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Background Document

For the EFP European Policy Workshop on

Active and Healthy Ageing – a Long-term View up to 2050

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1 Active and Healthy Ageing – A Long-term View

In this section we discuss some general issues in relation to healthy ageing: trends in life expectancy, global economic and demographic changes that affect ageing in Europe, and finally some specific development in European countries related to ageing, labour markets, welfare systems and pensions.

1.1 Trends in Life Expectancy

“In the long run we are all dead” runs the famous quote from economist John Maynard Keynes. Or will we be still alive? Life expectancy has drastically increased until now. (Average) life expectancy at birth has risen in Europe from around 45 years in 1900¹ to 65.6 years in 1950-1955 to 75.1 years in 2005-2010 and is expected to reach 81.5 years in 2045-2050².

If more and more diseases can be successfully treated (incl. cancers and severe injuries), what will remain to kill us may be old age. And even here some researchers suggest that even ageing as such could be slowed down, that signs of ageing could be reversed (as it has been shown in some animal studies) or that the ageing process may even be stopped altogether – and with this the ultimate cause of death (cf. e.g. Nature 2010³). Areas like cancer research and regenerative medicine, for example, are also closely linked to unlocking the secret of ageing.

Europe
 Life expectancy at birth by sex (years)
 Medium variant
 1950-2050

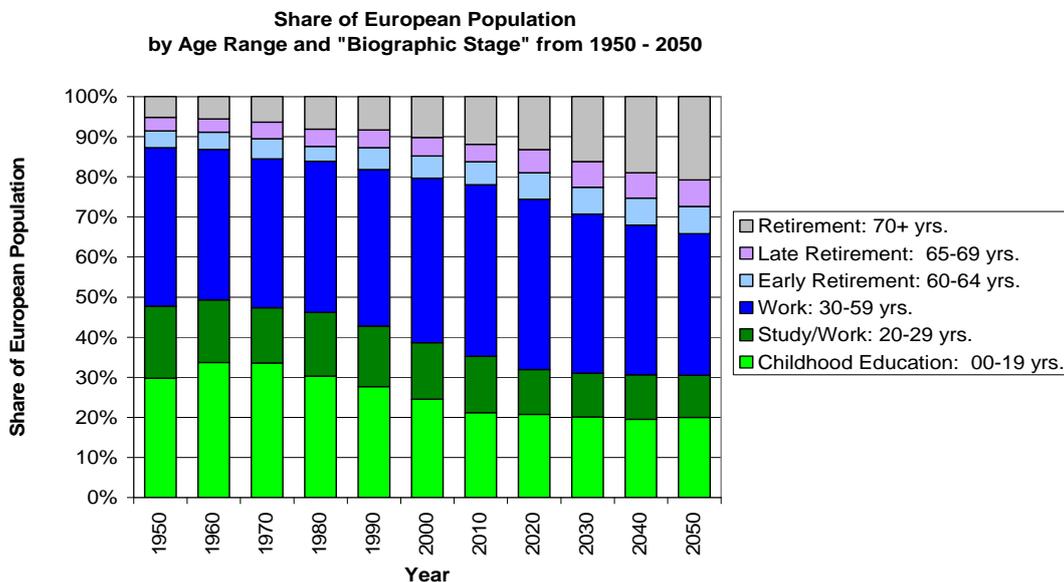
Period	Both sexes combined	Male	Female
1950-1955	65.6	63.0	68.0
1955-1960	68.0	65.2	70.6
1960-1965	69.7	66.6	72.5
1965-1970	70.4	67.0	73.5
1970-1975	70.8	67.2	74.2
1975-1980	71.2	67.3	74.9
1980-1985	71.7	67.7	75.5
1985-1990	72.8	69.0	76.5
1990-1995	72.6	68.3	76.8
1995-2000	73.1	68.9	77.3
2000-2005	73.8	69.6	78.0
2005-2010	75.1	71.1	79.1
2010-2015	76.1	72.3	79.9
2015-2020	77.1	73.5	80.7
2020-2025	78.1	74.6	81.4
2025-2030	78.9	75.6	82.1
2030-2035	79.6	76.4	82.7
2035-2040	80.2	77.1	83.3
2040-2045	80.9	77.8	83.9
2045-2050	81.5	78.5	84.5

Source: UN population statistics (2009)

¹ Data example for Germany, source: http://www.dkv.com/kunden_lebenserwartung-bevoelkerungsstruktur-demographie_63_12215_12230_85921.html

² UN population statistics <http://esa.un.org/UNPP/p2k0data.asp>

³ <http://www.nature.com/nature/journal/v469/n7328/full/nature09603.html>



Source: UN population statistics (2009)

As life expectancy increases, one needs to ask if people also remain healthier for a longer time. This question is important since failing health and age-related diseases put considerable burdens on the quality of life, economic prosperity and social security systems (financing of pensions and healthcare). But is life expectancy really increasing? Some projections even suggest that life expectancy may decrease due to lifestyle-related diseases such as those related to obesity⁴.

Other studies, however, point to a tendency of increasing life expectancy perhaps even at a faster rate.

*“Life expectancy for women in 2008 ranged between 77.0 years in **Bulgaria** and 84.9 years in **France** (in 2007), and was higher than for men in all Member States. [...]*

*In 2030, life expectancy at birth in the **EU27** is expected to rise to 85.3 years for women and 80.0 years for men, a difference of 5.3 years. [...]*

*This rise in life expectancy will be reflected by an increase in the proportion of women aged 65 and over: in 2008, a fifth (19%) of women in the **EU27** were aged 65 and over, while this share is expected to increase to a quarter (26%) in 2030.”*

Eurostat 2010 (http://epp.eurostat.ec.europa.eu/cache/ITY_PUBLIC/1-05032010-AP/EN/1-05032010-AP-EN.PDF)

⁴ <http://www.berlin-institut.org/online-handbookdemography/overweight.html> other sources



In response to the challenges of the ageing population in Europe, the European Commission has set up an innovation partnership with “[t]he overall goal of the Innovation Partnership is to increase the average healthy lifespan by two years by 2020” (cf. Dalli, 2010⁵; European Commission’s Health and Consumers DG, 2011⁶). Not only healthy ageing, but a general improvement of one’s health (e.g. in regard to lifestyle-related diseases that negatively impact people’s health in younger and older years) may become even more important in the current socio-economic settings.

Taking a long-term perspective on active and healthy ageing requires us to look beyond what the individual can do to promote his or her health and lifestyle for healthy ageing and include in the analysis a number of broader trends at international and national levels which relate to impacts associated with rising life expectancy.

1.2 Socio-Economic changes at the global level

Big changes are happening in the world which will affect the way we live and work in Europe in the future. These include the rapid rise of Asian economies, global demographic changes and growing resource scarcity. They are discussed briefly here as they determine national level context for ageing.

The 21st century marks a shift of economic and political power from the United States (US) and Europe towards the “emerging” economies of Asia. China in 2010 officially became the world’s second largest economy and is expected to overtake the USA as the world’s largest economy sometime around 2025. While there is a broad consensus that the shift of economic and political power towards Asia will have major consequences, there is wide disagreement both about the details of what exactly the Asian century will entail and about its specific consequences for Europe. Some see the growth of Asia as a threat for Europe, as economic activity moves to Asia and Europe may become more dependent on Asia. Others see the rise of Asia as a major opportunity with new markets for products and services.

A major uncertainty is that the shift of global economic weight towards Asia is occurring at a time of unprecedented demographic change. In Europe the ageing of population will soon start to have a major impact as the post World War II baby boom generation will start to retire. As the baby boom retirees outnumber new entrants in the labour market, labour shortages will increase. This is one of the reasons why there are calls to raise retirement ages and to increase labour participation by older workers (the precarious government budget situation in most European countries following the 2008/9 financial crisis is another reason). Demographic change is not limited to Europe. Japan is already an older society than Europe, Russia will be faced with a major fall in its population over the next 30 years, and even China will also soon start to experience the effects of ageing as a result of its one child policy. On the other hand countries as diverse as India and the United States, as a result of

⁵ http://ec.europa.eu/commission_2010-2014/dalli/docs/speech_ageing_en.pdf

⁶ http://ec.europa.eu/dgs/health_consumer/consumervoices/cv_12011_en.pdf



higher birth rates and immigration (in the case of the USA), will start to experience the effects of ageing at a later time and will be able to benefit longer from the demographic dividend⁷.

1.3 Socio-Economic changes in European countries

Economic and demographic changes will have a major impact on our societies. Events like the global financial crisis can put additional burden on the already stressed pension and social security systems. Growing unemployment leads to more welfare payments while at the same time fewer people are employed to pay contributions and payments like unemployment support are competing with pension payments. Also lower wages have a negative impact on pension and health care systems. Demographic changes like declining birth rates (“degreening”) also lead to a shrinking of working people being able to pay contributions for pensions, healthcare insurance and other social insurance. As some European governments are facing grave problems in regard to public finances, pensions, healthcare systems and welfare are also jeopardized.

According to Neelie Kroes Vice-President of the European Commission, “[t]oday in Europe there are still 4 people in employment for every retired person” but it is estimated that “by 2025 this will drop to 3 to 1 and by 2050 to only 2 to 1”⁸. If of those in employment a considerable share is also required to work in care for the elderly the problematic consequences for the economy and society in general are not hard to imagine.

Following the financial crisis many European economies are characterised by lower levels of economic growth, pressure on wages, and high unemployment. Social security systems are getting increasingly stressed and are at risk of entering in a vicious circle: less income, less contribution to social security systems, less tax income, more spending for welfare. If in addition, more resources need to be spent on pensions and medical care for the elderly, financing problems are getting increasingly severe as spending gets higher while incomes are being reduced.

Especially in countries with pay-as-you-go pension financing, declining birth rates have a negative effect on the system since fewer working people need to support a growing number of retirees. The problems get even more severe if unemployment is high and incomes are low. Currently there seems to be a contradicting situation where there is talk of labour shortage on one hand while at the same time youth unemployment remains a problem and healthy people in legal retirement age find it difficult to get a job if they want to continue to work⁹.

Also the need for more workers taking care of the elderly could challenge economic prosperity and growth as the number of people being active in research, development, engineering and the

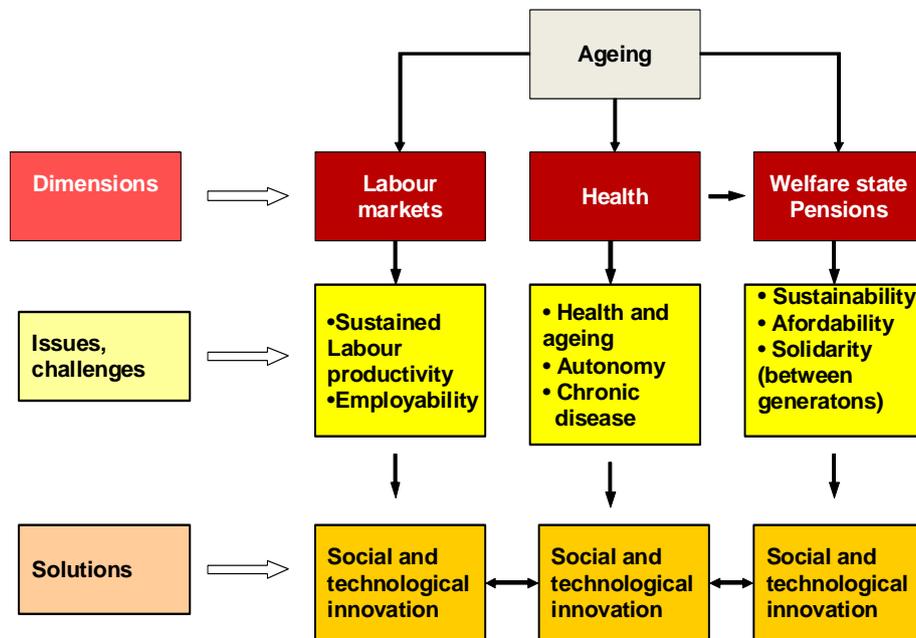
⁷ The demographic dividend refers to a population structure characterised by a large percentage of the population in the economic active age group (15-64 years) and a percentage of people in a situation dependency (younger and older citizens).

⁸ Address from Neelie Kroes Vice-President of the European Commission - AAL Forum 2010 Odense, 15 September 2010: http://www.europa-nu.nl/id/viimi743yyy9/nieuws/vice_voorzitter_van_de_europese?ctx=vhsjd8w6pdvc&start_tab0=40

⁹ http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Employment_statistics
(<http://www.urban.org/publications/412283.html>)

industry may even decline further. Immigration is considered as one solution for compensating for a shrinking labour force and filling the growing demand for care-workers. However, immigration also comes with societal challenges and recruiting nurses and care workers from developing countries could have negative impacts and lead to shortages (“brain drain”) in these regions¹⁰.

When looking at possible solutions to address problems caused by demographic changes, healthy ageing needs to be seen in a broader context as shown in the figure below. First, healthy ageing is related to developments in the labour market. Questions about the future of labour markets relate to the possibility of providing new jobs for older workers, and how to ensure that workers remain productive and enjoy work until later in life. With ageing there are also fundamental questions about the future of the welfare state and of the sustainability of pension systems, which in turn raises questions about retirement age and intergenerational solidarity.



¹⁰ <http://www.afrol.com/articles/12798>



2 Strategy and policy recommendations

Healthy ageing – or more precisely: the reduction of the amount of unhealthy life years¹¹ (regardless of life expectancy), or put differently: living disease-free as long as possible¹² – may be the only solution to ensure at the same time the sustainability of social security systems, pensions while also improving the quality of life. As many severe age-related diseases and disabilities occur in very late stages of life – after approx. 80 years – and an increasing number of people in modern societies are now surviving until this age, more people will be suffering in this regard¹³. Assuming that the maximum life expectancy of humans is fixed, it may be desirable to “cram” the diseased period into the very final years of one’s natural life time. This idea is termed “compression of morbidity”, i.e. raising the average age at first infirmity resulting in a shortening of an age-related diseased life span (cf. James Fries, 2005¹⁴) under assumption of no increases in human maximum (and average) life expectancy. This question in how far this could be achieved is still unclear and requires further scientific evaluation, e.g. with the help of medical, statistical analysis and (bio)gerontology studies.

Tackling the issue of healthy ageing and developing policy strategies depends on several factors which also include scientific facts as well as individual lifestyle choices and economic circumstances that are generally related to health but also touch on issues like personal freedom.

Some key questions that also relate to the goal of the innovation partnership with “[t]o increase the average healthy lifespan by two years by 2020”¹⁵ refer to the feasibility of this objective and the assessment of pathways for potential achievement as well as socio-economic implications if this goal may be reached or not.

What is exactly meant by the goal of “increasing the average healthy lifespan by two years”?

This goal is only viable if it implies the “compression of morbidity” or the shortening of unhealthy life years by two (or more?). As most people also wish for a long life if good health can be maintained, the question could also be asked in how far strategies for “compressing morbidity” may also be related to increasing the healthy life span (healthy life expectancy) as such. Would this also be desirable, or only under certain circumstances (e.g. if achieved with minimal technical intervention)? And should the vision stay with two years or should we strive for going even beyond? Currently, however, it is still unclear how to reliably achieve healthy ageing on a greater scale and what kind of science and developments as well as priority settings in R&D may be necessary?

¹¹ This reflects what is often referred to as “compression of morbidity” (cf. Fries, 2005), i.e. that the amount of years with age-related illness/disability would be compressed into a shorter time period (e.g. from 6 years with such disease/illness/disability to 3 years).

¹² Cf. Crimmins/Beltrán-Sánchez, 2010

(<http://psychogerontology.oxfordjournals.org/content/early/2010/12/06/geronb.gbq088.full>)

¹³ Cf. Freie Universitaet Berlin (<http://www.elfenbeinturm.net/archiv/2004/01.html>)

¹⁴ <http://www.milbank.org/quarterly/830427fries.pdf>

¹⁵ http://ec.europa.eu/dgs/health_consumer/consumerveice/cv_12011_en.pdf



Which products and services could contribute to better and healthier ageing and how can industries contribute to this goal?

In how far can “healthy ageing” or a “compression of morbidity” be achieved and what may it depend on?

Lifestyle-choices are often mentioned as an important and sufficiently proven factor for better general health and healthy ageing. Such choices include refraining from smoking, moderation in alcohol consumption and a balanced, healthy nutrition. But also socio-psychological factors like stress reduction, mental and physical activity and societal integration have positive impacts. In this sense, industries, employers as well as individuals will be responsible for enabling healthier living and ageing. But in how far can we expect people to comply with suggestions for healthy lifestyles in a society that values personal freedom?

Also biological and genetic dispositions are thought to impact the quality of ageing as well as the disposition to some health conditions (e.g. weight gain¹⁶) that could have some general impacts on healthy ageing. Here, however more research and scientific clarity is needed. More (interdisciplinary) research is needed to gain further important insights from biological¹⁷, medical¹⁸, sociological¹⁹, behavioural²⁰ and psychological perspectives²¹.

Advances in medicine and technology have certainly led to the current situation of a rising life expectancy, but they are also causing rising costs. Modern medicine manages to keep people alive for a longer time, but not necessarily contributes to significantly improving the quality of this life. In the US for example, the last years or even months in life are often the most expensive²². This raises the question about what medicine can and should do and where reforms may be considered and where priorities should be set.

What would the implication be if two more healthy years could be added to life?

If the envisioned goal of “increasing the average healthy lifespan by two years” would be achieved indeed, changes in regard to the job market and insurance systems may be needed in order to take full advantage of the improved situation. If people, for example, are able to remain longer employed due to better health, a sufficient number of suitable jobs needs to be created and people need to be given the incentive to remain economically active for a longer time. As older people may remain longer within the workforce, younger generations should not get disadvantaged by this. The direction of the ageing situation (healthy vs. unhealthy) thus greatly impacts the future of health care, pension and social security financing.

¹⁶ <http://www.healthy-ageing.nl/index.cfm?p=A5F1A8D4-9932-697B-2737C3B87D0A06CE>

¹⁷ E.g. biogerontology, biological studies about ageing

¹⁸ E.g. tackling age-related diseases

¹⁹ E.g. in relation to social integration, economic situations, care etc.

²⁰ E.g. lifestyle choices

²¹ E.g. wellbeing, social contacts, the role of spirituality etc.

²² <http://www.kaiserhealthnews.org/Stories/2010/March/09/fiscal-times-end-of-life.aspx>

What would be if the goal is not achievable?

If healthy ageing may not be achievable, ways need to be found – even more seriously and pressingly – how to deal with challenges like rising health care costs, financing of pensions, workforce decline and shortages in care personnel. In this sense one can not solely rely on the assumption that science, technology and lifestyle-changes will necessarily lead to the envisioned improvements.

2.1 Suggestions to address the “Ageing Challenge”

The following sections will sketch out some examples for potential “interrelations” in regard to different suggestions for decision-making which reflect that policy options and societal decisions are dependent on the given physical and economic realities as well as scientific and technological feasibilities. Raising the retirement age, for example, may not be a viable option if people’s health is already failing considerably at this time. Suggestions for making care-related work more attractive may be difficult if financial constraints persist. Improvements in health and medical technologies may only be of limited use if costs are far too high, and even the desire for improving people’s health in general, may conflict with a human’s freedom of choice and anti-discrimination.

2.1.1 Raising retirement age depends on prospects of health of the elderly

Life expectancy has been increasing especially for older people. The graph below shows life expectancy at the age of 65 years, which has been increasing at the rate of about one year of extra life per decade. This would in general call for linking retirement age to life expectancy.



If, on the other hand, a “compression of morbidity” is not possible and there may be no strategies against deteriorating health (for example in the case of workers with a history of physical work), raising the retirement age would not make much sense since people would not be able to work much longer anyway and may also consider it to be their right to enjoy a couple of work-free (retired) years within still acceptable health conditions. Especially dementia could be a considerable

problem as it severely affects the ability of economic contribution and requires large amounts of care and financial spending.

Priority setting in strategies for curing age-related diseases and disabilities

Tackling major disabling age-related diseases such as dementia and severe physical deterioration could enable people to stay active for a longer time. Here it needs to be assessed which age-related diseases are considered to be the most severe and disabling and which age-related diseases could be medically tackled easier and have higher prospects for success in finding potential cures. So the question arises in which area of R&D to invest. It could be argued that mental disability would deprive a person more from being socio-economically active than (certain kinds) of physical disability (e.g. being unable to walk).

2.1.2 Healthy ageing requires socio-economic adaptations

If healthy ageing would be possible indeed, changes in regard to the retirement age need to be implemented, whereas then, however, there also need to be enough jobs for the elderly. As unemployment (or low incomes) – especially youth unemployment may prevail – generational conflicts could be the result and financial burdens may only be shifted instead of being resolved.

2.1.3 Compression of morbidity raises questions about healthy life extension controversies

If a “compression of morbidity” is possible, it depends on the biological/medical circumstances of this achievement and the question if the strategy is also associated with an increase in maximum and average life expectancy. If different strategies may be feasible in this regard, decisions may need to be made if an increase in maximum/average life expectancy would be a desirable solution or not. In general, healthy life extension as a goal in itself is currently looked upon with controversy within many European countries.

2.1.4 If ageing would be considered as a disease new legal implications would arise

Looking at the disabling effects of age-related diseases and failing health for the individual (decrease in quality of life) and society (investments of time, money and human resources for elderly care) the question may even rise if ageing as such should be considered as a disease²³ as the disabling effects are causally related to becoming older²⁴. If ageing would, however, indeed be considered as a disease, it may have considerable impacts on the medical system and research and development (incl. legal issues for the development of “anti-ageing” medications²⁵).

²³ <http://www.reuters.com/article/idUSTRE64I6HV20100520>

²⁴ In the same way as the disabling effects of a sore throat are causally related to having a cold. If age-related disease symptoms show in young people, they are considered as a disease (Progeria).

²⁵ Drugs can only be developed for a specific disease (indication). Since currently ageing as such is not considered to be a disease, no drugs can be developed that may specifically tackle the ageing process/ageing as such.



2.1.5 If nothing can be done about age-related health problems, how can we balance efficiency with good care?

If nothing can be done to improve the health situation of 'average' aged people, the focus indeed needs to shift more towards improving care for the elderly, but also on the financial aspects of these requirements. This could lead to a delicate balancing of improving efficiency in care (e.g. through technological solutions such as tele-health, telemedicine, care robots etc.) and the desire for the human factor of care and "ageing in dignity".

2.1.6 Should we strive for an overall improvement in health?

Finally, the problem may actually not even rest in the challenge of ageing and tackling age related diseases but in the requirements for general improvements in health throughout the whole society. As some projections suggest in relation to lifestyle-related diseases (e.g. associated with obesity), failing health in younger years can be as burdensome (or possibly even more burdensome) as failing health in old age. If, however the call for general improvements in health gets louder, new social and ethical considerations may arise, e.g. in relation to personal freedom of choice (e.g. choices for an unhealthy/risky lifestyle), potential discrimination of unhealthy people or those (genetically) more prone to disease, solidarity in regard to welfare etc.

If an overall improvement in individual's health would be considered generally desirable for society, many different actors will be involved with regards to prevention, e.g. the food and beverage industry, workplaces, general industrial production, parents and teachers, medical professionals and many others.



3 Major Challenges with Ageing

Although a long life is generally regarded as something good – and at first glance these developments look positive – they also come with huge challenges. These challenges basically have to do with the health related problems that become increasingly probable to occur with the progressing of ageing. Physical frailness and especially cognitive decline and dementia (e.g. Alzheimer's disease) are the greatest issues since they lead to an inability of the affected person to perform productive work as well as the requirement for care-giving. Especially dementia is a large problem within the so-called knowledge society, where knowledge and mental capacities are the main resources for economic growth. Whereas physical disabilities (e.g. physical frailness, inability to walk etc.) can be compensated quite well with modern technology, cognitive decline cannot.

According to the World Alzheimer's Report 2010, "[t]he total estimated worldwide costs of dementia are US\$604 billion in 2010" and that the current (2010) number of "worldwide 35.6 million people living with dementia" could increase to "65.7 million by 2030 and 115.4 million by 2050"²⁶. People suffering with dementia can have a life expectancy with the disease up to 10 years²⁷.

"If dementia care were a country, it would be the world's 18th largest economy, ranking between Turkey and Indonesia. If it were a company, it would be the world's largest by annual revenue exceeding Wal-Mart (US\$414 billion) and Exxon Mobil (US\$311 billion)".

World Alzheimer Report, 2010

<http://www.alz.co.uk/research/files/WorldAlzheimerReport2010.pdf>

This puts a socio-economic strain on social insurance systems, health costs and leads to personnel shortages of care givers or prevents relatives from being able to be otherwise economically active because they are needed to provide care.

The following points could summarize the problem, especially from the perspective of socio-economic challenges:

- Increase in population share of elderly people who are alive for a longer time who:
 - are physically and/or mentally unable to work or actively participate in social life (reduction in quality of life)
 - who are physically and/or mentally unable to work and require care
 - who are retiring early although they would be able to be active in insurable employment

²⁶ <http://www.alz.co.uk/research/files/WorldAlzheimerReport2010.pdf>

²⁷ http://alzheimers.org.uk/site/scripts/documents_info.php?documentID=101



- Increase of health and pension expenditures due to:
 - an increase of people eligible for receiving pensions
 - growing health costs due to increasing health problems with higher age
 - increase in need for care (need for more personnel, facilities, medication)
 - progress in medical technologies that lead to higher medical expenses

- Decrease in share of population who is able to finance the pensions and health/care costs for these elderly people due to:
 - declining birth rates (less younger people)
 - early retirement of people who would be able to be active in insurable employment
 - elderly people seeking a job often have difficulties in finding one (ageism²⁸)
 - relatives who have to quit their regular work in order to care for elderly people
 - possibly lower wages (e.g. if young immigrants who could compensate for declining birth rates have lower paying jobs)
 - emigration of highly qualified and wealthy people to countries outside Europe/EU27 (decline in income from taxes and social insurance contributions)
 - economic crisis and unemployment can worsen the situation

Additionally, there are also other second-order issues that could arise within the context of unhealthy ageing (i.e. prolonged period of age-related disease/illness/disability). One could be organ shortage within the context of transplantation medicine, especially in regard to the effort of preventing more accidents due to improved safety technologies and general medical progress that increases the survivability rate (of younger people).

The ageing issue and the related socio-economic strain also bring in new socio-ethical controversies such as euthanasia and the topic of high end-of-life costs at least in the US, where the last 6 months of life seem to be the most expensive with a rising tendency²⁹. In Europe, this problem seems to be comparatively less serious. However it also needs to be asked what is actually driving medical costs and in how far cost-reductions would be economically feasible and socially and ethically acceptable?

A decline in religiosity could also contribute to an increase in related problems since religious institutions often perform care activities for free or low costs out of altruistic/religious motivation.

However, ageing does not necessarily equal bed-ridden, demented, frail and unproductive. There are also examples of people who have remained active and considerably healthy throughout their long life. Observations also suggest that people who live very long (up to 90 and beyond) generally seem to be healthier than those elderly who died younger and also die from other diseases and complications³⁰. This phenomenon may require further in depth scientific analysis since the question

²⁸ <http://forums.ec.europa.eu/debateeurope/viewtopic.php?p=204285&sid=abd883e717ef52c341810c5bc9f9c9a7>

²⁹ <http://www.reuters.com/article/idUSTRE69C3KY20101014>

³⁰ http://news.bbc.co.uk/2/hi/uk_news/magazine/6587309.stm



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about what distinguishes healthy agers from unhealthy agers (e.g. in regard to lifestyle, personal circumstances and biological/metabolic/genetic factors) may hold a key to healthy ageing strategies.

Currently, reliable strategies for “healthy ageing” in the sense of increasing the share of healthy years in old age or respectively decreasing/compressing the number of years with age-related disease/illness/disability are not available. However, it is suggested that certain especially lifestyle-related practices like eating habits, physical and mental activity etc. can contribute to general health improvements. In face of challenges to pension, health and social insurance systems, the “Ageing Society” has already become an important topic which led to proposals for changes in pensions, retirement age, nursing, care and health insurance.



4 Suggestions for tackling the “Ageing Challenge”

Many suggestions have already been made in order to tackle this growing challenge. The first section will deal with socio-economic suggestions while the latter part will focus on scientific and technological solutions.

4.1 Socio-economic suggestions – pensions and employment

4.1.1 Raising the retirement age

Most European countries have already raised the retirement age or perform deductions from pension payments in case of early retirement. Some countries also consider(ed) a reduction in pension payment or at least a freezing of raises. Both suggestions, however, have caused and are causing resistance from large parts of society. Also raises in retirement age are not suitable for some jobs, especially those that require physical activity (e.g. building and construction)³¹. Increasing the retirement age as such may also be no solution if age-related health problems are prevailing. If the retirement age is being increased, it also needs to be ensured that there are enough jobs available for elderly people.

Policy challenges:

- Older people still have more problems in finding a job, although the situation has improved³², but unemployed older workers still face difficulties³³.
- How to create jobs for the elderly in face of considerable unemployment rates of younger people?³⁴
- Is early retirement contradicting the goal of raises in retirement age?
- In how far are people able (and willing) to work longer? For people to stay longer in employment they need to be able to do so (sufficiently healthy) and from an individual perspective have the prospect of still enjoying a sufficiently long healthy time in retirement.
- What would a “compression of morbidity” mean in case of later retirement from a social/ethical perspective (i.e. people working as long as they are healthy and retire only when they start getting ill due to old age-related complications?)

³¹ Time online: <http://www.time.com/time/business/article/0,8599,2002296,00.html> and refer to the latest protests in France upon the proposal to raise the retirement age from 60 to 62 (http://www.eurofound.europa.eu/eiro/2010/07/articles/fr1007021i.htm?utm_source=France&utm_medium=RSS&utm_campaign=RSS)

³² The EU-27 employment rate for older workers (aged between 55 and 64) reached 46.0 % in 2009, compared with 45.6 % in 2008 (source: Eurostat http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Employment_statistics)

³³ According to research by the Urban Institute (US) “[w]orkers in that age group who have lost their jobs in the recession are one-third less likely to find new work than their counterparts age 25 to 34. And workers over age 62 were half as likely to be re-employed” (<http://www.urban.org/publications/412283.html>)

³⁴ “Rises in youth unemployment in the EU also continued to ease in January. Unemployment for this age group expanded by a modest 22 000 (or 0.4 %) to 5.5 million, with the unemployment rate for youth increasing by a mere 0.1 pps to 20.9 %. Nevertheless, even if the rises in the youth unemployment rate have weakened recently, they are still higher than the recent more limited increases in the rate for adults, which stabilised in January.” (source: http://ec.europa.eu/youth/news/news1724_en.htm)



- If birth rates are declining, fewer resources need to be spent on children – in how far could this compensate for the increase in older people?

4.1.2 Jobs for the elderly

If a raise of the retirement age is considered desirable, it needs to be made sure that there are enough and suitable jobs available for an ageing workforce. In some areas, especially which involve physical abilities, workplace-adjustments may need to be implemented.

Some companies, e.g. BMW³⁵ have developed schemes to better integrate older workers and keep them longer within their workforce, which sometimes also requires redesigns in the work environment (e.g. the installation of chairs and magnifying glasses as shown in the example cf. footnote) or the creation of new activities more suited for elderly people.

There could also be the possibility to actively create jobs for elderly people and utilise their competencies. Both practices are however especially difficult in case of cognitive decline and dementia and challenging for people with considerable age-related physical disabilities/health problems.

Policy challenges:

- Creating incentives to keep and employ older workers
- Support for retraining, re-skilling and life-long-learning
- In how far should governments be involved or in how far should employment decisions be left to the market?
- Should different insurance schemes be implemented for elderly workers?
- Improvement of the (social) integration of older workers and the prevention of “ageism” (discrimination due to age)
- How to balance the goal of reducing unemployment of younger people with keeping older people employed for a longer period?
- Healthy ageing is a precondition to longer work-life – how can this be achieved?

4.1.3 Changes in social security schemes

Some countries also have changed their social security financing schemes, either by more emphasizing the need for additional private insurance and pension savings or by raising contributions to social insurance (health, pension) or taxes. All suggestions, however, are criticised by employers who are confronted with higher financial burdens and higher personnel costs (which could challenge price competitiveness) or employees who need to pay more for insurances and have less net income available. Especially current young generations may be double-burdened since they still need to finance the pensions for current retirees but are also required to take care of their own future pensions to a considerable extend. According to projections, by 2025 there will only be 3 people employed for every retired person as compared to 4 employed people in 2010, a situation

³⁵ <http://www.zdf.de/ZDFmediathek/beitrag/video/1011306/Arbeitsmarkt-Fit-fuer-den-Job-im-Alter#/beitrag/video/1011306/Arbeitsmarkt-Fit-fuer-den-Job-im-Alter> and cf.: <http://www.eurofound.europa.eu/areas/populationandsociety/cases/de020.htm>



that is expected to decrease to 2 employees per retiree in 2050³⁶. This situation which is the result from a combination of higher life expectancy and declining birth rates puts stress on the financing situation of pensions. Even more challenges will arise if unemployment figures are high or overall income is low. Immigration is also considered as an option to compensate for the declining birth rate, but this also comes with challenges since most immigrants are likely to come from non-European countries which may impose additional cultural problems.

Policy challenges:

- How should the financial burden be distributed? (Sharing the burden between young and old)
- Is there a pension guarantee also for future generations?
- How to enable and motivate the current generation of young people to save for their pensions? (May also require related education and reliable support and information providing³⁷).
- How can people improve their financial situation for medical costs during retirement?
- Assessment of economic effects related to social security, insurances and pensions in view of income and the creation of jobs
- How to improve immigration policy and balance integration of migrants with cultural diversity?
- Could there be the danger of a growing divide between rich and poor people in regard to health-care, pensions and living standards after retirement? And if so, how can this be avoided?

4.2 Socio-economic suggestions – care-taking and care

4.2.1 Relatives as caretakers

If the current trends in ageing patterns continue, a severe shortage in care-workers for the elderly is expected as “By 2020 there will be a shortage of approximately 1,000,000 healthcare workers in the EU”³⁸. Thus it is suggested that relatives should get more involved in care-taking³⁹. This could, however, prevent people from being active in (higher paying) insurable employment. If the cases are severe (especially with dementia or severe disability), non-professional relatives may not be able to cope with the situation and may need to seek professional assistance. According to a 2009 Eurobarometer survey “[t]wo-thirds of Europeans feel that people who care for elderly relatives are let down by social services”⁴⁰. Taking care of ageing relatives can also be a physical and psychological challenge and may have negative effects on family life (mothers may thus be responsible for taking care of their parents as well as their own family/children). The situation may get more problematic as the number of life years in dependency of care may increase.

³⁶ Address from Neelie Kroes Vice-President of the European Commission - AAL Forum 2010 Odense, 15 September 2010: http://www.europa-nu.nl/id/viimi743yyy9/nieuws/vice_voorzitter_van_de_europese?ctx=vhsjd8w6pdvc&start_tab0=40

³⁷ <http://www.moneyobserver.com/news/10-10-26/young-people-need-change-their-attitude-towards-retirement-saving>

³⁸ http://ec.europa.eu/health-eu/newsletter/54/newsletter_en.htm

³⁹ <http://www.eurofound.europa.eu/areas/populationandsociety/family.htm>

⁴⁰ <http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/09/206&type=HTML>



Policy challenges:

- In how far should family care-taking be supported by the government, e.g. financially or through professional support?
- Better support for people who are taking care of ageing (or disabled/permanently ill) relatives through social services (incl. e.g. better support for child day care etc.)
- Training and qualification of family care-takers
- Tackling financial issues related to taking care of relatives (lacking time for regular employment, lacking income, financial needs for care-taking)

4.2.2 Elderly taking care of the even older people

Another suggestion that is already being discussed (and possibly practiced) is the concept of elderly taking care of other (even more) elderly⁴¹. This could decrease the need for additional care personnel as well as nursing costs, whereas here, professional supervision is likely needed, but to a lesser extent. This could also create the opportunity for activities for retired/elderly people or even create new jobs for them.

One model that is for example provided in Hogewey/the Netherlands is that of community living of elderly people, in case of Hogewey even people with dementia⁴². Here demented elderly are living together and are assisting each other within a home-like environment with the supervision of professional caregivers.

Policy challenges:

- Regulatory issues and support
- In how far should governments be involved in supporting/setting up required structures and networks or should this be left to the market and social initiatives?
- Should institutions that provide such care structures get some benefits (e.g. in regard to taxation etc.)?

4.2.3 Nursing homes

The classic model is nursing homes, whereas here personnel shortages seem to be a problem which also affects the quality of care. Here also increases in patients as well as constraints in budgets and personnel (or decreasing affordability) are issues. Community living as it is provided in the example of Hogewey (cf. above) could provide a new model for improvement in quality of life, whereas cost considerations may play a (restricting) role.

Policy challenges:

- Who should be in charge of quality control in nursing homes?
- Improvements in possibilities for hiring and training foreign care-takers/nurses and accept foreign certificates
- Financing of nursing-home care

⁴¹ http://www.associatedcontent.com/article/336779/seniors_caring_for_seniors_pros_and.html?cat=12

⁴² <http://www.zdf.de/ZDFmediathek/beitrag/video/1011306/Arbeitsmarkt-Fit-fuer-den-Job-im-Alter#/beitrag/video/1139064/Alzheimersiedlung-in-den-Niederlanden> and <http://www.vivium.nl/index.php?p=271>



- Balancing economic considerations and rationalisation with the wish for good and humane care
- Implications for the economy if more and more people are needed in the nursing profession

4.2.4 Immigrants for healthcare

The Philippines, India and Cuba, for example, have already discovered the need for care personnel in Europe and other (post) industrialised countries where the ageing society is rapidly causing a challenge. Thus, the Philippines (and other alike countries) are already training people as care workers for the elderly who will then emigrate to Europe or elsewhere to work there in elderly care either at home or in care facilities⁴³.

Policy challenges:

- Adaptation/improvement of immigration policy
- Training and certification as well as acknowledging foreign certificates and diplomas
- Negative effects of migrating medical personnel from developing/emerging countries for their home countries and their domestic development

4.2.5 Retirees going abroad

Other countries, e.g. Thailand⁴⁴, are actively advertising for retirees to go abroad (e.g. to South East Asia) in order to receive an affordable retirement life and care. However a number of elderly actually would like to stay within the place they live for a long time – or at least remain in their country. Cultural aspects could here also be a hindering point.

Policy challenges:

- Issues regarding visas, insurance, registrations etc.
- Funeral regulations (transfer after death to home country etc.)

4.2.6 Palliative care, dying in dignity and euthanasia

Palliative care does not focus on curing a disease (because it is incurable with today's methods) but on reducing the symptoms and suffering and improving the quality of life of the diseased. Especially in regard to the high costs in end-of-life care and possibly "unnecessary" prolongation of life in suffering (e.g. 'dying in the sterile environment of a hospital with machines instead of friends and family') without hope for improvement, palliative medicine and care gets increasing attention. Pain management as one central element in palliative care has only recently got more attention in research and development and hospital practice, but still needs improvement in many cases⁴⁵.

Palliative care is also related to a certain view about death as a natural process, but also closely related to the controversial topic of euthanasia. Euthanasia is a taboo topic within most countries,

⁴³ <http://www.migrationinformation.org/feature/display.cfm?ID=271>

⁴⁴ http://internationalliving.com/2009/02/chiang_mai/

⁴⁵ <http://www.bbc.co.uk/news/health-11728163>



but discussions are growing, especially within the general public and among ethicists⁴⁶. One major aspect that is frequently mentioned in this context are high end-of-life costs (especially in the US, to a lesser extent in Europe) as well as the bad quality of life for some people who spend their last days in intensive care units at hospitals.

"In 2002, The [Netherlands](#) legalized euthanasia including physician assisted suicide. The law codified a twenty year old convention of not prosecuting doctors who have committed euthanasia in very specific cases, under very specific circumstances. The [Ministry of Public Health, Wellbeing and Sports](#) claims that this practice "allows a person to end their life in dignity after having received every available type of palliative care."

Dutch Ministry of Health, Welfare and Sports (<http://english.minvws.nl/en/themes/euthanasia/>)

But the question about dying in dignity – which also contains the question about euthanasia – is becoming an important topic⁴⁷. It is not only about what is considered as “active euthanasia” (still a very taboo topic) but about the question what kind of treatment (or discontinuation of treatment) should be provided under which circumstances and where should a person spend the last days of one's life.

As a side effect, these considerations have also spurred the discussions about the definition of death (which is far from clear and far from being defined in a unified and biologically sound way), which also affects the issue of organ transplantation, coma patients, the possibility of measuring brain death, the reversibility of some signs of death due to modern technology (e.g. resuscitation)⁴⁸ and has called for more scientific research about the process of dying (thanatology)⁴⁹. This, in turn also encouraged the (biological) science about the process of ageing (biogerontology)⁵⁰.

Another related – but a bit less controversial – suggestion is about “compressing” (i.e. reducing) the unhealthy years at the end of one's life (cf. e.g. James Fries⁵¹).

Policy challenges:

- Taboo topic
- Legal challenges within EU countries (euthanasia is considered illegal)
- Can end-of-life medical costs be reduced in an ethically acceptable manner?
- Ethical concerns
- Prevention of misuse
- Issues regarding the right for self-determination
- Conflict between self-determination of patients and ethical standards/practices within medicine

⁴⁶ <http://www.futureagenda.org/?p=944> and <http://ccforum.com/inpress/cc3894>

⁴⁷ E.g. <http://www.medscape.com/viewarticle/719493> and <http://www.scottish.parliament.uk/business/bills/pdfs/mb-consultations/Dying%20with%20Dignity%20Consultation%20paper.pdf>

⁴⁸ <http://ccforum.com/inpress/cc3894>

⁴⁹ http://en.wikipedia.org/wiki/School:Mortuary_science_and_thanatology

⁵⁰ <http://www.bg-rf.org.uk/news/press20090821.html>

⁵¹ <http://www.milbank.org/quarterly/830427fries.pdf>

- Diverging definitions (e.g. of death) and medical practices (e.g. when to start an intervention and when not)
- There could be a thin line between “compression of morbidity” and discussions about euthanasia which may cause socio-political controversies.

4.2.7 Lifestyle

In general, lifestyle choices and practices like good nutrition, physical activity (jogging, yoga, swimming etc.), preventing obesity, mental activity (e.g. through mental training and practice but also by keeping a wide spectrum of interests etc.), well-being (stress reduction, meditation etc.) as well as moderation of alcohol consumption and no smoking and the avoidance of toxic and cancer-causing substances are considered to contribute to a generally healthier lifestyle and thus also to healthier ageing.

There is also a variety of dietary and lifestyle-related suggestions for fostering healthy ageing, i.e. trying to prevent or minimize the negative side effects of ageing and age-related diseases. Physical and mental activity, yoga and meditation as well as balanced and healthy diet with fewer calories (e.g. Okinawa diet or (CRON) caloric restriction⁵²) are being suggested. Research suggests, however, that many factors – genetic, biological and life-style related – are coming together to influence the trajectory of one’s ageing path: healthy vs. unhealthy.

There is also growing interest in finding pharmacological solutions for preventing, slowing down or countering/reversing cognitive decline, especially in the elderly. Many, often natural substances like ginseng or ginkgo biloba and foods like berries and red wine are suggested to have positive effects in this regard, whereas many of them are scientifically unproven, disputed or even disproved (as in the case of ginkgo⁵³ and recently in regard to resveratrol⁵⁴).

There is also research being conducted in regard to the effect of so-called nootropics (e.g. Ritalin, Modafinil and others), i.e. medication that can positively influence cognitive abilities like concentration and wakefulness on elderly and demented patients.

Here the question arises, who should be responsible and how to provide incentives for favourable healthy lifestyles with potential positive effect on healthy ageing? How much self-responsibility should individuals take and how much responsibility should be taken up by industries, e.g. the food industry or producers of consumer goods (e.g. in regard to toxicity, ergonomics etc.)? Which incentives and rewards should be given for adhering to a healthy lifestyle (e.g. in regard to insurance schemes) and who assesses reliably which lifestyles, products and activities are really beneficial for one’s health and healthy ageing? If looking at the large amount of products that are marketed to be allegedly beneficial for health and disease prevention (incl. “anti-ageing”), it is doubtful if the consumer can make informed choices and distinguish between reliable information and fraud.

⁵² E.g. CRON diet, cf. also: http://cordis.europa.eu/fetch?CALLER=EN_NEWS&ACTION=D&RCN=31993

⁵³ <http://www.medscape.com/viewarticle/714476>

⁵⁴ <http://www.sens.org/node/1759>



Policy challenges:

- In how far would incentives for healthier lifestyles conflict with a person's freedom to choose?
- How to provide incentives for industries to produce products more beneficial for health and how to (scientifically and objectively) assess such claims?
- Should the development of products with the aim of being beneficial for healthy ageing be supported by governments and public moneys?
- What kind of research and definitions of "ageing" are necessary to develop respective products?
- How to ensure equal access to beneficial products?
- How should access and availability be financed?
- More focus on preventative measures?
- How to avoid lifestyle-related diseases such as obesity-related problems and who is responsible for their occurrence/avoidance (individuals, industries, public health?)
- Regulations on medicine and drugs

4.3 Technological suggestions

4.3.1 Assisting technologies for the elderly

Researchers and industries are already developing technologies that can be used for assisting elderly people in better performing their day to day activities in a (maximal) independent manner. Suggestions range from intelligent household devices (incl. sensors, cameras, communication systems and home automation) over tele-health and health monitoring devices (incl. intelligent clothing) to care robots. Such technologies can mostly assist in performing routine (physical) tasks (e.g. mobility assistance, fetching objects, doing errands), monitoring activities to improve safety (household appliances, intake of medicine and food etc.), monitor vital signs to alert medical personnel in case of emergencies and remind of schedules and assist in some administrative tasks (e.g. managing doctor's appointments, reminding of payments etc.)⁵⁵.

The current stand of technology and Artificial Intelligence is still not advanced enough to perform sufficiently reliable tasks autonomously in cases of higher care needs or in case of demented patients. Also interfacing still seems to remain a challenge since elderly people often have declined motor skills (e.g. for using keyboards), speech and hearing difficulties (in regard to giving commands and hearing instructions from the system), declined vision (reading texts and instructions) and strength and/or reaction time/mental alertness (to manage the machinery in case of accidents/malfunction). Improvement in autonomous systems performance requires interdisciplinary research⁵⁶.

There also arise ethical as well as legal issues in regard to (semi-) autonomous machines in the area of care-giving.

⁵⁵ The TNO report "Robotics for Healthcare" provides a substantial overview about latest and envisioned developments: http://www.tno.nl/downloads/TNOKvL_report_RoboticsforHealthcare1.pdf

⁵⁶ Cf. e.g. http://robotics.usc.edu/~tapus/publications/tapus_RAM2007.pdf



Policy challenges:

- Necessary regulatory issues and changes (standards, safety/safety certificates, building regulations etc.)
- Addressing liability questions in regard to autonomous systems (e.g. care-robots)
- Who should provide the communication and security infrastructure (e.g. in regard to tele-health)?
- New job requirements (e.g. in regard to tele-health applications)
- What kind of R&D is necessary to improve such support systems, where to invest, how to train people and how to get the needed human resources (e.g. engineers etc.)?
- Implementation of infrastructures more suitable for the elderly (ramps, size of letters on signs, visual and acoustic support etc.); who should be responsible for the implementation and financing?

4.3.2 Assisting technologies for caregivers

Another line of technologies is rather designed in order to assist the helpers, especially in regard to errands (fetching and bringing things) as well as activities that require physical strength (e.g. lifting patients). Lifters, automated beds, robots for performing errands (e.g. bringing food, water and medication) and even so-called exoskeletons belong to the line of innovations. Physical assistance seems to be of relevancy, especially since a considerable share of care-workers is women. However, also here, technical challenges in regard to reliability, safety and hygiene (especially in case of exoskeletons and mobile robots) remain⁵⁷.

Policy challenges:

- Financing and financial support?
- Reliability issues
- Attracting more males for care-taking professions?
- Acceptance of new technologies by caregivers

4.4 Medical suggestions

4.4.1 Neuroscience

Much R&D activities are being conducted in order to tackle major disabling diseases and conditions associated with ageing, e.g. motor-neuron diseases (e.g. Parkinson's), but especially cognitive decline and dementia (e.g. Alzheimer's)⁵⁸ which is also an (official) driver behind the so-called "blue brain" project⁵⁹.

If looking at scientific research projects especially in the area of neuro- and bioscience, a large part of the descriptions refer to age-related diseases, especially dementia/Alzheimer's disease. The task of developing medication to counter or prevent dementia/Alzheimer's disease is being pursued within a large number of research projects and industries.

⁵⁷ http://www.tno.nl/downloads/TNOKvL_report_RoboticsforHealthcare1.pdf

⁵⁸ E.g. http://www.sfn.org/index.aspx?pagename=brainBriefings_10_unravelingalzheimers

⁵⁹ <http://sv.epfl.ch/page-26599.html>



This also goes together with basic research in neuroscience in relation to finding the causes for dementia/Alzheimer's disease, which could be genetic, influenced by lifestyle or related to metabolic processes (or failures of metabolic processes).

So-called plaques as well as protein misfolding⁶⁰ belong to the theoretical explanation models of (some forms of) dementia. The understanding of causes and mechanisms could lead to effective medication, but many issues are still unclear and still remain subject to basic research and animal studies.

Policy challenges:

- Assessment of research projects in regard to their probability for success
- Priority-setting for R&D (what should be R&D priorities in relation to “healthy and active ageing”?)
- More support for “Frontier Science” (i.e. new approaches and breakthroughs, high innovations, not to be confused with “fringe science”) and widening the scope of the FET-Flagship initiatives beyond ICT (e.g. more integration of biology, neurosciences and medicine)?
- How to improve the effectiveness of the research systems?

4.4.2 R&D on other diseases

Other medical developments aim at other kinds of diseases and disabilities that more likely occur with ageing. Examples are cardiovascular and pneumatic diseases, infections, eye diseases, hearing loss and loss of muscle and bone mass, resulting in higher risk of fractures. Here prosthetics as well as envisioned regenerative medicine and gene therapy (e.g. for the regeneration of organs, eyesight and muscle/bone loss) are topics in research and development. Other innovations relate to health monitoring and early diagnostics (e.g. in regard to the formation of blood clots leading to heart attacks or strokes), where for example miniaturised sensor systems or even micro/nanobots for in-vivo monitoring are being envisioned as future solutions, e.g. for detecting and removing plaques that could lead to dementia. Also biotechnological and pharmacological solutions (e.g. AGE inhibitors like Metformin) or specific enzymes that clear up accumulated harmful “metabolic waste” (which may also be related to diseases like diabetes) are being envisioned⁶¹.

Policy challenges:

- Support for R&D that could also be beneficial for healthy ageing, e.g. regenerative medicine, tissue engineering, cancer research, smart diagnostics?
- More support and funding for research especially addressing the issue of ageing (e.g. (bio)gerontology)?

⁶⁰ http://www.sfn.org/index.aspx?pagename=brainBriefings_10_protein folding

⁶¹ http://www.sciencedirect.com/science?_ob=MIimg&_imagekey=B8CX1-4YMJWMV-D-1&_cdi=40073&_user=603085&_pii=S1262363603727931&_origin=search&_coverDate=09%2F30%2F2003&_sk=999709995.7997&view=c&wchp=dGLzVzz-zSkzV&md5=a904774b237470417ec031dcf9b7fb03&ie=/sdarticle.pdf



4.5 Scientific Understanding and Tackling of the Ageing Process⁶²

Whereas the suggestions mentioned so far are mostly focussed on impact minimising or countering specific age-related problems and effects, another research trajectory aims at understanding the ageing process as such. A better understanding of the ageing process itself could also lead to improved and earlier interventions to prevent the negative effects of the ageing process.

This kind of research trajectory includes general theories about ageing, studies in biology, metabolism etc. as well as studies of healthy aged people (e.g. supercentenarians) and animals who possess what is called “negligible senescence” (no ageing) such as turtles⁶³ and animal experiments on healthy ageing and healthy longevity.

All these research trajectories derive from the premises that the ageing process as such is the reason for the physical and cognitive problems that occur with progressing age and that the ageing process as such is the root issue to be tackled. A better understanding about the ageing process itself could thus lead to better strategies to counter its negative effects. However, this research field of biogerontology is still young and gets only slowly recognised by an increasing number of biologists and interdisciplinary researchers, e.g. through the Max Planck Research Network on Ageing⁶⁴.

Policy challenges

- Should ageing itself be defined as a disease⁶⁵? And if so, new (legal) possibilities may open up for the pharmaceutical/medical industry as well as the food/beverage industry.
- Development, introduction and support of new research areas and study programs dealing with the science of ageing?
- Assessment of social and ethical considerations if ageing itself would be considered as a disease.

⁶² Examples of research findings can be found here: <http://quemot.wordpress.com/tag/life-extension/>

⁶³ <http://www.agelessanimals.org/>

⁶⁴ <http://www.maxnetaging.mpg.de/>

⁶⁵ “Nir Barzilai of the Albert Einstein College of Medicine at Yeshiva University in New York, says one way of trying to face down this enormous burden of disease is to look at the biggest risk factor common to all of them - ageing. “There's one thing everybody is missing”, he said. “Ageing is common for all of these diseases – and yet we're not investigating the common mechanism for all of them. We are just looking at the specific diseases.”
(source: <http://www.reuters.com/article/idUSTRE64I6HV20100520>)



5 Examples: Foresight Studies and R&D

5.1 Foresight Studies

Many foresight studies dealing with the issue of ageing and healthy ageing focus on statistical projections about e.g. age distributions and figures for expected expenditures, cases of diseases (e.g. dementia) and a lack of care-personnel.

Especially the rising expenditures for health care, medicine, elderly care/nursing and pensions as well as severe shortages in nursing/health-care personnel are featured in many foresight reports, projections and forecasts. Although reforms of the health and pension systems are considered as necessary and healthy ageing is thought to be crucial for tackling the socio-economic challenges associated with the ageing society, no real concrete suggestions are being made about how to achieve this goal.

Examples:

- World Economic Forum (2008): The Future of Pensions and Healthcare in a Rapidly Ageing World (<http://www.weforum.org/pdf/scenarios/Transforming-Pensions-Healthcare.pdf>)
- AARP International (2007): Major Developments and Trends in Global Ageing (http://www.aarpinternational.org/usr_doc/unbsproceedings.pdf)
- Welsh Institute for Health and Social Care (2007): Nursing: Towards 2015 – Alternative Scenarios for Healthcare, Nursing and Nurse Education in the UK in 2015 (<http://www.nmc-uk.org/Documents/Research%20papers/Nursing%20towards%202015%20full%20report%20.pdf>)
- Olshansky (2007): Pursuing the Longevity Dividend Scientific Goals for an Ageing World (<http://deepblue.lib.umich.edu/bitstream/2027.42/75679/1/annals.1396.050.pdf>)
- The Danish Council for Strategic Research (2006): Danish national foresight study “The Ageing Society 2030” (<http://en.fi.dk/publications/2006/the-ageing-society-2030/the-ageing-society-2030.pdf>)

In regard to science and technology, many foresight studies are presenting future technologies associated with age-related care which mainly include topics like care-robotics, ambient/smart living, health surveillance technologies, prosthetics and technical aids, and tele-health and e-health systems relying on ICT and Artificial Intelligence. Many of the suggestions look technically feasible and much progress has already been made in these areas in reality, but some may come with legal challenges (liability issues in regard to autonomous systems) as well as questions about societal acceptability. Finding technological solutions for improving the quality of life and autonomy of the elderly also seems to be a considerable driver for industries related to ICT and robotics.

Examples:

- Butter et al.: Robotics4Healthcare (http://www.tno.nl/downloads/TNOKvL_report_RoboticsforHealthcare1.pdf)
- Frog Design + Fast Company: The Future of Healthcare is Social (http://images.fastcompany.com/health-care/FC_FutureofHealthcare.pdf)



- E&C (2010): Intel Study Reveals Telehealth Will Dramatically Transform Health Care (http://www.euplus.com.sg/E&C_PDF/Page_16.pdf)

Another category of foresight studies goes much further and really tries to envision a future where healthy ageing has become a reality. Such studies often derive from the premises that it may be possible in the not too distant future to unravel the biological causes for age-related diseases/disabilities and even the mechanisms of ageing itself and find medical/technological strategies to counter negative developments of biological ageing. Such foresight studies often include visions of regenerative medicine, gene therapy, manipulation of metabolic mechanisms and bio/nanotechnologies for repairing organ failures, regenerating tissues, regrowing/restoring organs and cells and removing plaques and other harmful metabolic by-products. Some even envision healthy lifespans far beyond a century (as a result of strategies for healthy ageing) and general significant improvements in health and vitality.

Examples:

- Observatory Nano (2010): Focus Report Nanotechnology in Regenerative Medicine (<http://www.observatorynano.eu/project/filesystem/files/Nano%20regenerative%20medicine%20technical%20economic%20-%20final%20-%2023%20April%202010.pdf>)
- MaRS (2009): NEUROTECHNOLOGY: Focus on Ageing Industry Briefing Commercial opportunities and Ontario's strengths (<http://www.marsdd.com/dms/reports/Neuro-June-17-Final/MaRS-Neurotechology.pdf>)
- Moni Saha (2009): Nanomedicine: Promising Tiny Machine for the Healthcare in Future – A Review (http://www.omjournal.org/ReviewArticle/PDF/200910/RA_NanomedicinePromising.pdf)
- De Grey/Rae: Ending Ageing: The Rejuvenation Breakthroughs That Could Reverse Human Ageing in Our Lifetime (<http://www.amazon.com/Ending-Aging-Rejuvenation-Breakthroughs-Lifetime/dp/0312367066>)

5.2 Cutting-edge age-related R&D⁶⁶

5.2.1 Example: Modelling Ageing as “System Failure”

Dr. Leonid Gavrilov for example, draws an interesting comparison between reliability theory as used in engineering, ageing (as wear and tear within organisms), death (as catastrophic failure) and the difference between machine construction and biological systems. Whereas (classic) artificial machines are being built to function reliably with low fault tolerance, biological systems are not constructed very reliably but keep working due to high redundancy and high fault tolerance. Death can be regarded in this sense as the breakdown of all redundancy mechanisms. Gavrilov also discovered a parallel in failure schemes between machines and humans: machines as well as humans either fail at in the early beginning (manufacturing errors / child mortality) and then reach a plateau of stable reliability (in humans approx. until the age of 20) and then the probability of failure

⁶⁶ The research and findings mentioned in the following may still be seen outside the established mainstream research, but could be interesting in the context of foresight studies as well as the assessment of “frontier science”, innovation and potential paradigm shifts.



accelerates exponentially (in humans and machines). Thus, ageing can be considered as also following the general reliability theory as expressed in mathematics⁶⁷.

5.2.2 Example: Does the human ageing process stop at a certain age?

A theory proposed by Michael Rose, for example, suggests that at a certain older age, the overall ageing process in humans is actually slowing down and even reaches a so-called “immortal phase” where further ageing processes stop, even in humans. The only reason why people degenerate and finally die anyway is, according to this hypothesis, due to the accumulated damage that has happened before. This theory, based on the interpretation of statistic findings, is however disputed within the scientific community and in a way contradicts the model by Gavrilov. If there would turn out to be some real (less disputed) scientific evidence behind this theory, it could open up new ways for tackling the ageing process⁶⁸.

Example: Supercentenarian studies⁶⁹

Stephen and Natalie Coles, for example, are doing research on Supercentenarian (people older than 110) in order to find patterns that led to their long life as well as problems that occur in the context of ageing. They think that a slow down of the ageing process at some point in time as proposed by Prof. Dr. Michael Rose is not true. The question still remains controversial within the scientific community.

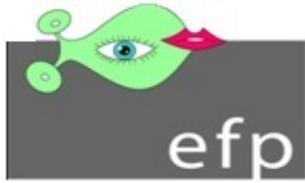
Coles & Coles think that lifestyle/environment as well as genetic factors play an important role in healthy ageing and long life. They have also observed that people who age unhealthy also die younger and that people who reach a certain old age (over 90) have a higher probability of making it to 100 and above. However, if being 100, the probability of dying the next year also increases with each year (this is one factor that leads to disputing Michael Rose’s theory). They also dispute the theory of an unlimited human life span since the record of longevity – with the age of 122 years - is not being broken. Thus, “life extension” may be more about extending average life span (more people getting up to 80, 90 and 100+ years) than in maximum life extension (people getting far older than 122 years of age).

In regard to statistics, it is often difficult to reliably determine the age of supercentenarians because record from early times are often unreliable and some people are listed in records and statistics just because they have not been registered as dead.

⁶⁷ <http://longevity-science.org/Agging-Theory-2006.pdf>

⁶⁸ <http://www.oup.com/us/catalog/general/subject/LifeSciences/EvolutionaryBiology/?view=usa&ci=9780195095302>

⁶⁹ <http://www.supercentenarian-research-foundation.org/organization.htm>



Example: Metabolic research⁷⁰

Other research strategies aim at understanding metabolic processes and their contribution to (negative) ageing effects. Examples are Advanced Glycation End products (AGEs) which build up with time (ageing) and cause a loss of tissue elasticity, i.e. tissue stiffness, fractures, cataracts and thus damages internal organs. AGEs are also related to diseases like diabetes and (possibly) Alzheimer's disease (and other age-related diseases). Thus therapeutic strategies aim at countering/minimizing the related chemical reactions (glycation) or reducing the amount of AGEs⁷¹.

If the metabolic mechanisms (e.g. breaking down of proteins, harmful metabolic side/end products, development of plaques) are better understood as well as the causes for failure of eliminating damaging and toxic end products, preventative strategies or damage reversal mechanisms could be developed.

Other research aims at understanding damages to cells and DNA and finding protective solutions or counter measures to reverse (accumulated) damage. This research line is also closely related to cancer research but also to regenerative medicine.

Example: Regenerative medicine⁷²

Regenerative medicine, which is very much envisioned in the area of finding alternatives to shortages of donor organs for transplantation can also play an important role in healthy ageing. Especially in regard to neuroscience, the link between those two is already big⁷³. But if new biological (and even recipient-identical) tissue and organs can be grown in the laboratory, age-damaged organs, body parts and tissue may also be "exchanged" for new and functional ones. In case of dementia, renewal and re-growth of neural cells could be a counter-strategy that is envisioned and already researched upon⁷⁴. However, caution is needed when assessing online articles especially about stem cell treatments for Alzheimer's disease since most of them do not represent reliable information.

5.2.3 Example: Healthy Life Extension

Consequently, if looking at the aim of healthy ageing ideally envisioned as living up to a 100 in good health, the question about human life span arises. If strategies would be found to enable the large majority of people to grow old in good health, one may ask why people ought to "drop dead" with 100 then. An unanswered related question that occurs in this context is about the maximum achievable life span of humans. Some researchers argue that although more and more people are living longer (increase of average life expectancy), the maximum life span to be achieved by humans

⁷⁰ <http://www.internationaldiabetesmonitor.com/PDFs/828.pdf>

⁷¹ http://www.sciencedirect.com/science?_ob=MIimg&_imagekey=B8CX1-4YMJWMV-D-1&_cdi=40073&_user=603085&_pii=S1262363603727931&_origin=search&_coverDate=09%2F30%2F2003&_sk=999709995.7997&_view=c&_wchp=dGLzVzz-zSkzV&_md5=a904774b237470417ec031def9b7fb03&_ie=/sdarticle.pdf

⁷² http://www.alliancerm.org/mates_presentation_jan2010.pdf

⁷³ E.g. <http://www.usuhs.mil/cnrm/>

⁷⁴ E.g. http://www.emea.europa.eu/docs/en_GB/document_library/Presentation/2010/05/WC500090649.pdf



has not been exceeded and remains at around 120 years of age⁷⁵. Other researchers (among them perhaps most famously Aubrey de Grey), however argue that if real medical interventions are being developed that counter the development and accumulation of products and organic failures that cause age-related physical and cognitive decline, or if regenerative medicine would be available, also the maximum life span of humans could be extended (beyond the average 120 years) as it is the case with animals that exhibit negligible senescence (e.g. turtles^{76,77}).

Recently, researchers succeeded in partially “[reversing] age-related degeneration in mice, resulting in new growth of the brain and testes, improved fertility, and the return of a lost cognitive function [...] by engineering mice with a controllable telomerase gene” (cf. Harvard Gazette⁷⁸). There are currently conducted several scientific animal studies aimed at the goal of slowing down or reversing age-related degeneration or the ageing mechanism as such. At least within animal studies, results indicate the possibility of (at least limited) feasibility of this goal.

Although the socio-economic effects of healthy ageing are considered to be huge (cf. e.g. Olshansky⁷⁹), healthy maximum life-span increases are causing more controversies, although demographic effects may be less dramatic than commonly assumed as it is shown by demographers Leonid A. Gavrilov and Natalia S. Gavrilova even in extreme longevity scenarios.

TABLE 1. EXPECTED SIZE OF SWEDISH POPULATION IN 2105 UNDER DIFFERENT PROJECTION SCENARIOS

Population projection scenario	Projected population size in year 2105	Population change over a century ^a 2105/2005
No life extension interventions	6,064,750	0.6703
Negligible senescence after 60	10,998,418	1.2156
Negligible senescence accepted by 10% of population	6,558,104	0.7248
Negligible senescence initially accepted by 10% of population with growing acceptance	7,833,616	0.8658
Continuous rejuvenation after age 60 years (Gompertz $\alpha = -0.005$ per year)	11,032,385	1.2194
Continuous rejuvenation after age 40 years (Gompertz $\alpha = -0.005$ per year)	13,321,983	1.4724
Aging slow down (Gompertz α is decreased by one half)	6,942,963	0.7674

^aThe size of Swedish population in 2005 is equal to 9,047,752.

Source: Leonid A. Gavrilov and Natalia S. Gavrilova (2010)⁸⁰

If healthy life extension may turn out to be a side effect of healthy ageing strategies as well as regenerative medicine, questions arise about how to deal with such new developments. Even AXA research (the research institute from the AXA insurance firm) is considering the possibility of

⁷⁵ http://www.prb.org/pdf06/nia_futureoflifeexpectancy.pdf

⁷⁶ <http://www.agelessanimals.org/>

⁷⁷ <http://www.sens.org/sens-research/what-is-sens>

⁷⁸ <http://news.harvard.edu/gazette/story/2010/11/partial-reversal-of-aging-achieved-in-mice/>

⁷⁹ <http://www.aaas.org/spp/rd/Olshansky.pdf> and

<http://deepblue.lib.umich.edu/bitstream/2027.42/75679/1/annals.1396.050.pdf>

⁸⁰ <http://longevity-science.org/Projections-RR-2010.pdf>



extended healthy ageing and advocates research for healthy ageing for improving quality of life and because of economic benefits⁸¹.

“In recent decades, scientists have learned enough about the biological ageing processes that many believe it will become possible to slow ageing in humans. We contend that the social, economic, and health benefits that would result from such advances may be thought of as “longevity dividends,” and that they should be aggressively pursued as the new approach to health promotion and disease prevention in the 21st century. The time has arrived for governments and national and international healthcare organizations to make research into healthy ageing a major research priority.”

Olshansky et al. (2007)

<http://onlinelibrary.wiley.com/doi/10.1196/annals.1396.050/abstract>

However, the idea of life extension, even though it will be achieved in good health, is causing some ethical controversies as, for example, expressed by Pope Benedict.

“Modern medical science strives, if not exactly to exclude death, at least to eliminate as many as possible of its causes, to postpone it further and further, to prolong life more and more. But let us reflect for a moment: what would it really be like if we were to succeed, perhaps not in excluding death totally, but in postponing it indefinitely, in reaching an age of several hundred years? Would that be a good thing? Humanity would become extraordinarily old, there would be no more room for youth. Capacity for innovation would die, and endless life would be no paradise, if anything a condemnation.”

Vatican (2010)

http://www.vatican.org/es/holy_father/benedict_xvi/homilies/2010/documents/hf_ben-xvi_hom_20100403_veglia-pasquale_en.html

⁸¹ http://www.axa-research.org/lib/rc/uploads2/communiques/AXA_ECHO_1.pdf



6 Conclusions

Most people wish for a long life, though a long life in good health is nothing that seems to be taken for granted. Although human life expectancy has dramatically increased over the last century, this new prospect of old age comes with a burden if accompanied by failing health and disease. In addition to an increasing life expectancy, declining birth rates put additional stress on pension and social security systems since fewer and fewer employees need to support one pensioner over a larger time span. If ageing is accompanied by failing health, more elderly care is needed whereas personnel shortages are already present today. The necessity for economic thinking and rationality in care-taking also conflicts with the desire for humane care and nursing.

The same medical progress that has caused the dramatic increase in life expectancy has also led to growing expenses in health care and medicine. In some countries, especially the US, the last months in one's lifetime are expected to be the most expensive in regard to medical costs. This of course raises the question about the necessity of some medical procedures. On the other hand, the conventional ethical considerations also do not allow for not trying everything possible to save a human's life. This is also the reason why euthanasia, for example, is such a controversial topic, although it is also perceived positively under some circumstances related to old age and severe illness.

Restructuring in pension systems, health care, insurance systems and social security are considered necessary in face of the expected demographic developments of higher life expectancy and declining birth rates with the result of a shrinking workforce able to finance the whole system. Raising the retirement is seen with controversy and protest by many retirees and many older people are not able to find a job or are not able to work due to age-related disabilities, physical and mental problems. The introduction of pension reforms that focus more on individual savings for one's own pensions also leads to an additional burden for younger people who still need to finance the current retirees but at the same time also need to save money for their own retirement.

One solution to improve the situation would be to shorten the amount of years in failing health due to old age. The ideal situation would be to live a long life in good health followed by "sudden death". On second glance, one could ask, however, why a person should just drop dead while still being in good health and if such a situation would be desirable. Besides desirability, it is still scientifically uncertain if a strategy like the "compression of morbidity" (compression of the amount of years spent with age-related diseases) would be feasible and how it should be achieved.

Much R&D is already invested in tackling age-related diseases such as cardiovascular diseases and neurodegenerative conditions, which require interdisciplinary cooperation in many areas. However, some researchers like Nir Barzilai of the Albert Einstein College of Medicine at Yeshiva University even suggest that ageing as such should be looked at and tackled as a disease itself⁸². And indeed, some research is already being conducted in animal studies aimed at slowing down or reversing age-

⁸² <http://www.reuters.com/article/idUSTRE64I6HV20100520>



related degeneration as such or even the ageing process itself. Some organisms like turtles exist that display a natural negligible senescence (i.e. they do not age) or have the ability of self regeneration (e.g. starfish and some jellyfish).

In the meantime, much focus is also put on lifestyle-related influences that positively/negatively impact the healthiness and quality of ageing. Healthy nutrition, exercise and physical/mental activity are considered as positively impacting factors. However, there is also the danger of false promises of “anti-ageing” products and scientific fraud in age-related research.

Coming back to the “overall goal of the Innovation Partnership [...] to increase the average healthy lifespan by two years by 2020”^{83,84}, the first set of questions need to address the concrete objective of this goal as well as scientific requirements and feasibility assessments for achieving this objective. What kind of knowledge is needed, what kind of R&D needs to be conducted and which framework conditions (e.g. socio-economic) need to be implemented?

⁸³ http://ec.europa.eu/commission_2010-2014/dalli/docs/speech_ageing_en.pdf

⁸⁴ http://ec.europa.eu/dgs/health_consumer/consumervoices/cv_12011_en.pdf