It's not ageing, stupid: Why population ageing won't bankrupt health systems

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Context

Population ageing is seen as a main challenge facing societies over the coming decades. As life expectancy has increased while fertility rates have declined, European countries and high income countries around the world are faced with a demographic shift where older people comprise an increasingly large share of the population. To put it into context, in 2000, the share of the population in the European Union (EU) over age 75 was 8.3%. [1] By 2050, the share over age 75 is expected to double to 16.6%.

While longer life spans are a welcomed result of technological advancements, improvements in the coverage of effective health care, reduction in exposures to environmental, biological, and behavioural risk factors, and other societal gains, [2] there are concerns that caring for an ageing population will put untenable pressures on global economies, public finances, and possibly lead to the end of the welfare state as we know it because of worries that the level of benefits in today's high-income countries is unsustainable as more and more people reach older ages. [3] With nearly half the disease burden in high-income countries arising in older people, and cardiovascular disease (CVD) being the leading contributor to disease burden, [4] some commentators are of the view that if older people are sick and dependent on support, caring for a burgeoning older population will not be possible.

In this narrative review, we explore how population ageing is likely to affect health care expenditures (HCE) over the coming decades. We review the literature on the relationship between population ageing and HCE. Utilising HCE projections, we show that despite the increasing share of the older population over the next few decades, in fact, the changing age-mix is not a main driver of HCE growth. Rather, as has been the case historically, price growth and technological advancements, independent of population ageing, will be the main contributor to health spending increases. Importantly, the prices paid for health care and the decision to adopt new technologies are policy choices that are amenable to intervention.

Population ageing and future HCE growth

At first glance, the inexorable growth in health spending due to population ageing seems like a plausible concern. On average, per capita HCE is higher for older age groups (Figure 1). [5] This currently observed relationship of higher HCE for older people would intuitively suggest a sharp and dramatic rise in HCE over the next several decades, as the proportion of people above the age of 60 continue to increase. However, in reality, population ageing alone, will only have modest effects on future HCE growth. This is because even though per person spending on older people, on average, is greater than for younger people, the share of the population who are at these older, most costly ages increases very slowly over time, so that there are only incremental increases in expenditure growth year on year.

Analysts can quantify future changes in health care expenditure trends that will be attributable exclusively to population ageing using historical data on health expenditure patterns by age and population projections by age.[6] Here, we use EU-28 population projections available from the Organization for Economic Co-operation and Development (OECD). These population projections incorporate estimates of fertility rates, life expectancy and levels of immigration and suggest that the population in the EU will age over time. For example, in 2019 14.3% of the population is estimated to be over age 70, while by 2050 this will increase to 22.5%. Data on health spending per person by broad age group for the EU are available from the Ageing Working Group of the European Commission.

Holding per person health care expenditure levels by age constant, analysts can calculate how total and per person health care expenditure levels would look in the future if only the population age-mix were to vary in the future but the level of per person spending for individuals of different ages stayed the same. This is accomplished by multiplying the number of people in each age group in each projection year by the fixed per person spending for that age group; dividing by the total population gives per person spending for each projection year which varies only due to the change in the age-mix of the population.

A key element of this type of analysis is the assumption that, relatively speaking, the level of per person spending for older people compared to younger people will remain the same in the future as it is currently. To put it simply, while actual expenditures per person will

undoubtedly change over time for all age groups due to changes in prices, technology, care delivery models and other factors, it is assumed that these factors will affect spending levels for people of all ages equivalently. What this means is that if, say, a 65-year-old today uses three times as many resources for health care as a 25-year-old, the same relative intensity of treatment will persist in the future, even if actual spending levels per person increase for everyone. Allowing the relative intensity of treatment by age to remain constant permits analysts to isolate specifically the effects of the changing age-mix of the population to more accurately understand how population ageing by itself will affect health expenditure trends in the future.

With these assumptions in mind, we estimate that in the EU, average annual growth in per person health spending is expected to grow no more than 0.6 additional percentage points per year between 2015 and 2050 due to changes in the population age-mix (Figure 2). In fact, from about 2030 onwards, the contribution of the changing age-mix to per person health expenditure growth is expected to decline, reaching just over 0.2 percentage points of additional growth due to ageing by 2050. To give that some perspective, median annual nominal growth in per person health care spending among the OECD countries was 5.5% between 2000 and 2015. In that context, ageing can be seen as only a minor contributor to growth.

A key question is whether older people are becoming more or less in need of health services, and whether those services will be comparatively more or less resource-intensive. If older people are overwhelmingly less healthy and require considerably more expensive treatments for a longer duration, it is possible that ageing will be a greater challenge than this sort of analysis suggests. Therefore, we explore the possible trajectories of the health care needs of older people and evaluate how ageing could interact with other non-demographic drivers of HCE.

The health care needs of older people

Several studies that have assessed the individual determinants of HCE have found health expenditures to be largely concentrated in the final years of life. [7–9] When these studies account for high expenditures at the final years of life, the relationship between ageing and

HCE is diminished, implying that underlying health could be an important determinant of HCE growth. In other words, the currently observed age profile of health expenditure might be explained by the fact that relatively more people in older age groups will be in their final years of life compared to younger age groups. Based on this premise, studies conducted at the individual level have further assessed the effects of approaching death (time to death) on HCE over time. These studies have often concluded that controlling for time to death attenuates the association between ageing and HCE, meaning that time to death, regardless of the age at death, would be a key determinant of heath expenditure. [10–13]

The key implication of these studies is that morbidity is a significant driver of HCE. This is because the final years of life are a potential reflection of underlying morbidity – time-to-death acts as a proxy for severity of illness. It is estimated that spending in the last 3 years of life could account for as much as 24.5% of overall health care cost, which suggests that high costs are driven by people with chronic conditions that are associated with shorter life expectancies .[14] Therefore, the level of morbidity within older age groups is an important consideration when assessing HCE, and if morbidity among the elderly age groups significantly worsens over time, this could result in a sharper rise in HCE than our projection suggests.

For the past several decades, CVD has been the leading contributor to disease burden in older people globally. [15] In Europe, in 1990, 48.3% of the total disease burden (as measured by disability-adjusted life years) was attributed to CVD in people aged 75 years and older (Figure 3). [16] In 2015, even though CVD was still the leading contributor to disease burden in older people (Figure 3), the incidence and mortality rates for CVD have been steadily declining since 1990, reducing the overall disease burden (39.2% of total disease burden in people 75 years and older). [16] In Europe, the reduction in CVD related mortality varied across countries, with declines initially observed in Western Europe, but from the mid-1990s onward, the CVD death rates in many Central and Eastern European countries converged with those in other high-income countries. [17] This decline in the CVD mortality rate is a reflection of the progressive decline in the death rate for ischemic heart disease (IHD), the leading cause of health loss due to CVD among the elderly (Figure 4).

While the fall in CVD deaths has been identified as a major contributor to the rise in older age life expectancy in high-income countries, [2 18] there is no clear consensus on the factors

explaining this trend in CVD disease burden among the elderly. The fall in CVD prevalence and death rates have coincided with declines in established CVD behavioural risk factors like smoking and physiological risk factors such as blood pressure and serum cholesterol, partly due to changes in diet, but also due to the better pharmacological management of hypertension and dyslipidaemia. [19] [20] In addition, improvements in the treatment of acute coronary events have also been a key driver of these observed CVD trends. [21,22] Untangling the effects of CVD medical interventions, lifestyle changes, and the controlling of risk factors in explaining the decline in CVD prevalence and deaths remain a key challenge.

A better understanding of these factors is particularly important in order to assess if increased longevity will be associated with better health because worsening morbidity in older age groups is a factor that can affect future HCE growth. Epidemiological research posits two predominant views on the relationship between increasing life expectancy and health – the so called "compression of morbidity" and "expansion of morbidity" hypotheses. The compression of morbidity hypothesis predicts a reduction in the number of years lived in poor health as a proportion of life expectancy. [23] The expansion of morbidity hypothesis assumes the opposite – increased longevity will result in an increase in the number of unhealthy years lived relative to healthy life-years. [24,25] In addition, a third scenario termed "dynamic equilibrium", assumes that the increase in life expectancy will shift morbidity and disability into older ages (delay the onset of serious disease states), with the duration of illness ultimately remaining unchanged. [26]

Studies that have attempted to predict how morbidity among older age groups will change in the future have shown mixed evidence. Several studies, including some disease-specific studies, project a morbidity compression or constant morbidity (dynamic equilibrium) scenario – severe morbidity will be experienced later in life closer to death. [27–30] Notably, similar projections have been made on future disability, where a postponement of disability among the elderly is predicted, based on the currently observed trend of declining late-life disability. [31,32]

While the results from these studies seem to suggest that as populations live longer, the morbidity profiles of the older age cohorts are unlikely to change in a way that would trigger a sudden rise in HCE, this evidence should be interpreted with caution for several reasons. First, the gains in life expectancy achieved in high-income countries could stagnate or even

reverse. In the United Kingdom (UK) , there is evidence of life expectancy at ages over 60 falling during the period between 2013 and 2015, with the largest decline observed for those aged over 85 years. [18] Socio-economic inequalities in life expectancy have also widened in the UK. [33] Similar declines in life expectancy at older age groups (>65) were observed in other high-income countries during 2014-15, but these countries experienced gains in life expectancy the following year. [34] In the United States, life expectancy at age 65 increased between 2015 and 2016, with death rates decreasing significantly for all age groups over 65 years. [35]

Second, some country specific results indicate either no improvement or an increase in severe disability among the elderly population, albeit, this was observed for the very old age cohorts (80 years or older). [36,37] Within CVD, there are concerns that the prevalence and incidence of congestive heart failure and atrial fibrillation could increase due to ageing and improved survival from AMI. [38,39] Recent evidence from the UK indicates rising standardised incidence in heart failure in people older than 85 years, [40] although in reality, this very old population would represent a relatively small proportion of the elderly cohort. Further, the same study found the overall age-sex standardised incidence of heart failure has declined by 7% from 2002 to 2014.

Third, in addition to the inherent difficulty in identifying the factors that explain disease burden trends over time, another factor to bear in mind when interpreting this evidence is the potential biases introduced by the artefactual effects that stem from changing measurements and diagnoses of morbidity and disability.[18] This makes cross-country comparisons and even comparing across time periods within a country difficult.

Therefore, to proxy a potential expansion of morbidity scenario, we forecast future health expenditures due to ageing but assume that the average per person health expenditure of someone between 55-59 years of age is more in line with current spending levels of someone 5 years older – between 60 and 64. We subsequently assume commensurate increases in spending at all older age groups that would be indicative of older people being in comparatively worse health – essentially as if they were treated like someone 5 years more senior beginning in their mid-50s until death (Figure 5). This forecast once again shows that due to ageing being a slow gradual process combined with the fact that the older age groups represent a relatively small proportion of the population, our HCE growth projection for a

morbidity expansion scenario does not vary substantially from the baseline estimates, ultimately converging around the year 2035.

Interaction of ageing with price growth and medical innovation

On its own, the impact of ageing on HCE is likely to be limited. However, ageing could exacerbate the effects of the major non-demographic drivers of HCE. While the influence of real income growth on HCE is a subject of considerable debate, in general, estimates of HCE tend to increase with income aggregation, with the main point of uncertainty being the magnitude of this relationship (income elasticity). [41] Once real income growth has been accounted for, there is still a residual growth that can be explained by some combination of technological progress, relative prices and the features of health care policies and institutions. [42] While these factors have an effect on HCE independent of ageing, it is possible that as the proportion of the elderly grow, the health care targeting the needs of this population could influence price growth and medical innovations.

There is some evidence to suggest that medical innovations are targeted more at older age groups and disproportionately benefit them, resulting in shifts in HCE towards these older cohorts. [27,43,44] In addition, if an age profile of health care consumption that increases disproportionately with GDP per capita is assumed (age specific income elasticities), where the age shape of health care consumption shifts upward and higher for older ages relative to the younger age groups when GDP per capita rises, then ageing will have a greater impact on future HCE growth than we have predicted. In other words, the impact of population ageing on HCE will be due to both the increasing proportion of the elderly and the increase in the intensity of use of health care resources as GDP per capita rises.

However, while HCE projections made based on this assumption have found a steep initial increase in HCE during the phase in which there is a rapid shift in the proportion of the population that fall into older age groups, HCE growth is more modest afterwards. [45] This is because rapid population ageing is a temporary phenomenon caused by the sharp decline in the size of birth cohorts (fertility transition). Population ageing will subsequently continue at a slower pace due to declining mortality rates. In addition, GDP per capita will only grow slowly in high-income countries and higher income elasticities are only expected for the

oldest ages, which represent a small proportion of the old-age cohort. Thus, even assuming ageing interacting with non-demographic drivers of HCE, the impact of ageing on HCE growth is likely to be modest. Most importantly, the HCE growth that comes about due to income growth and medical innovation, whether as a result of a larger elderly population, or independent of it, is amenable to policy interventions.

Conclusions

An ageing population is unlikely to be the main driver of future HCE growth. Even though older people, on average, currently incur higher per person health care spending than younger people, the share of the population who are at the oldest and most costly age groups increases very slowly over time. We project the changing age-mix in the EU to result in the increase of the average annual growth in per person health spending by no more than 0.6 additional percentage points per year between 2015 and 2050.

Two factors that could exacerbate the effect of ageing on HCE are worsening morbidity among older people and ageing interacting with non-demographic drivers of HCE. Evidence from the literature suggests that both of these factors are still unlikely to result in a significant and unsustainable rise in HCE growth. While evidence on future predicted morbidity associated with increasing longevity is mixed, even an expansion of morbidity scenario is unlikely to substantially influence future HCE growth due to the slow process of ageing and the oldest age groups representing a relatively small proportion of the population. Similarly, ageing interacting with non-demographic drivers of HCE would likely only have a modest impact on HCE growth for the same reasons.

Price growth and technological advancements will be larger contributors to future HCE growth than an ageing population and these factors require more attention. There is significant variation across and even within countries in the prices of pharmaceuticals, medical devices and the provision of medical procedures. [46,47] For example, a 2014 OECD review of 13 countries found a three-fold between-country and six-fold within-country difference in the rates of cardiac procedures performed. [48] The magnitude of these variations suggests these are unlikely to be differences in need but rather potentially unnecessary provision of care. This is apparent, for instance, in the use of cardiac resynchronisation

therapy (CRT) devices, where an estimated 30% of patients do not attain symptomatic benefit, partly due to inappropriate patient selection. [49] Similarly, variations in prices are observed for medical devices, which account for about 7% of health expenditures in the EU. [50] For instance, the prices of coronary stents and pacemakers were found to be higher in France and Italy compared to Germany and the UK. [51] While further research is needed to establish a causal relationship between prices and explanatory factors, these findings indicate that the ability to control these supply-side and systems related factors is going to be a key determinant of future HCE growth. Importantly, these potentially unwarranted variations in provision and pricing are amenable to policy interventions and how the health care system is organised.

This is not to imply that the challenges and consequences of population ageing should be neglected. Health care systems should anticipate the changing health care needs of a gradually ageing population and determine the allocation of resources necessary to support any changes in medical practices, such as the development of a multi-disciplinary workforce to effectively deliver integrated care. In addition, further investment in long-term care (LTC) is necessary to create alternatives to costly hospital care. For example, higher utilisation of outpatient LTC for end-of-life care could reduce hospitalisations and lead to a higher share of out-of-hospital deaths. [52] Lastly, active engagement is required from the medical and policy community to ensure the continuity of the health improvements observed among the elderly, particularly primary and secondary preventative interventions that delay the onset and progression of disease and reduce health inequalities.

Conflict of interest statement

Conflicts of interest - nothing to declare.

References

1. OECD. Population projections [Internet]. 2014. Available from: https://www.oecd-ilibrary.org/content/data/data-00538-en

2. Mathers CD, Stevens GA, Boerma T, White RA, Tobias MI. Causes of international increases in older age life expectancy. The Lancet. 2015 Feb;385(9967):540–8.

3. Cylus J, Normand C, Figueras J. Will population ageing spell the end of the welfare state? European Observatory on Health Systems and Policies; 2018. (The Economics of Healthy and Active Ageing).

4. Prince MJ, Wu F, Guo Y, Gutierrez Robledo LM, O'Donnell M, Sullivan R, et al. The burden of disease in older people and implications for health policy and practice. The Lancet. 2015 Feb;385(9967):549–62.

5. European Commission. The 2015 ageing report: economic and budgetary projections for the 28 EU Member States (2013-2060). [Internet]. Brussels: European Commission; 2015 [cited 2019 Feb 8]. (European Economy). Available from: http://bookshop.europa.eu/uri?target=EUB:NOTICE:KCAR15003:EN:HTML

6. The 2018 ageing report: underlying assumptions and projection methodologies. [Internet]. European Commission; 2017 [cited 2018 Dec 20]. (European Economy Institutional Papers). Report No.: 065. Available from: https://ec.europa.eu/info/sites/info/files/economy-finance/ip065_en.pdf

7. Polder JJ, Barendregt JJ, van Oers H. Health care costs in the last year of life--the Dutch experience. Soc Sci Med. 2006 Oct;63(7):1720–31.

8. Madsen J, Serup-Hansen N, Kragstrup J, Kristiansen IS. Ageing may have limited impact on future costs of primary care providers. Scandinavian Journal of Primary Health Care. 2002 Jan 1;20(3):169–73.

9. Yang Z, Norton EC, Stearns SC. Longevity and health care expenditures: the real reasons older people spend more. J Gerontol B Psychol Sci Soc Sci. 2003 Jan;58(1):S2-10.

10. Zweifel P, Felder S, Meiers M. Ageing of population and health care expenditure: a red herring? Health Economics. 1999 Sep;8(6):485–96.

11. McGrail K. Age, costs of acute and long-term care and proximity to death: evidence for 1987-88 and 1994-95 in British Columbia. Age and Ageing. 2000 May 1;29(3):249–53.

12. Häkkinen U, Martikainen P, Noro A, Nihtilä E, Peltola M. Aging, health expenditure, proximity to death, and income in Finland. Health Economics, Policy and Law. 2008 Apr;3(02).

13. Seshamani M, Gray A. Ageing and health-care expenditure: the red herring argument revisited. Health Econ. 2004 Apr;13(4):303–14.

14. French EB, McCauley J, Aragon M, Bakx P, Chalkley M, Chen SH, et al. End-Of-Life Medical Spending In Last Twelve Months Of Life Is Lower Than Previously Reported. Health Affairs. 2017 Jul;36(7):1211–7.

15. Roth GA, Johnson C, Abajobir A, Abd-Allah F, Abera SF, Abyu G, et al. Global, Regional, and National Burden of Cardiovascular Diseases for 10 Causes, 1990 to 2015. Journal of the American College of Cardiology. 2017 Jul;70(1):1–25.

16. Global Burden of Disease Collaborative Network. Global Burden of Disease Study 2016 (GBD 2016) [Internet]. Seattle, United States: Institute for Health Metrics and Evaluation (IHME); 2017. Available from: http://ghdx.healthdata.org/gbd-results-tool

17. Kesteloot H, Sans S, Kromhout D. Dynamics of cardiovascular and all-cause mortality in Western and Eastern Europe between 1970 and 2000. Eur Heart J. 2006 Jan;27(1):107–13.

18. Hiam L, Dorling D, Harrison D, McKee M. Why has mortality in England and Wales been increasing? An iterative demographic analysis. Journal of the Royal Society of Medicine. 2017 Apr;110(4):153–62.

19. Jones DS, Greene JA. The Contributions Of Prevention And Treatment To The Decline In Cardiovascular Mortality: Lessons From A Forty-Year Debate. Health Affairs. 2012 Oct;31(10):2250–8.

20. Clement G, Giovannelli J, Cottel D, Montaye M, Ciuchete A, Dallongeville J, et al. Changes over time in the prevalence and treatment of cardiovascular risk factors, and contributions to time trends in coronary mortality over 25 years in the Lille urban area (northern France). Archives of Cardiovascular Diseases. 2017 Dec;110(12):689–99.

21. Puymirat E, Simon T, Steg PG, Schiele F, Guéret P, Blanchard D, et al. Association of changes in clinical characteristics and management with improvement in survival among patients with ST-elevation myocardial infarction. JAMA. 2012 Sep 12;308(10):998–1006.

22. Puymirat E, Aissaoui N, Cayla G, Lafont A, Riant E, Mennuni M, et al. Changes in One-Year Mortality in Elderly Patients Admitted with Acute Myocardial Infarction in Relation with Early Management. Am J Med. 2017 May;130(5):555–63.

23. Fries JF. Aging, Natural Death, and the Compression of Morbidity. New England Journal of Medicine. 1980 Jul 17;303(3):130–5.

24. Gruenberg EM. The Failures of Success. Milbank Q. 2005 Dec;83(4):779–800.

25. Kramer M. The rising pandemic of mental disorders and associated chronic diseases and disabilities. Acta Psychiatrica Scandinavica. 1980 Sep 1;62(S285):382–97.

26. Manton KG. Changing Concepts of Morbidity and Mortality in the Elderly Population. The Milbank Memorial Fund Quarterly Health and Society. 1982;60(2):183–244.

27. Christensen K, Doblhammer G, Rau R, Vaupel JW. Ageing populations: the challenges ahead. Lancet. 2009 Oct 3;374(9696):1196–208.

28. Long MJ, Marshall BS. The relationship of impending death and age category to treatment intensity in the elderly. Journal of Evaluation in Clinical Practice. 2000 Feb 1;6(1):63–70.

29. Wong A, Baal PHM van, Boshuizen HC, Polder JJ. Exploring the influence of proximity to death on disease-specific hospital expenditures: a carpaccio of red herrings. Health Economics. 2011 Apr 1;20(4):379–400.

30. Dormont B, Grignon M, Huber H. Health expenditure growth: reassessing the threat of ageing. Health Economics. 2006 Sep 1;15(9):947–63.

31. Lafortune G, Balestat G. Trends in Severe Disability Among Elderly People: Assessing the Evidence in 12 OECD Countries and the Future Implications [Internet]. Paris: Organisation for Economic Co-operation and Development; 2007. (Health Working Papers). Report No.: 26. Available from: https://www.oecd-ilibrary.org/content/paper/217072070078

32. Freedman VA, Martin LG, Schoeni RF. Recent Trends in Disability and Functioning Among Older Adults in the United States: A Systematic Review. JAMA. 2002 Dec 25;288(24):3137.

33. Office for National Statistics. Health state life expectancies by national deprivation deciles, England and Wales: 2014 to 2016. Newport: Office for National Statistics; 2018. (Statistical bulletin).

34. Ho JY, Hendi AS. Recent trends in life expectancy across high income countries: retrospective observational study. BMJ. 2018 Aug 15;362:k2562.

35. Kochanek KD, Murphy S, Xu J, Arias E. Mortality in the United States, 2016 [Internet]. Washington, D.C: National Center for Health Statistics; 2017 p. 8. (NCHS Data Brief). Available from: https://www.cdc.gov/nchs/data/databriefs/db293.pdf

36. Winblad I, Jääskeläinen M, Kivelä S-L, Hiltunen P, Laippala P. Prevalence of disability in three birth cohorts at old age over time spans of 10 and 20 years. Journal of Clinical Epidemiology. 2001 Oct 1;54(10):1019–24.

37. Parker MG, Ahacic K, Thorslund M. Health changes among Swedish oldest old: prevalence rates from 1992 and 2002 show increasing health problems. J Gerontol A Biol Sci Med Sci. 2005 Oct;60(10):1351–5.

38. Deo R, Varosy PD. Invited commentary-Global arrhythmia burden: the public health implications of the rise in atrial fibrillation comment on "The increasing burden of atrial fibrillation compared with heart failure and myocardial infarction." Arch Intern Med. 2012 May 14;172(9):741–2.

39. Lacey L, Tabberer M. Economic burden of post-acute myocardial infarction heart failure in the United Kingdom. Eur J Heart Fail. 2005 Jun;7(4):677–83.

40. Conrad N, Judge A, Tran J, Mohseni H, Hedgecott D, Crespillo AP, et al. Temporal trends and patterns in heart failure incidence: a population-based study of 4 million individuals. The Lancet. 2018 Feb;391(10120):572–80.

41. Getzen TE. Health care is an individual necessity and a national luxury: applying multilevel decision models to the analysis of health care expenditures. J Health Econ. 2000 Mar;19(2):259–70.

42. de la Maisonneuve C, Oliveira Martins J. A Projection Method for Public Health and Long-Term Care Expenditures [Internet]. Paris; 2013 Jun [cited 2018 Dec 19]. Report No.: 1048. Available from: https://doi.org/10.1787/5k44v53w5w47-en

43. Goldman DP, Shang B, Bhattacharya J, Garber AM, Hurd M, Joyce GF, et al. Consequences of health trends and medical innovation for the future elderly. Health Aff (Millwood). 2005;24 Suppl 2:W5R5-17.

44. Wong A, Wouterse B, Slobbe LCJ, Boshuizen HC, Polder JJ. Medical innovation and age-specific trends in health care utilization: Findings and implications. Social Science & Medicine. 2012 Jan 1;74(2):263–72.

45. Mason CN, Miller T. International projections of age specific healthcare consumption: 2015–2060. The Journal of the Economics of Ageing. 2018 Nov;12:202–17.

46. NHS. Atlas of Variation: Procurement. National Health Service; 2014.

47. Vogler S, Vitry A, Babar Z-U-D. Cancer drugs in 16 European countries, Australia, and New Zealand: a cross-country price comparison study. Lancet Oncol. 2016 Jan;17(1):39–47.

48. OECD. Geographic Variations in Health Care: What Do We Know and What Can Be Done to Improve Health System Performance? [Internet]. Paris: Organisation for Economic Co-operation and Development; 2014. (OECD Health Policy Studies). Available from: https://doi.org/10.1787/9789264216594-en

49. Khan FZ, Virdee MS, Fynn SP, Dutka DP. Left ventricular lead placement in cardiac resynchronization therapy: where and how? Europace. 2009 May 1;11(5):554–61.

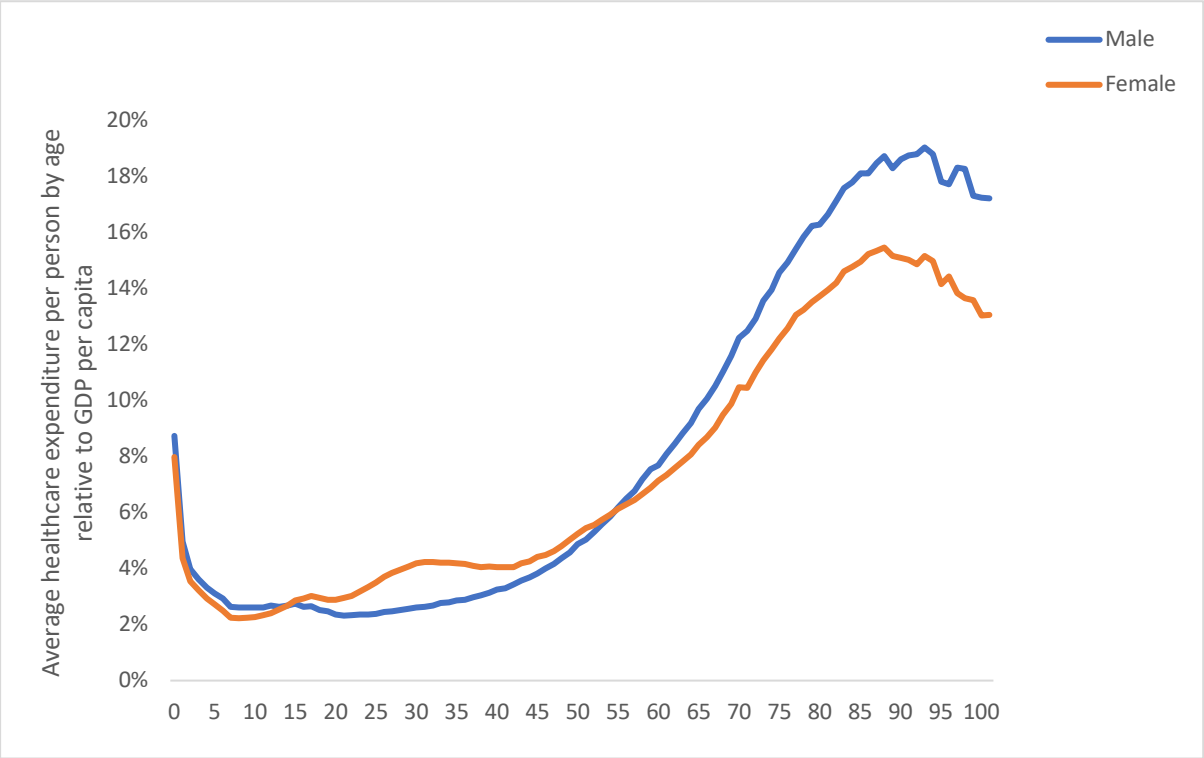
50. MedTech Europe. The European medical technology industry - in figures [Internet]. MedTech Europe; 2016. Available from: https://www.medtecheurope.org/resource-library/the-european-medical-technology-industry-in-figures-2016/

51. Wenzl M, Mossialos E. Prices For Cardiac Implant Devices May Be Up To Six Times Higher In The US Than In Some European Countries. Health Affairs. 2018 Oct 1;37(10):1570–7.

52. Orlovic M, Marti J, Mossialos E. Analysis Of End-Of-Life Care, Out-Of-Pocket Spending, And Place Of Death In 16 European Countries And Israel. Health Affairs. 2017 Jul;36(7):1201–10.

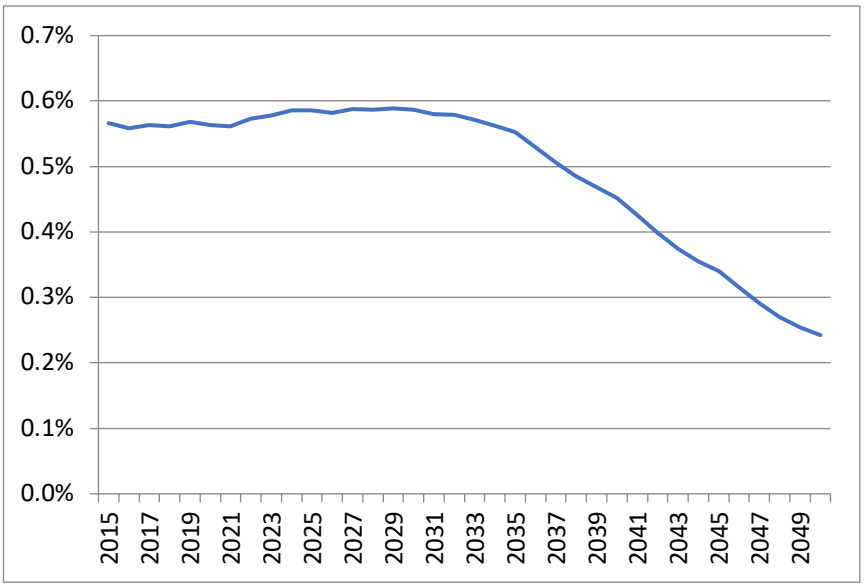
Figures

Figure 1: European Union* health care expenditure by age and gender relative to gross domestic product per capita



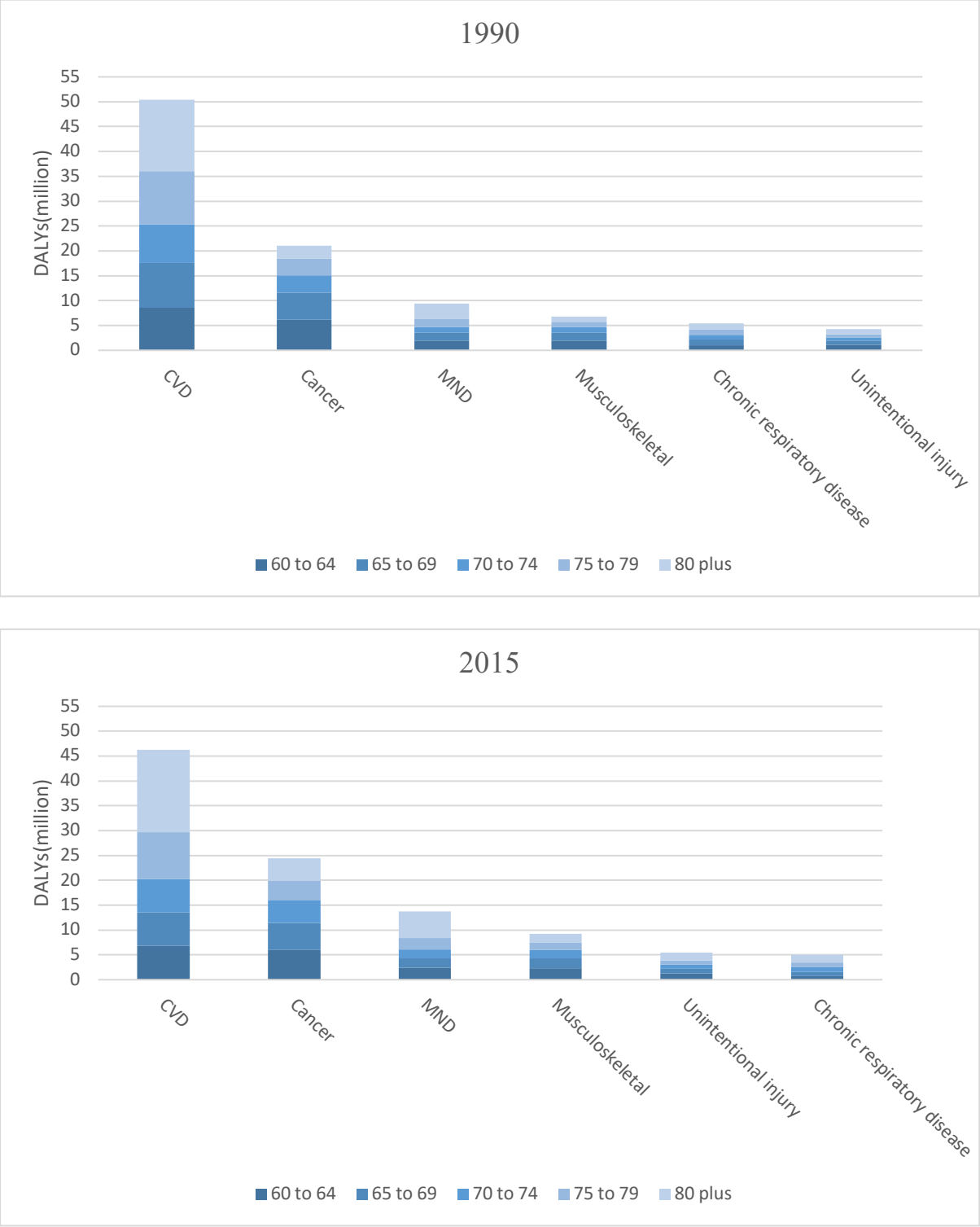
* Including Norway. Excluding France.
Source: European Commission (2015). The 2015 Ageing Report: Economics and budgetary projections for the 28 EU Member States (2013 – 2060)

Figure 2: Contribution of changing-age mix to per person health care expenditure growth, 2015-2050, European Union



Source: Organisation for Economic Co-operation and Development population projections, European Union Ageing Working Group (AWG) spending by Age, Author's calculations

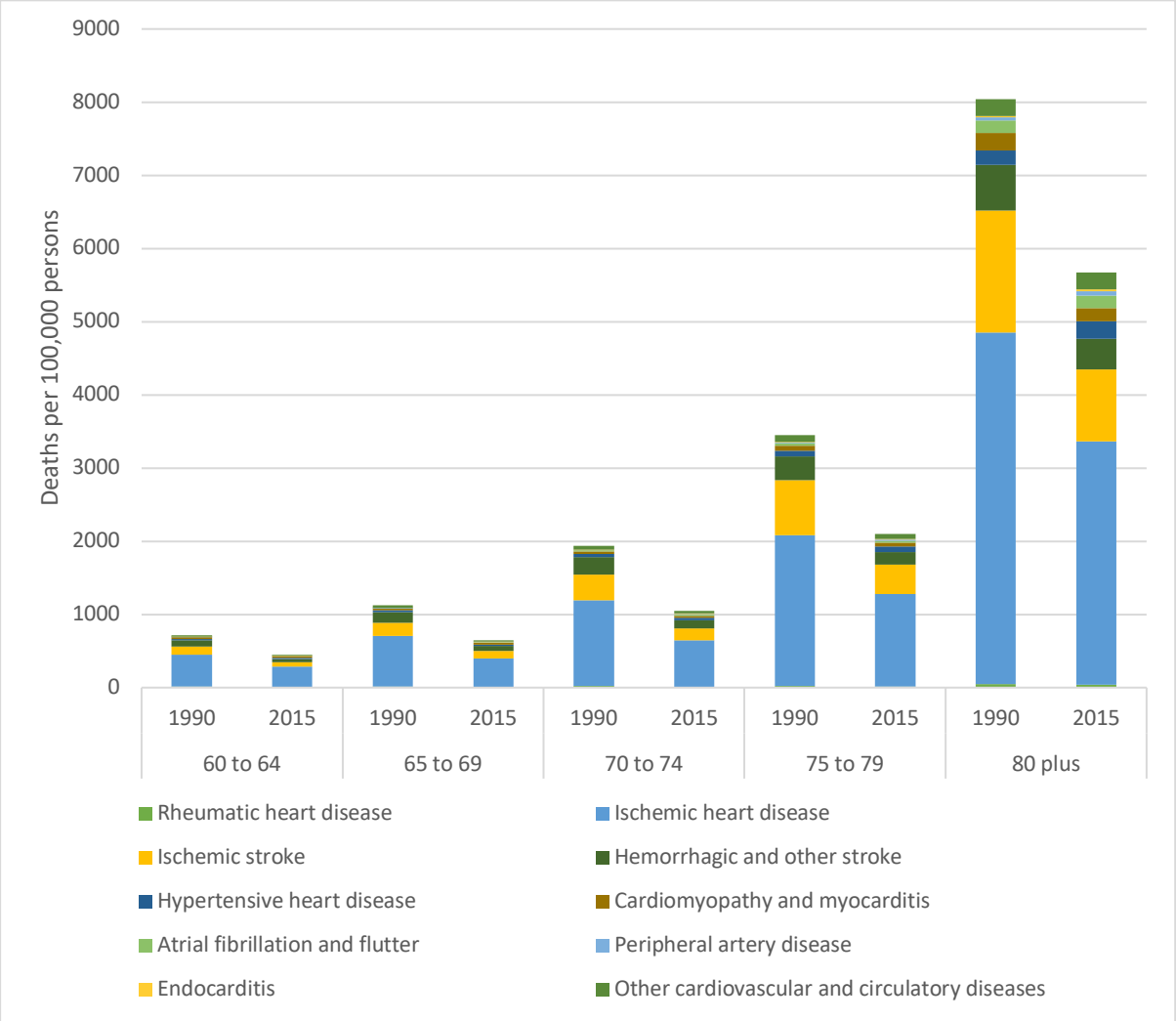
Figure 3: Leading contributors to burden of disease in people aged 60 years and older in Europe, 1990 and 2015 – disability-adjusted life years (million) by disease



Source: Global Burden of Disease Collaborative Network, Institute for Health Metrics and Evaluation

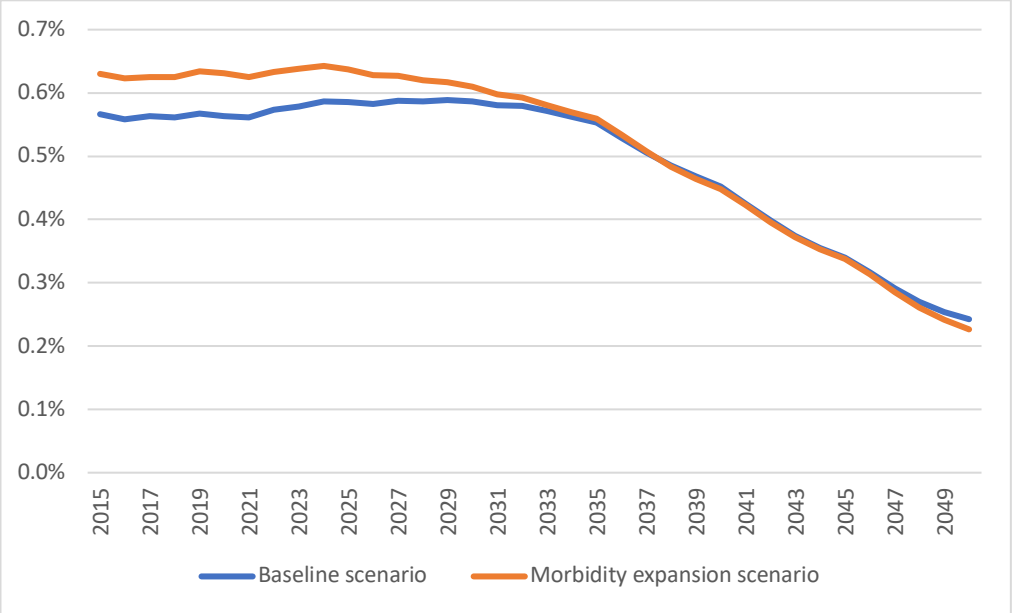
CVD, cardiovascular disease; MND, motor neurone disease

Figure 4: Death rate for cardiovascular diseases in Europe – 1990 & 2015, by age category



Source: Global Burden of Disease Collaborative Network, Institute for Health Metrics and Evaluation

Figure 5: Contribution of changing-age mix to per person health care expenditure growth in a morbidity expansion scenario



Organisation for Economic Co-operation and Development population projections, European Union Ageing Working Group (AWG) spending by Age, Author's calculations