which jurisdictional boundaries need to be stretched to cover emerging technology fields.

[Lack of] Privacy: In 2019, GAO reported that the United States does not have a comprehensive Internet privacy law governing the collection, use, and sale or other disclosure of consumers' personal information.[14] At the federal level, the Federal Trade Commission (FTC) currently has the lead in overseeing Internet privacy; however, to date FTC has not issued regulations for Internet privacy other than those protecting financial privacy and the internet privacy of children, which were required by law. GAO found that there are limited privacy protections under federal law for consumer data used for marketing purposes. The scope of protections provided under current law has been narrow in relation to: (1) individuals' ability to access, control, and correct their personal data; (2) collection methods, sources, and types of consumer information collected; and (3) new technologies, such as tracking of web activity and the use of mobile devices. GAO recommended that Congress consider developing comprehensive legislation on internet privacy that would enhance consumer protections and provide flexibility to address a rapidly evolving Internet environment. Issues that should be considered include:

- which agency or agencies should oversee Internet privacy,
- what authorities an agency or agencies should have to oversee internet privacy, and
- how to balance consumers' need for Internet privacy with industry's ability to provide services and innovate.

[14] GAO, Internet Privacy: Additional Federal Authority Could Enhance Consumer Protection and Provide Flexibility, GAO-19-52 (Washington, D.C.: Jan. 15, 2019).

UK

Parliamentary Office of Science and Technology (POST), Grant Hill-Cawthorne

Elderly population

An ageing society

In November 2018, the Office for National Statistics produced their latest overview of the UK population.
[5] This noted that the UK population is ageing. In 2007, the proportion of the population that was aged 65 years or over was 15.9%. By mid-2017 this had increased to 18.2% and is projected to continue to increase to 20.7% by 2027. While improvements in life expectancy have stalled in recent years, the UK population is still living longer than ever before; a child born between 2015–2017 can expect to live 79.2 years if male and 82.9 years if female. 20.8% of newborn boys and 31.7% of newborn girls will now live to be centenarians. By 2041, the 1960s baby boomers will now be in their 70s and 80s, with an additional 8.6 million people aged 65 years and over in the UK – about the size of London.[5]

The ONS uses a metric called the old-age dependency ratio (OADR). This is the number of people of State Pension age (65 years and older) per 1000 of the working-age population (aged 16–64 years). In 2007, the OADR was 244 and this increased to 289 by mid-2017. This increase in OADR coincides with a decrease in fertility rates – from 1.87 children per woman in 2007 to 1.79 in 2016.[5] The Government has proposed to bring the increase in State Pension age (SPA) to 68 timetable forward from the previous 2044–2046 to 2037–2039.[6] Without this, the OADR by 2041 would be 419. This change in SPA will keep the OADR stable until about 2030, but without further increases it will still rise steeply after this date.

This ageing population will produce pressure on many sectors, including health and social care, transportation, pensions and housing. Some of these will be explored below.

Employment

Since the mid- to late-1990s, older male employment rates (50 years and over) have begun to increase, following a decrease due to the decline in traditional industries.[7] Employment rates for older women have increased steadily since the mid-1980s. For the past 2 years, the number of people aged 65 years and over has remained stable at around 1.2 million, the main reason given that they are not ready to stop work.

Public spending

Pensions were the largest item of welfare expenditure in 2016, with the State Pension accounting for an increase from 3.6% of GDP in 1997 to 4.6% in 2016. Forecasts for 2021–2022 predict that

people aged 21 to 65 will contribute more in tax than they consume in public spending, with this switching when over the age of 65. Contributions through taxation peak at age 45 at £24,700 per year, with the same amount in total spending reached at 85 years, and then increasing thereafter.

Healthcare

At age 65, men and women will be in good health for about half of their remaining life expectancy. As life expectancy increases, so does the amount of time that people will spend in poor health. The Health Survey for England found that 29% of 60–64 year olds had two or more chronic conditions, by 75 years this increases to about 50%.[8] Dementia is highly associated with ageing, particularly in those aged in their mid-70s and above. It is estimated that 2 million people in the UK will have dementia by 2050.[9]

Social care

Social care requirements also increase with age. About 20% of men and women aged 75–84 years have problems washing or dressing. By age 85 years, this increases to 34% of men and 42% of women. In particular, people aged 65 years and over and on low incomes are more likely to need help with activities of daily living. While they are more likely to receive help than those on higher incomes, people in the lowest income bracket have a 23% care gap – 35% need help but only 12% receive help with activities of daily living. With a real terms decrease in social care funding, much of this caring responsibility falls to informal carers, usually female family members in their 50s and 60s. Many of these people will be working and some will have children – leading to the "sandwich generation" of caregivers.[10]

Well-being

Studies between 2012–2015 have found that measures of well-being; life satisfaction, worthwhile, happiness and lack of anxiety; tend to be lowest at ages 50–55 and improve to peak at 70–74 years. However, older people are more likely to live alone than younger people, with older women more likely to live alone than older men. In addition to loneliness at home, older people are more likely to have difficulties accessing services such as GPs, hospitals, banks or post offices. While many services have moved online, more older people year-on-year are becoming digitally literate. Between 2011 and 2017 the proportion of people aged 75 years or older who had used the internet in the past 3 months doubled from 20% to 41%. While digital exclusion is likely to become less of an issue as people who use the internet in their working life age, the pace of technological advance is still outstripping uptake in older people.

Current status of the use of technology and social innovations in elderly care

The demand for, and cost of, social care is expected to rise as the number of users increase and their needs become more complex.[11] At the same time, social care is facing challenges in recruiting and retaining staff, and from reduced funding.[12, 13] For example in England, government funding

to local authorities has reduced by 49% in real terms since 2010.[14] The charity, Skills for Care, estimates that the number of staff leaving jobs in adult social care in England (both local authority and independent) increased by 8% between 2012/13 and 2017/18.[15]

There is growing interest among care providers, charities, and academics in using robotics to improve the quality of care and ease pressure on the social care system.[16, 17, 18, 19, 20, 21] New technology to support social care is expected to be a theme in the upcoming Green Paper on adult social care in England,[22] and its potential has also been highlighted by the Scottish Government,[23] the Welsh Government,[24] and in Northern Ireland.[25]

Robotics Technology

Many of the robots and robotic devices developed for social care appear to still be at the conceptual or design phase[26] and, currently, there are technical limitations to the tasks that they can undertake. For example, most struggle with certain tasks like operating in unstructured environments, and robots cannot yet match human ability to pick up and store items.[27] The 2017 Amazon Robotics Challenge event, which brought together robotic engineers to compete on a gripping robot challenge, revealed that even the most advanced machines continue to have difficulty handling items that are wrapped in plastic, are obscured, or which bend and change shape when moved.[28] The issue of how robots and robotic technology integrates or replaces existing technology and how they integrate with their environment has also been raised as a key question.[19]

This may change with increasing investment in robotics and a number of trials are already being undertaken in the social care sector.[26] According to the National Audit Office, the UK Government has invested over £300 million in RAS research since 2012.[29] The European Commission (EC) is also investing €700 million between 2014-2020 in its joint partnership with the robotics industry and academia (SPARC), which is expected to yield a total investment of €2.8 billion.[30] Using patents as a measure of innovation,[31] in 2013, the Intellectual Patent Office found a 24% increase in the publication of patents in RAS from 2011–2012, compared with a 13% increase in patent publications for all technologies. This was in excess of the overall growth in each year except 2009-2010.[32] According to the research firm CB Insights, venture capital investments more than doubled in 2017 to $587 million.[33]

Uses of Robotics in Social Care

Robotics in social care can take many forms, for example: automated vacuum cleaners, wearable devices to assist with walking, and machines that physically resemble humans or animals. While much has been written about the potential uses of such technology, the development and use of robotics in social care is still relatively new and, as yet, there is limited evidence of robotics technology being used in social care outside of some small-scale trials.[26, 34, 35] Use may increase as existing smart technologies, such as home hubs and smartphones, are used in care delivery.[26] The underpinning evidence base on robotics in social care currently suffers from a number of limitations:

- Limited focus. Most of the focus has been on how technology can aid social care for older people, and fewer studies have looked at care for children or those with lifelong learning disabilities.[26]

- Methodological weaknesses. Many studies have small sample sizes and the findings are not generalisable to other contexts.[36]
- Context specific. Many studies have been conducted in Japan,[37, 38] which has a different social care system and different cultural values around care. These factors may shape the acceptance and effectiveness of the technology in the UK.[39]
- Limited availability of technology. While some robots are commercially available (such as robot vacuum cleaners), much of this technology is being trialled and are not widely used within the social care sector.[26]
- Knowledge gaps. Few studies have explored the effects on the social care workforce or the cost-effectiveness of using robotics in social care.[40]

It has been suggested that robotics can provide three types of assistance: physical, social, and cognitive.[19, 22, 41]

Physical Assistance

Robots providing physical assistance have been developed to perform tasks such as lifting and carrying.[26] Robots have also been developed to assist with tasks like feeding,[42] washing[43] and walking, and are being developed to support physiotherapy.[44, 45, 46, 47] Prototypes of robotic toilets have also been developed that can raise, tilt, recognise the user and adjust their settings.[48] A 2018 review identified few studies that reported on the effectiveness of physically assistive robots in social care.[36] One study looking at the results of an EC funded pilot project found that physically assistive robots (such as semi-autonomous wheelchairs) helped to promote mobility and assisted with users' personal care.[49]

Social Assistance

Socially assistive robots include robots that aid daily living activities, such as those that remind users when to take their medicines, and those that detect and prevent falls.[20, 26, 50-] It can also include robots designed to provide companionship and assist with loneliness and social engagement,[51] monitor and improve well-being, and help educate preschool children.[52, 53] A pilot conducted by Hampshire County Council found that, while the Amazon Echo did not reduce the costs of care, it did result in a reduction in users' self-reported feelings of isolation and loneliness.[36] Other pilot studies on socially assistive robots that can provide reminders, monitor and provide non-physical support to assist therapy have also been conducted.[54]

Several reviews have reported positive impacts from socially assistive robots on users' mental health, like reducing users' self-reported levels of depression and agitation, and increasing self-reported quality of life. Studies have also suggested that robots can encourage social interaction between users such as care home residents.[36, 55, 56, 57, 58]Two studies have suggested robots can promote social behaviour in children with autism, although the research overall was noted to lack substantial quantitative data.[59, 60] However, one review reports that results were mixed as to the effectiveness of these robots when compared with soft toys and to the robot when it was switched off (a placebo robot).[36]

Cognitive Assistance

Robots have been developed to support people to perform cognitive tasks, such as improving users' memory and supporting people with dementia.[36, 61, 62] They have also been proposed as an alternative method for assessing cognitive skills of children with disabilities.[63] Studies use a range of different measures to demonstrate cognitive improvement, however, making comparison difficult (for example, cognitive tests, such as Mini-Mental State Examination which is used to measure cognitive impairment).[64, 65-66]

Implications for elderly, staff and working places

Cost of Social Care

Using robotics could reduce social care costs by: enabling older people to stay in their homes for longer rather than going into residential care; preventing hospitalisation through falls, illnesses, and keeping people healthier for longer; and reducing staffing costs by automating a greater number of tasks.[67] In 2018, the think tank, the Institute for Public Policy Research (IPPR) estimated that the use of robotic and other technology could improve productivity in the adult social care sector through increased automation of administrative tasks up to the value of £6 billion a year.[17] A 2014 review found that assisted living technologies (such as sensors that can monitor the health and safety of users remotely[68]) reduce costs. However, it noted the limited evidence available, much of which was deemed to be of poor quality.[69] Potential savings are weighed against the costs of introducing robotics technology.[17, 70] Robots can be expensive, which may present a barrier to their wider use in social care.[71, 72, 73] Other types of interventions that support people to live more active and healthy lifestyles may also result in savings by reducing incidences of disability and chronic health conditions amongst older people, thereby promoting independence and autonomy in later life.[74]

Quality of Care

In July 2018, the CQC rated over 80% of adult social care in England as 'good' or 'outstanding', and 18% as 'requiring improvement' or 'inadequate'. It also noted variability between geographical areas.[75] The consensus is that robots should not completely replace human care, particularly the pastoral aspects.[27, 76] Robotics may free up time for caregivers, enabling them to focus on delivering a better service for care recipients.[19, 77] However, there are concerns that the quality of social care may diminish with the use of robots, because robots are incapable of fulfilling the social or emotional needs of older care recipients, and may increase loneliness and isolation amongst this group.[26, 78, 79, 80, 81]

Social Care Workforce

Increasing the use of robotics in social care will require training for current staff to be able to work alongside the technology.[71] It may also increase jobs in other sectors, such as for those with skills in robotics, including data analysts and programmers.[82] However, this may have knock-on effects

if the social care sector is required to buy in such skills, given the potential salary differentials, raising the question about whether this outweighs any efficiencies created by the use of robotics.

Future perspectives and reflections

Challenges to the use of robotics in social care include ethical issues; such as autonomy, privacy and deception, and public attitudes; and legal and regulatory concerns. Many of these also apply to AI more widely.[83]

Ethical Issues

Ethical issues relating to the use of robots vary depending on the type of user, e.g. child, adult, caregiver; the type of robot in use; and the environment in which the robot operates, e.g. a residential care home or private home.[84, 85, 86, 87]

Autonomy, Consent and Independence

Robotics has been suggested as a way to increase users' autonomy and dignity.[19, 88, 89] However, focus groups with older people and caregivers identified concerns about: the degree to which robots could prevent people from engaging in risky behaviours like smoking; the extent that robots could make users do something if they did not wish to, like take scheduled medication; and the potential that users may become dependent on robots, undermining their ability to do things for themselves and reducing independence.[90, 91] Concerns about dependence have also been raised about the use of human caregivers.[92] It is also unclear how vulnerable social care users, such as children, may be able to give informed consent to the use of robotics.[93]

Privacy

As with other internet-enabled and recording technologies, robots that are capable of accessing the internet and recording large amounts of data raise questions over privacy and security.[94, 95] Those capable of processing personal data are subject to regulation under the EU General Data Protection Regulation (GDPR), which requires 'privacy-by-design', whereby data protection safeguards are built into technology early on.[96, 97, 98] However, this may not cover other kinds of data, such as social media activity and internet search history, which could be used to reveal information about users and those around them.[99] Robots may be seen as more objective than human caregivers, which may promote users' privacy.[100]

Security

Robots with poor security could be vulnerable to hacking, posing risks to video and voice recordings, with the potential to be controlled remotely by an attacker.[101] The vulnerabilities of NHS cyber security systems have been previously highlighted.[102] All providers with access to NHS patient information are required, annually, to demonstrate compliance with the data security and information governance requirements set out in the NHS Data Security and Protection Toolkit (DSPT).[103] As of November 2018, just over half (53%) of the 24,000 providers in England had

registered on the DSPT website and, of these, 77% had submitted the assessment, 2% had started but not submitted, and 10% had yet to start it.[104]

Bias, Deception and Infantilisation

Robotics and AI technology can have in-built biases that may reinforce stereotypes and discriminate unfairly.[105, 106] Robots designed to resemble animals or humans may deceive users, particularly vulnerable users who may not be able to distinguish the robot from a real pet or person.[58, 107, 108, 109]

Public Attitudes

Attitudes to robotics are shaped by people's previous experience and expectations and may be indicated through their attitudes to computers and related technologies more generally.[110, 111, 112, 113] Studies report mixed attitudes towards the use of robots in social care amongst users and caregivers, and it is unclear how such attitudes vary across age groups and between different types, and functions, of robots.[114, 115, 116] Research suggests that the design of robots is key to their acceptance and effectiveness.[112, 117] A project by the Isle of Wight Council suggested that, for social care, cobots were perceived more positively than robots as they were less likely to replace caregivers.[118]

Legal and Regulatory Concerns

Organisations that set regulatory standards for the design of social and care robots include the British Standards Institution (BSI) and the International Organization for Standardization (ISO), and a number of standards currently apply.[119] The EPSRC-funded UK-Robotics and Autonomous Systems Network,[19] has highlighted the need for international governance and regulation in this area, and a 2017 European Parliament report called for the creation of a European Agency for robotics to supply public authorities with technical, ethical and regulatory expertise and a voluntary ethical code of conduct.[120]

Legal and regulatory challenges include determining legal personality and determining legal liability for decisions made by robots.[86, 121, 122, 123, 124] A 2017 European Parliament report suggested that autonomous robots could be granted 'electronic personalities' to enable them to be held liable for damages.[125] However, an open letter to the EC signed by 156 AI experts from 14 European countries warned that this would be "inappropriate" from a legal and ethical perspective.[126] The diverse functions of robots may mean that robots are regulated differently. For example, robots that remind users to take medication may be classified as medical devices and regulated by the Medicines and Healthcare Products Regulatory Agency, while those processing personal data are regulated under GDPR.[127, 128] Clarifying ownership of data collected by robotics has been highlighted as an issue of concern.[129, 130] Data gathered from robots may be beneficial to roboticists in developing the technology, improving AI, and for machine learning, but this may include personal or sensitive data.[131, 132]

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