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Impact of Demographic Change on Health Expenditure 2022-2025

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Report Summary

Background

- Demographic change is a driver of health expenditure and is considered in the annual Budget process in order to maintain the 'Existing Levels of Service' (ELS) that have been approved by Government.

- This paper provides estimates of the additional funding required to maintain ELS out to 2025 when considering only demographic change. It therefore assumes no policy change in the model of care provided or any potential savings that may arise.

- Previous demographic estimates have been informed by initial IGEES work in this area (Connors et al., 2016; Connors et al., 2019). However, as highlighted by the Parliamentary Budget Office (2019), the demographic cost pressure estimated in this work is likely underestimated as only certain service areas of the total health budget are modelled.

- The previous IGEES work (Connors et al., 2016; Connors et al., 2019) reflects the limited age specific expenditure data in the Irish health system. Age specific administrative data on expenditure is available for approximately 70% of public acute hospital expenditure and 60% of Primary Care Reimbursement Services expenditure, representing approximately 40% of the operational service areas in the health budget that can be linked to direct service utilisation.

- While the availability of administrative age specific expenditure data in the health system has not improved, it has been possible to draw on ESRI publications from the Joint Research Programme in Healthcare Reform with the Department of Health to improve on estimates on the impact of changing demographics. This paper therefore seeks to build on the previous IGEES work by expanding the scope of the service areas considered and by using more age specific data.

Methods

- In this paper, only the demographic impact on ELS is considered. Healthcare prices (pay and non-pay) are held constant and thus real expenditure (volume-based) growth is modelled. However, as highlighted by the Fiscal Council (2020) and ESRI (Keegan et al., 2020), the majority of ELS expenditure requirements relate to pay and price increases. These are subject to examination elsewhere as part of the Budget process.

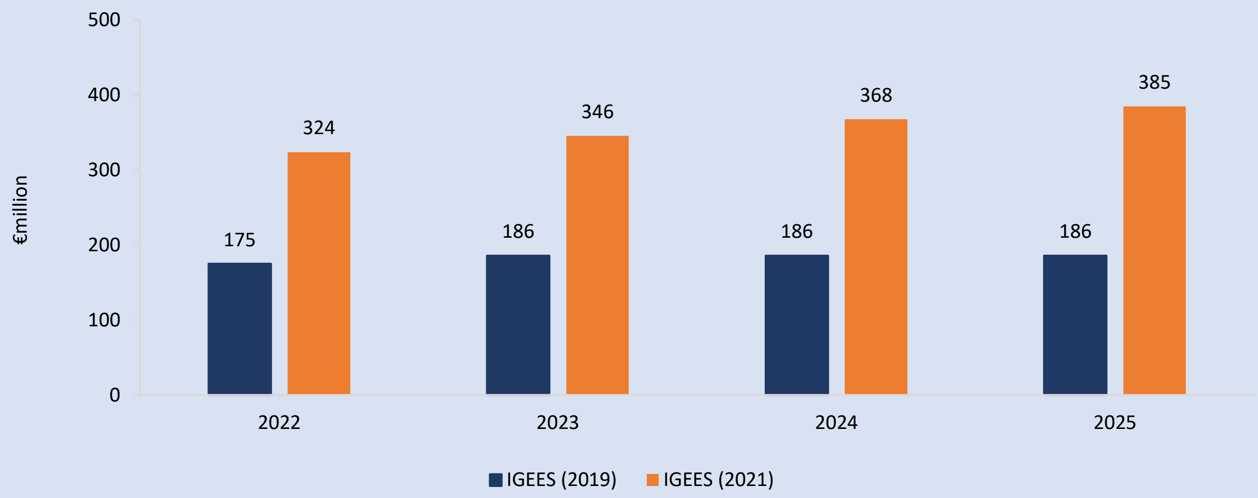
- A cell-based method was used to model available age and sex specific expenditure data, where the expenditure by age and sex is combined with age and sex specific population projections. Expenditure lacking age specific information was modelled using the total population growth, or with age specific cohort growth where service utilisation could be linked to specific age and sex cohorts.

- Population projections were created using the CSO 2019 population estimate and the CSO's assumptions around fertility and mortality developments. The immigration and emigration numbers applied in this analysis are consistent with the Department of Finance's Stability Programme Update 2021, where the migration estimates for 2020 and 2021 have been adjusted to take account of the impact of Covid-19. To account for the uncertainty around net migration in population projections, a sensitivity analysis was undertaken where net migration was varied for the period 2022-2025.

Findings

- Using a base year of 2019, the paper estimates that an increase in expenditure of **€324m** is required in **2022** to maintain ELS when considering only demographic change, increasing to **€385m** in **2025**. This compares with an estimate of **€175m** for **2022** by IGEES (2019), increasing to an average annual cost of **€186m** between 2023-2026. The main reason for the increase in estimates in this analysis is due to the use of more age specific data and expanding the scope of service areas modelled.

Figure 1. Demographic cost pressures 2022-2025 estimated by IGEES (2019) and this paper IGEES (2021).



Policy implications and future research

- This analysis feeds into one of the objectives of IGEES expenditure reviews, which is to support the Government's deliberations in setting multi-annual expenditure ceilings through analyses of future pressures and challenges (Irish Government Economic Evaluation Service, 2021).

- While this analysis has drawn on the outputs of the Department of Health and ESRI's Joint Research Programme, improvements to health administrative data would provide a firmer basis for future estimates. The implementation of Individual Health Identifiers could improve future analyses.

- It is also a strategic goal for the Department of Health to improve the estimates of future health expenditure requirements. The move towards population-based resource allocation, as outlined in the Sláintecare reform programme, could potentially improve the predictability and transparency of funding allocations in health. This would link various population characteristics to funding allocations using a formula, where demographic characteristics such as age and sex are fundamental components of such funding formulas.

Contents

1. Introduction

The overall objective of this paper is to estimate the pure demographic impact on current expenditure required to maintain 'Existing Levels of Service' (ELS) and potentially assist in informing medium term expenditure ceilings[1] out to 2025. This objective feeds into one of the goals of the Irish Government Economic Evaluation Service (IGEES) 'Spending Reviews', which is to support the Government's deliberations in setting multi-annual expenditure ceilings through analyses of future pressures and challenges (Irish Government Economic Evaluation Service, 2021). As this exercise estimates the change in expenditure needed to maintain an existing level of service in the base year, it is important to highlight at the outset that this paper does not consider whether the existing level of service to be maintained is adequate to meet demand.

The Irish Budget process follows the Department of Finance (DoF) medium term budgetary framework. On or before the 15th of October each year, the Minister for Finance and Minister for Public Expenditure and Reform present the annual Budget statement and Expenditure report to the Dáil. This sets out the Government's taxation policy, expenditure decisions and budgetary targets for the upcoming year (Department of Finance, 2014). The expenditure report outlines Departmental estimates for the coming year as well as expenditure ceilings for the next three years. The three-year expenditure ceiling is a central part of the medium-term expenditure framework of the budget and was introduced after recognising the need for clear medium-term planning (Department of Finance, 2014).

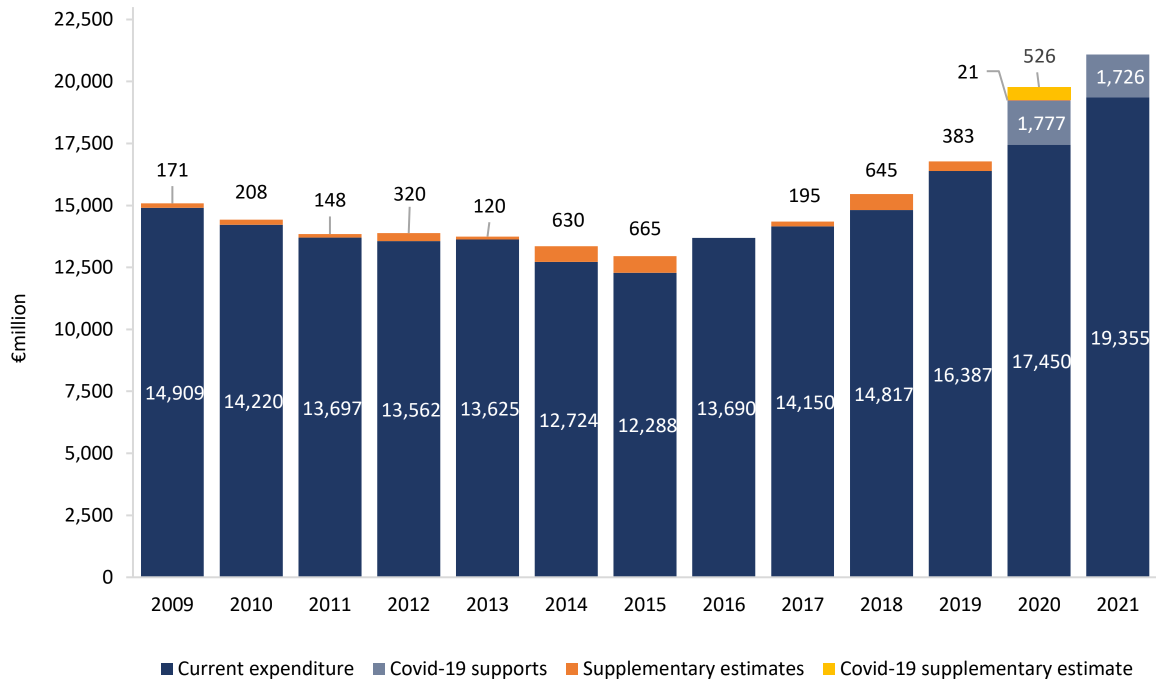
Recently, the Irish Fiscal Advisory Council (2021) highlighted the importance of greater accuracy in medium term expenditure ceilings:

"*The Medium-term Expenditure Framework is not working. It has become clear in recent years that departmental expenditure ceilings are set, not with a view to controlling spending with realistic ceilings, but merely to comply with legal requirements. The ceilings do not reflect likely pressures from demographics, prices, and pay increases*" (Irish Fiscal Advisory Council, 2021: p. 10).

Supplementary estimates have frequently been allocated, indicating the need for better financial forecasting and management. Figure 2 shows the gross current health expenditure and supplementary estimates allocated over the period 2009 to 2021. A decline in allocation from the previous year can be seen for the years 2010 to 2015, reflecting central saving measures as a result of the financial crisis. An increase in allocation from the previous year can be seen from 2016 onwards, with the level of funding higher than the 2009 level from 2018 onwards. Covid-19 support expenditure amounted to €2,303m and €1,726m in 2020 and 2021 respectively. €526m of the €2,303m 2020 Covid-19 support was allocated as a supplementary estimate (Department of Public Expenditure and Reform, 2020a).

[1] The Government sets expenditure ceilings across Government Departments, representing the maximum volume of financial resources that it can use in each of three years. http://www.budget.gov.ie/Budgets/2014/Documents/Part%20III%20-%20Ireland's%20Public%20Expenditure%20Framework%20in%20Comparative%20Perspective.pdf

Figure 2. The Health budget 2009-2021: gross current expenditure, Covid-19 related supports, gross supplementary estimates and Covid-19 supplementary estimate.



Sources: DPER databank, Appropriations accounts 2009-2019 and 2020 Supplementary estimates for public services.

Demographic change is one of the drivers of health expenditure. The impact of changing demographics on expenditure is considered in the annual estimates process as part of the overall provision of funding to the health sector including funding for the existing level of service and additional capacity. Demographic analysis informs the provision of funding as part of overall budgetary provision across a number of sectors including Health, which have been informed by previous IGEES work (Connors et al., 2016; Connors et al., 2019). However, as highlighted by the Parliamentary Budget Office (PBO), the demographic cost pressure for Health estimated in this work is likely underestimated as only certain service areas of the total health budget are included (Parliamentary Budget Office, 2019). This is largely due to data on age specific health expenditure being limited in Ireland making estimations of the impact of changing demographics on overall health expenditure difficult.

At present, the age specific expenditure available in the health system are for in-patients and day patients in public acute hospitals[2] (approximately 70% of total public acute hospital expenditure) and for certain schemes[3] of the Primary Care Reimbursement Service (PCRS) (approximately 60-65% of total PCRS expenditure). The age specific expenditure in public acute hospitals is recorded by the HSE Healthcare Pricing Office, while the PCRS age specific expenditure is recorded in the Primary Health Information System. The available age-specific data in the health system accounts for approximately

[2] This is captured through activity-based funding. Outpatient care and Emergency Department care are not included in activity-based funding.

[3] These schemes are the General Medical Services Scheme, Drugs Payment Scheme, Long-Term Illness Scheme, Community Ophthalmic Services Scheme and Dental Treatment Services Scheme.

40% of the operational service areas in the health budget that can be linked to direct service utilisation (authors calculations).

Until recently, Ireland has been one of only three countries not providing age specific healthcare and long-term care expenditure data to the European Commissions' (EC) Ageing Report (European Commission Directorate-General for Economic and Financial Affairs, 2018). However, progress in this area has been made as age profiles for healthcare and long-term care were provided to the EC's Ageing report for the first time for the 2021 publication (European Commission Directorate-General for Economic and Financial Affairs, 2021). These age profiles were informed by the Economic and Social Research Institute (ESRI) publications through the Joint Research Programme in Healthcare Reform between the ESRI and the Department of Health (Brick et al., 2020; Keegan et al., 2020; Walsh & Lyons, 2021; Wren et al., 2017). These publications form part of the HIPPOCRATES[4] model, which provides base year estimates and projections of healthcare demand, capacity and expenditure. Recently, projections of public acute hospital expenditure were published (Keegan et al., 2020) and work is currently underway to project healthcare expenditure for the non-acute sector.

Drawing on ESRI publications that estimate and project healthcare demand and expenditure, this paper seeks to update previous IGEES work estimating the demographic impact on health expenditure by expanding the scope of the service areas considered and by using more age specific data. Expanding the HSE operational service areas modelled in this paper reflects the existence of a demographic component on health service demand and expenditure. The additional services included in this paper, compared to the previous IGEES work (Connors et al., 2016; Connors et al., 2019) are:

- Outpatient and Emergency Department Care
- Palliative Care
- Remaining PCRS expenditure lacking administrative age specific data
- The National Screening Service
- Disability Services
- Primary Care
- Social Inclusion[5]
- Mental Health
- Local Demand Led Schemes[6]
- The National Ambulance Service
- The National Cancer Control Programme

The analysis of public acute hospital expenditure by Keegan et al. (2020) where age and sex specific profiles for outpatient and emergency department care were developed, show that there is variation in expenditure by age and sex for these services. Emergency department care expenditure was highest for the youngest (<4 years) and oldest individuals (75 years and older) for both males and females and outpatient expenditure was highest for 45-49 year olds for females and for 65-69 year olds for males

[4] The Hippocrates Model was developed at the ESRI in a programme of research funded by the Department of Health. https://www.esri.ie/research/health-and-quality-of-life/hippocrates-model

[5] Social inclusion services are targeted health services for vulnerable and excluded groups in Ireland. https://www.hse.ie/eng/about/who/primarycare/socialinclusion/about-social-inclusion/

[6] Local demand-led schemes include HIV drug costs and statutory allowances such as blind welfare allowance. https://www.hse.ie/eng/services/publications/serviceplans/national-service-plan-2019.pdf

(Keegan et al., 2020). Palliative care has an ageing effect, reflecting increasing morbidities at older ages (May et al., 2020). The majority of the PCRS expenditure lacking health system administrative age specific data is high-tech drug expenditure (Connors, 2017). High-tech drugs are prescribed or initiated in hospital and include anti-rejection drugs for transplant patients, growth hormones or medicines used in conjunction with chemotherapy. Expenditure on High-tech drugs has increased substantially in recent years, reflecting the cost of new (on-patent) drugs as well as growth in the stock of existing medicines (Connors, 2017). There is likely a demographic component to the diseases treated with high-tech drugs[7]. However, a key driver of expenditure growth in this service area is the non-demographic driver of technology, see section two for a discussion of the drivers of healthcare expenditure.

The national screening service encompass four national screening programmes. The national breast screening programme, the national cervical screening programme and the national bowel screening programme all have a demographic component as these are services provided to certain age groups of the population. The national diabetic retinal screening programme is targeted at people with type 1 and type 2 diabetes aged 12 years and older and a changing size and age structure of the population will therefore impact on the demand for this service. Disability Services have a demographic component with e.g. higher utilisation of residential care at older ages and there is a relationship between day service utilisation and school-leavers (National Disability Authority, 2018).

ESRI work estimating and projecting the demand for health services delivered in the community is currently underway. Previous estimations of the demand for public health nursing and community therapy services indicate that there is variation in demand by age and sex (Wren et al., 2017). Total population growth can be expected to increase the demand for primary care. Similarly, while the demographic utilisation and expenditure profiles by age and sex for mental health services, social inclusion services, local demand led schemes, the national ambulance service and the national cancer control programme is currently limited, as the size of the population grows, the demand for these services can be expected to grow. This is also in line with the Fiscal Council's most recent projections of health expenditure, where they model areas lacking age specific expenditure with total population growth (Irish Fiscal Advisory Council, 2020a).

[7] Forthcoming IGEES work on the High-Tech Drug scheme may be able to inform more detailed age cost estimates in this area in the future.

2. Drivers of Healthcare Expenditure

Drivers of healthcare expenditure are generally divided into demographic and non-demographic drivers (de la Maisonneuve & Oliveira Martins, 2015). Population ageing, expressed through the increase in the share of the population aged 65+, was originally considered as the fundamental demographic driver, while the income effect/elasticity, expressed as GDP per capita, was considered as the fundamental non-demographic driver (Kleiman, 1974; Newhouse, 1977). However, additional determinants of healthcare expenditure were subsequently proposed as regression analyses found that ageing and income effects did not constitute the entirety of the determinants of healthcare expenditure (Marino et al., 2017). Ageing and income explained c. 50% of healthcare expenditure in the first cross-sectional studies using regression modelling (Marino et al., 2017).

These additional determinants of healthcare expenditure include relative prices, technology as well as the impact of policies and institutions, and are grouped under the non-demographic drivers along with the income effect (de la Maisonneuve & Oliveira Martins, 2015).

Non-Demographic Drivers

The income effect refers to the positive relationship between national income and aggregate healthcare expenditure (Farag et al., 2012). Rising incomes leads to an increase in expectations of the quality and scope of healthcare (Licchetta & Stelmach, 2016; Lorenzoni et al., 2019; Marino et al., 2017). However, the size of the income effect is debated. The income elasticity of healthcare (the responsiveness of healthcare expenditure to a change in income) appears to vary depending on the level of aggregation. At an individual level, the sensitivity of spending on healthcare depends on the level of public or private insurance coverage (European Commission Directorate-General for Economic and Financial Affairs, 2018). If an individual is fully covered with no co-payments required, healthcare demand will be independent of individual income (European Commission Directorate-General for Economic and Financial Affairs, 2018). At national level, healthcare spending is driven by various considerations[8] and although there is general consensus with regard to the relationship between rising national income and rising demand, the strength of the relationship is not established (European Commission Directorate-General for Economic and Financial Affairs, 2018). While older cross-sectional studies found income elasticities above one[9] (Leu, 1986; Newhouse, 1977), a critique of these studies relates to the challenge of isolating the effect of national income on demand, as healthcare spending is determined by factors other than income which themselves tend to be correlated with income. In addition, health status which is affected by healthcare spending is likely to affect economic growth (European Commission Directorate-General for Economic and Financial Affairs, 2018). More recent studies using panel data have estimated the income elasticity of demand for healthcare at approximately one[10] or below one[11] (Medeiros & Schwierz, 2013; Vargas Bustamante & Shimoga,

[8] There is an inherent correlation between revenue raising of funds to cover healthcare spending at national level, but policies and political priorities relating to healthcare spending can dilute the link between national income and public healthcareexpenditure (European Commission Directorate-General for Economic and Financial Affairs, 2018).

[9] An income elasticity of demand above one means that an increase in income is accompanied by a greater than proportionate increase in demand. These good are often referred to as 'luxury' or 'superior' goods.

[10] An income elasticity of demand of one, or unitary income elasticity of demand, means that an increase in income is accompanied by a proportionate increase in demand.

[11] An income elasticity of demand between 0 and 1 means that an increase in income is accompanied by a less than proportionate increase in demand. These goods are often referred to as 'necessity' goods.

2018; Xu et al., 2011), while Acemoglu et al., (2013), when trying to estimate the causal effect of income on healthcare expenditures, found an elasticity of 0.72 with an upper value of 1.13. Mehrara et al. (2010) analysed the income elasticity of healthcare for OECD countries and found an income elasticity above one (unity), indicating that demand increases more than proportionate to the rise in income. A recent analysis of the income effect in Ireland found that a 1% change in national income results in a change in Government spending on healthcare of 0.7%, reflecting an income elasticity of 0.7 (Parliamentary Budget Office, 2020).

Healthcare prices tend to rise at a greater rate than prices in the rest of the economy and this relationship is conceptualised as 'relative prices' (Keegan et al., 2020). Baumol's 'cost disease' theory explains this relationship (Marino et al., 2017). Baumol (1967) posited that pay rates in healthcare and other sectors with low productivity growth (that is, where productivity gains are limited in nature) will grow in line with pay rates in sectors of the economy with high productivity growth (that is, where productivity gains can be more easily achieved) to prevent major shifts in the labour force (Marino et al., 2017). Underpinning this theory is the low productivity growth nature of healthcare, where technological developments will likely not lead to large productivity increases, as it is difficult to substitute technology for a healthcare professional. New technological developments could instead drive up healthcare volume (through e.g. faster diagnostic tests) (Marino et al., 2017).

Technology impacts healthcare expenditure through technological advancements (Newhouse, 1992; Smith et al., 2009) which is closely interlinked with the other demographic and non-demographic drivers. As national income increases, there are typically more advances in medical technologies that extend the scope of health services, but which comes with a cost (Lorenzoni et al., 2019). Technological advancements impact demographic change by extending life expectancy and changing patterns of morbidity, and as such, there is a link between technological advancements and assumptions around health and ageing (see next section 'Demographic Drivers' for an elaboration of these assumptions).

The 'policy and institutions' effect relates to health system structures such as provider reimbursement mechanisms and health system financing models (de la Maisonneuve & Oliveira Martins, 2015). Salary and capitation reimbursement mechanisms for primary care have been associated with lower healthcare expenditure, on average, compared with fee-for-service mechanisms (Christiansen et al., 2006; Gerdtham et al., 1998). The relationship between the share of publicly financed healthcare expenditure and total healthcare expenditure is not clear (see e.g. Jönsson and Eckerlund, 2003; Gerdtham et al., 1998; Bech et al., 2011 in Wren & Fitzpatrick, 2020). Furthermore, with regard to publicly financed healthcare expenditure, and as highlighted by Wren & Fitzpatrick (2020), some studies assessing health system financing models as a determinant for healthcare expenditure have found that healthcare expenditure tends to be higher in social insurance systems compared to tax financed systems (Wagstaff, 2009; Wagstaff & Moreno-Serra, 2009).

When considering drivers of healthcare expenditure, it is important to note that some increases in healthcare expenditure are accompanied with higher quality or improved access, which can be the result of technological or policy developments or income effects (Marino et al., 2017). An increase in healthcare expenditure from an increase in national income means that a country is spending more on healthcare as the country is getting richer, which could be desirable if it comes with an improvement in quality or access (Marino et al., 2017).[12] As outlined previously, there is a link between higher national income and increases in medical technology spending. As highlighted by Cutler & McClellan, (2001) medical technology costs need to be compared with benefits.[13] In addition, Sorenson et al. (2013) argue that a better understanding of the added value of medical technologies to the healthcare system is needed, and in particular which technologies work best and are most cost-effective, and under which circumstances. Beyond clinical and therapeutic, benefits may include higher quality of care, improved quality of life and greater efficiency in care delivery (e.g. reduced length of stay) and enhanced ability to work or return to work (Sorenson et al., 2013).

Non-demographic drivers play a substantial role in explaining increases in healthcare expenditure. However, the focus of this paper is on the demographic drivers of healthcare expenditure which are elaborated on in the following section.

Demographic Drivers

Demographic drivers of healthcare expenditure relate to the change in the size, age- and sex structure of the population and assumptions around health and ageing (de la Maisonneuve & Oliveira Martins, 2015; Marino et al., 2017). A growing population will affect total healthcare expenditure by increasing overall demand for healthcare services, while the age structure of the population influences healthcare expenditure as utilisation of health services varies over the life cycle. Expenditure tends to be higher at older ages, in the first stage of life and during maternity years for women (Keegan et al., 2020). An ageing population could therefore result in overall higher per capita healthcare expenditure, reflecting the higher utilisation at older ages (Keegan et al., 2020). It has been suggested that the observed difference in healthcare expenditure between young and old persons is primarily caused by proximity to death rather than differences in calendar age (Zweifel et al., 1999). There is evidence that a large share of health expenditure is concentrated in the final years of life, as indicated by studies in Ireland (Layte, 2007), the US (McGrail et al., 2000; Spillman & Lubitz, 2000), Switzerland (Zweifel et al., 2004) and Germany (Busse et al., 2002). In particular, proximity to death seems to be an important predictor of acute/hospital healthcare expenditure (McGrail et al., 2000; Spillman & Lubitz, 2000; Busse et al., 2002).

Assumptions around health and ageing concern the relationship between decreases in mortality (increases in life-expectancy) and accompanying effects on morbidity. Originally, decreased mortality was thought to reflect improvements in population health status, i.e. a decrease in morbidity (Przywara, 2010). However, as more reliable data became available (lifetables, mortality, morbidity and disability) this simple relationship is no longer supported (Przywara, 2010). The three dominant hypotheses explaining the relationship between total and healthy (morbidity-free) life-expectancy have emerged in the literature. These are; (i) the expansion of morbidity, (ii) the compression of morbidity and (iii) the dynamic equilibrium (Przywara, 2010). These assumptions are often included in long-term projections of healthcare expenditure or demand, see e.g. the European Commission's ageing report (European Commission Directorate-General for Economic and Financial Affairs, 2018, 2021) and ESRI's projections (Keegan et al., 2020; Wren et al., 2017).

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[12] If healthcare is a superior good, for which demand increases more than proportionate to the rise in income, this means that societies will increase the weighting of healthcare in their consumption bundles as they get richer. This would be in contrast to necessities like food, for which expenditure tends to grow more slowly than income, leading to a decline in expenditure shares of necessities as incomes rise.

[13] Benefits include increased longevity, improved quality of life and less time absent from work.

The expansion of morbidity hypothesis assumes that developments in medicine relate to the prevention of fatal outcomes of degenerative diseases, however, the disease pattern in the population remains the same. As a result, most of the life years gained are spent in bad health, or put differently, a higher proportion of people with bad health advance in age (see Gruenberg 1977, Olshansky et al. 1991, Verbrugge 1984 and Guralnik 1991 in (Przywara, 2010). Contrary to this, the compression of morbidity hypothesis assumes that gains in life expectancy are driven mainly by changes in the patterns of disease. As a result, people live longer because the onset of chronic degenerative disease is being postponed to later ages and healthy life expectancy grows more than total life expectancy (see Fries 1980, 1983, 1989, 1993 in (Przywara, 2010). The dynamic equilibrium hypothesis assumes that increased life expectancy is accompanied by a postponement of morbidity and/or disability and in effect, healthy life expectancy broadly grows at the same rate as total life expectancy (see Manton et al. 1995 in (Przywara, 2010).

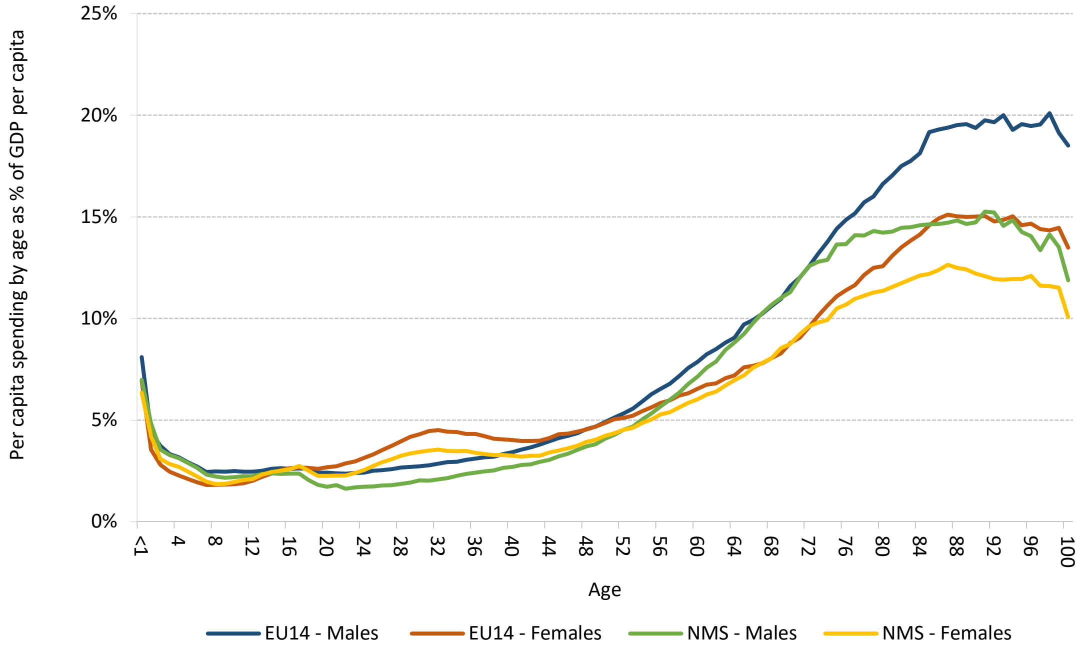
Pure Demographic Effect

The 'pure' demographic effect is estimated by only considering the impact of changing demographics (size and age structure of the population) on expenditure, while everything else is assumed constant (Parliamentary Budget Office, 2019). It represents a no policy change scenario (i.e.no changes in the delivery of care assumed) where healthcare costs stay the same and are not impacted by any of the non-demographic cost drivers previously outlined.

The impact of changing demographics on health expenditure can vary across service areas. Expenditure on Long-Term Care (LTC) is likely more sensitive to an ageing population given that a higher proportion of LTC recipients are elderly. Yang et al., (2003) analysed US Medicare expenditure and found that the relationship between expenditure and the share of the population aged 65+, called the 'pure ageing effect', was a major driver of long-term care expenditure, while for inpatient expenditure, they found that closeness to death was the most important reason for higher expenditure.

The effect of an older population on healthcare expenditure is illustrated by a 'j-shaped' curve, generally found when plotting national per capita healthcare expenditures by age, e.g. see EC Ageing report 2021 (European Commission Directorate-General for Economic and Financial Affairs, 2021) or (Keegan et al., 2020). The 'j-shaped' curve illustrates that expenditure tends to be higher at the beginning of life and at the later stages of life. Figure 3 plots per capita public healthcare expenditure as a % of GDP by age and sex for EU member states in 2019. A sharp increase can be seen in per capita expenditure from 55 years for males and from 60 years for females reflecting higher morbidity in older ages (European Commission Directorate-General for Economic and Financial Affairs, 2021). An increase in spending can also be seen during maternity years for women (European Commission Directorate-General for Economic and Financial Affairs, 2021), see Figure 3.

Figure 3. Per capita expenditure by age and sex as a percentage of GDP per capita for EU Member States (EU14 and New Member States).



Source: Reconstructed graph II.2.1 in the 2021 Ageing Report, with permission from the Ageing Working Group of the European Commission (European Commission Directorate-General for Economic and Financial Affairs, 2021: p. 106).

3. Existing Evidence Base for Funding Demographic Change in Ireland

The impact of changing demographics on health expenditure is recognised by the Department of Public Expenditure and Reform (DPER) (Department of Public Expenditure and Reform, 2020c). As outlined previously, as part of the expenditure management process, DPER publish 3-year expenditure ceilings (Department of Public Expenditure and Reform, 2020b). For the Health, Education and Social Protection Vote, these expenditure ceilings consider the impact of changing demographics, where allocations have been informed by IGEES work in 2016 (Connors et al., 2016; Department of Public Expenditure and Reform, 2019b).

The Expenditure Report for each of the years 2017 - 2020 (Department of Public Expenditure and Reform, 2017, 2018, 2019a) references these demographic estimates and the IGEES 2016 work, with the 2020 report stating:

"The Irish Government Economic and Evaluation Service paper, Budgetary Impact of Changing Demographics 2017 – 2027, published in 2016, forecasted the likely additional costs over the next decade due to increased demands for public spending across the health, education and social protection areas. These forecasts have been used to inform demographic funding provided to these Departments on an annual basis through the Estimates process. In this context, this Budget is no different, with the demographic allocations included in the Departmental ceilings out to 2022 guided by these estimates. An updated version of the paper is published alongside this Report. Given the importance of demographic changes to future budgetary planning, consideration will be given to the findings of this new paper over the coming months and any changes arising will be set out in the Mid-Year Expenditure Report 2020" (Department of Public Expenditure and Reform, 2019b).

In Budget 2021, €630m was provided for the maintenance of the ELS. This includes the impact of national and sectoral pay deals and reimbursements of drugs currently approved. The proportion provided which was specifically referenced as being linked to demographic pressures in Health is outlined at €180m (Department of Public Expenditure and Reform, 2020d) and this is informed by the updated IGEES work in 2019, where the demographic cost pressure for 2021 was estimated at €175m (Connors et al., 2019).

However, in their review of approaches to estimating the impact of changing demographics on health expenditure, the Parliamentary Budget Office argue that *"these estimates likely underestimate the total cost pressure as they only consider certain components of total health expenditure"* (Parliamentary Budget Office, 2019: p. 1). The components considered are the age specific expenditure available in acute hospitals[14] and the Primary Care Reimbursement Services (PCRS)[15], the Nursing Home Support Scheme (NHSS) and Older Persons' Services (OPS) (Connors et al., 2016; Connors et al., 2019). In 2019, these service areas together accounted for approximately 53% of total

[14] Age specific expenditure is available for in-patients and day patients, representing approximately 71% of total acute hospital expenditure (2018 level).

[15] Age specific expenditure was available for approximately 66% of total PCRS expenditure in 2017. Schemes with age specific expenditure are the General Medical Services Scheme, Drugs Payment Scheme, Long-Term Illness Scheme, Community Ophthalmic Services Scheme and Dental Treatment Services Scheme.

healthcare expenditure that can be considered to have a demographic impact[16], see Table 8 in the methods section.

Details of this paper are provided in the next section, followed by an overview of more recent work by the Irish Fiscal Advisory Council and the Economic and Social Research Institute (ESRI), projecting the demographic impact on health expenditure.

IGEES (2019) 'Budgetary Impact of Changing Demographics from 2020-2030'

The IGEES 2019 paper 'Budgetary Impact of Changing Demographics from 2020-2030', estimates demographic cost pressures for health expenditure. As previously mentioned, four operational service areas are included in the analysis, namely, acute hospital services, PCRS, NHSS and OPS. It is recognised that "there are *other areas of health spend which have smaller demographic components however for these areas, there is limited data available on expenditure across age cohorts*" (Connors et al., 2019: p. 13).

The population projections used in the report are the CSO's M2F2[17] projections, assuming a net migration of +20,000 annually and that the total fertility rate decreases from 1.8 to 1.6 by 2030 (Connors et al., 2019). In a scenario analysis, the M1F2 (high migration) and M2F1 (high fertility) population projections are used. The CSO's M1 scenario assumes an annual net migration of +30,000, while their F1 scenario assumes that the total fertility rate remains at the 2016 level of 1.8 (Connors et al., 2019).

For acute hospital services, the available age specific expenditure for in-patients and day patients is modelled using the 2017 Hospital In-Patient Enquiry data on cost structures and utilisation rates by age cohorts (Connors et al., 2019). The demographic cost pressures are calculated by multiplying the relative cost per case (by age group) with the projected number of discharges for each age group[18] (Connors et al., 2019). No age specific information is available in health administrative data with regard to the acute hospital service expenditure areas of Emergency Department and Outpatient care, (which represents approximately 29% of acute hospital expenditure)[19]. These areas of acute hospital services were not modelled in the IGEES 2019 paper (Connors et al., 2019).

The PCRS component is modelled by calculating per capita costs for each age group for the PCRS schemes with age specific data in 2017 (Connors et al., 2019). These per capita costs are held constant, assuming that both costs and utilisation rates are unchanged, and are combined with age specific population projections (Connors et al., 2019). The projected expenditure by age group is aggregated to give the total cost for each scheme (Connors et al., 2019). Finally, the GP visit card component of the General Medical Scheme takes account of the extension in eligibility for GP services to the population under 6 years and over 70 years (Connors et al., 2019).

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[16] Healthcare expenditure in areas where patients utilise services is considered to have a demographic impact. These service areas are broadly similar to previous work conducted by the Department of Health, modelling the demographic impact on healthcare expenditure (Department of Health,2014).

[17] The CSO's population and labour force projections 2017-2051 include two fertility assumptions and three migration assumptions, going from higher to lower assumptions. The two fertility assumptions are F1 (high) and F2 (central) and the three migration assumptions are M1 (high), M2 (central) and M3 (low).

[18] The age groups used are 0-4, 5-14, 15-44, 45-54, 55-64, 65-74, 75-84 and 85+.

[19] 2018 levels.

NHSS is modelled based on previous IGEES work in 2015 and 2017 (Campbell & Connors, 2015; Meirmans, 2017). Based on this work, an annual average increase in recipient numbers of 0.82% is assumed with the split between private and public recipients assumed to remain at 79% private and 21% public. Furthermore, the individual contribution provided by new members entering the scheme is assumed to have increased[20] and the cost of care is assumed to remain constant at the 2018 level (Connors et al., 2019).

For OPS, the demographic cost pressure is calculated by applying the growth in the population aged over 65 years, reflecting the concentration of utilisation in this age group and the lack of age specific data in the service area (Connors et al., 2019).

The estimated demographic cost pressures are shown in Table 1, amounting to a total annual cost of €171m in 2020, €175m in 2021 and 2022 respectively, and an average annual cost of €186m between 2023 - 2026, and €191m between 2027-2030 (Connors et al., 2019).

Table 1. Annual and average (avg.) annual demographic costs 2020-2030 (Connors et al., 2019).

	Annual cost (€m) 2020	Annual cost (€m) 2021	Annual cost (€m) 2022	Avg. annual cost (€m) 2023-2026	Avg. annual cost (€m) 2027-2030
Acute Hospitals – age specific	91	94	94	100	102
PCRS – age specific	43.6	44.5	44.1	46.8	48.1
Older Persons' Services	28.8	28.6	29.1	31.0	32.6
NHSS	7.7	7.7	7.8	7.9	8.2
Total Health	**171**	**175**	**175**	**186**	**191**

Irish Fiscal Advisory Council (2020) 'Long-term Sustainability Report'

In the Fiscal Council's 'Long-term Sustainability Report: Fiscal challenges and risks 2025-2050' (LTSR), the demographic impact on healthcare expenditure is modelled for HSE expenditure, PCRS and Long-term residential care (Irish Fiscal Advisory Council, 2020a; 2020b).[21] The available age specific expenditure within acute hospital care and PCRS is modelled using age-group specific growth (Irish Fiscal Advisory Council, 2020a). OPS and palliative care are modelled by applying the growth in the population aged 65+. NHSS is projected based on the current age profile of applicants and the average length of stay, which is assumed to stay unchanged throughout the projection period (Irish Fiscal Advisory Council, 2020a). The remaining expenditure is modelled with the total population growth.

The Fiscal Council produces its own population projections using a cohort component model.[22] The CSO population estimate for 2019 is projected forward by age and sex as a function of developments on fertility rates, survival probabilities and migration flows (Irish Fiscal Advisory Council, 2020a). For the period 2020-2025, net migration flows are consistent with the DoF Stability Programme Update 2020, while the CSO's assumptions around mortality rates are used throughout (Irish Fiscal Advisory Council, 2020a). The baseline assumptions around net migration are net flows of around 14,000 to

[20] Through "*…a combination of rising wealth and income among present retirees and the declining numbers of relatively expensive legacy patients, it is expected that declines in the unit cost will offset much of projected increase in demand*" (Campbell & Connors, 2015: p. 18).

[21] Expenditure sources are Eurostat (COFOG data), DPER data bank and DPER Revised estimates for 2019 (Exchequer expenditure).

[22] The cohort component model projects the population broken down by adding and subtracting the demographic components of change.

2031. The Fiscal Council's baseline projections are on average, close to the CSO's lower migration scenario (M3) of average net migration flows of 10,000 over the entire projection horizon (Irish Fiscal Advisory Council, 2020a). For the 2030s, projections correspond with those of the CSO's second scenario (+20,000), as well as with Eurostat's baseline estimates (Irish Fiscal Advisory Council, 2020a). The Fiscal Council's projections of future fertility are based on a model of age-specific fertility rates (Irish Fiscal Advisory Council, 2020a). The total fertility rates used by the Fiscal Council are slightly higher than the two CSO scenarios (F1, F2) throughout the projection period (Irish Fiscal Advisory Council, 2020a).

In addition to estimating the demographic impact on expenditure, the impact of national income[23] and prices (pay and non-pay) are also estimated. Price pressures for health are modelled by separating health expenditure into pay and non-pay components (50/50 division) (Irish Fiscal Advisory Council, 2020a). The pay component is projected by linking it to average economy-wide wage growth[24] (Irish Fiscal Advisory Council, 2020a). The non-pay component of health expenditure is projected assuming that prices grow in line with general prices, but to reflect price increases from technological costs, a one percentage point is added to the GNP deflator (Irish Fiscal Advisory Council, 2020a).

The Fiscal Council estimates indicate that health and pensions will be the main contributors to age-related public expenditure pressure over the long term[25]. Health expenditure is projected to increase as a share of GNI*[26] from 8.3% in 2019 to 13.2% in 2050 (Irish Fiscal Advisory Council, 2020b). The total projected annual increase in health expenditure in the short term is €1,581.5m in 2022, €1,196.8m in 2023, €1,160.9m in 2024 and €1,379.5m in 2025, see Table 2. Of these increases, the growth attributed to demographics is estimated at €380.6m in 2022, reaching €567.6m in 2025 (Irish Fiscal Advisory Council, 2020c). The impact of demographics on health expenditure increases significantly over the projection period, reflecting the interaction between demographics and prices (the growth in prices increases the base cost on which the demographic driver is modelled upon) (Irish Fiscal Advisory Council, 2020a).

Table 2. Annual cost increases 2022-2025 by demographic and other pay and non-pay pressures (Irish Fiscal Advisory Council, 2020c).[27]

	Annual cost (€m) 2022	Annual cost (€m) 2023	Annual cost (€m) 2024	Annual cost (€m) 2025
Demographics[28]	380.6	476.1	517.8	567.6
Other pay and non-pay	1,200.9	720.7	643.1	811.9
Total Health	**1,581.5**	**1,196.8**	**1,160.9**	**1,379.5**

Note: The Fiscal Council demographics estimates do not offer a like-for-like comparison with the estimates shown in this paper. They are also a function of price and demand pressures accumulating in previous years. Estimates on a like-for-like basis would suggest demographic pressures of the order of €300 million per annum[29].

[23] In the base case scenario, health expenditure is assumed to grow in line with real GNP per capita at an elasticity of one, and at an elasticity of 0.7 in a scenario analysis. For more details, see Fiscal Council's Long-term Sustainability methodology report.

[24] Wages are assumed to grow in line with labour productivity, so that real wage growth matches labour productivity gains in the long run.

[25] These are also the largest age-related expenditure areas in the base year.

[26] GNI* is a modified Gross National Income Indicator that excludes globalisation effects of the Irish economy. https://www.cso.ie/en/releasesandpublications/in/nie/in-mgnicp/

[27] A breakdown of cost increases for 2021 are not available.

[28] This includes the compound effect of price and demand pressures.

[29] Personal communication with the Fiscal Council, 1st June 2021.

ESRI & Department of Health Research Programme in Healthcare Reform

Work carried out through the Joint Research Programme between the ESRI and the Department of Health (DoH) has enabled a greater understanding of population demand of health services, as well as the associated expenditure required to meet this demand over the medium-term. This has been enabled through the development of the ESRI's macro-simulation model, HIPPOCRATES. Using a bottom-up approach, projections are based on activity rates, demographics and unit costs (Keegan et al., 2020; Wren et al., 2017).

In 2017, the first report from the HIPPOCRATES model was published, projecting the demand for public and private health and social care services out to 2030 (Wren et al., 2017). Wren et al. (2017) find that demand for public services are projected to increase across all areas of health and social care, with the greatest increase in areas primarily used by older people, namely, long-term and intermediate care as well as home support care[30] (Wren et al., 2017).

In 2020, the first report projecting health expenditure for the HIPPOCRATES model was published providing baseline age and sex specific activity profiles for in-patient, day patient, emergency department care and outpatient care (Keegan et al., 2020). These activity profiles are adjusted for assumptions around health and ageing and then combined with population projections for respective age and sex specific cohorts. Finally, the activity profiles are combined with baseline unit costs, adjusted (indexed) for inflationary pressures (wage growth and price inflation) based on the ESRI's macroeconometric model COSMO[31] (Keegan et al., 2020). Pay is projected with government-sector wage growth of 2.2% (low pressure scenario), 2.5% (central scenario) and 3.5% (high pressure scenario) per annum (Keegan et al., 2020). Non-pay is divided into drug costs and Other costs, with drug costs projected at 4.2% (low pressure scenario), 5.2% (central scenario) and 6.2% (high pressure scenario) per annum and other costs indexed to projected inflation rate plus 0.5 percentage point per annum (low pressure scenario) and plus one percentage point per annum (central and high pressure scenarios) (Keegan et al., 2020).

The ESRI produce their own population projections[32] for the HIPPOCRATES model, providing three scenarios: a central scenario based on trends in the data and linked to medium-term projections for the Irish economy and a high and low population scenario (Keegan et al., 2020; Wren et al., 2017). The central scenario population projections assume that mortality rates decrease with gains in life expectancy at birth from 79.5 years for males and 83.4 years for females in 2015 to 82.7 years for males and 85.8 years for females in 2030 and 83.5 years for males and 86.5 years for females in 2035 (Keegan et al., 2020). In their central scenario, considering the impacts of Covid-19, net migration is assumed to decline from the 2019 level of +33,700 to +5,000 in 2022 and then stay constant at +10,000 per annum thereafter. The total fertility rate is assumed to stay unchanged from the 2019 rate of 1.72 (Keegan et al., 2020).

Keegan et al. (2020) project public acute hospital expenditure to increase in nominal terms by between 3.6% to 5.4% on average per annum to 2035. This is largely driven by increases in pay. When the effects of inflationary pressures (pay and non-pay) are removed, expenditure is projected to increase

[30] In 2018 the home help and home care packages schemes were merged into the home support scheme.

[31] COSMO (Core Structural Model of the Irish Economy) is a structural macroeconometric model of the Irish economy which models the behaviour of the economy in a small open-economy framework (Keegan et al., 2020).

[32] Using a cohort component method.

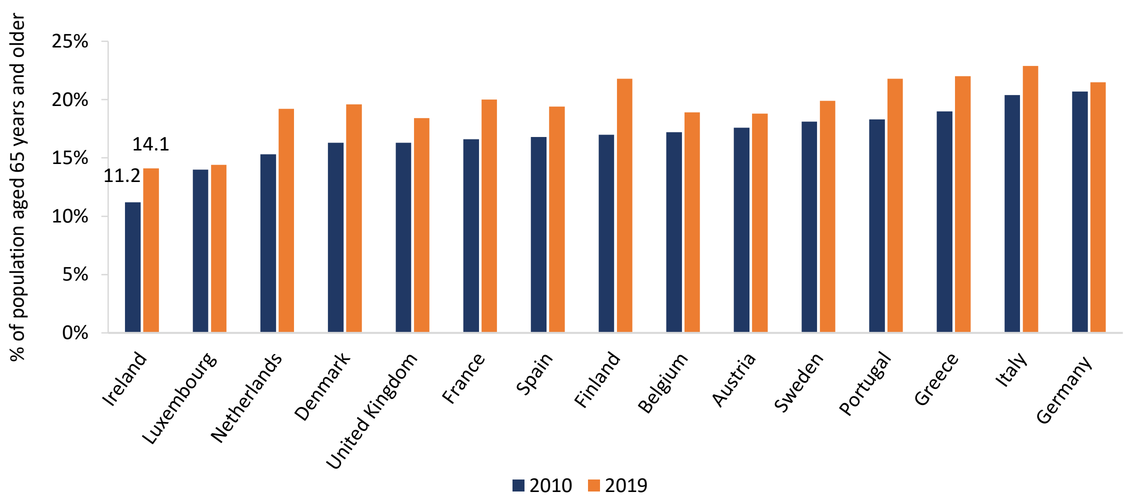
(in real terms) between 1.2 to 1.7% on average per annum to 2035 (Keegan et al., 2020). This increase reflects a ‘volume’ increase, which can be attributed to demographic change (Keegan et al., 2020).

At the time of writing, work is currently underway by the ESRI to project health expenditure for the non-acute sector. In addition, analyses of the utilisation of services, to feed into the HIPPOCRATES model are published by the ESRI. In 2020, a baseline analysis of utilisation of specialist disability services was published (Brick et al., 2020).

4. Projected Demographic Change for Ireland

Ireland has a relatively young population when compared to EU15[33] countries and when measured as the share of the population aged 65 and over. Using this measure, and although the share increased with 2.9 percentage points over the period, Ireland ranked 15th of the EU15 countries in both 2010 and 2019, reflecting a growth in the population aged over 65 across all EU15 countries, see Figure 4. Finland showed the greatest increase over the period with a growth of 4.8 percentage points while Luxembourg showed the smallest increase with a growth of 0.4 percentage points. EU's population is ageing and Eurostat project that the old-age dependency ratio[34] for the EU as a whole will increase from 34% in 2019 to 59% by 2070, with increases across all member states (European Commission Directorate-General for Economic and Financial Affairs, 2021). However, Ireland is one of a few other member states (along with Cyprus, Luxembourg, Sweden and Malta) where the total population is projected to increase. Ireland's total population is projected to increase from 4.9 million in 2019 to 6.5 million in 2070, representing an increase of 31.7% (European Commission Directorate-General for Economic and Financial Affairs, 2021). Net migration is a key contributor to Ireland's total population growth (Osés-Arranz, 2019), and migrants tend to be concentrated in the 15-44 ages (Keegan et al., 2020). Net migration can therefore be expected to impact demand on certain areas in health, e.g. maternity services, but does not directly contribute to the ageing effect of the population with per capita healthcare expenditure increasing sharply from 55-60 years, as illustrated in the j-shaped curve in figure 3.

Figure 4. Share of population aged 65 and older across EU15 countries in 2010 and 2019.



Source: Eurostat 2021.

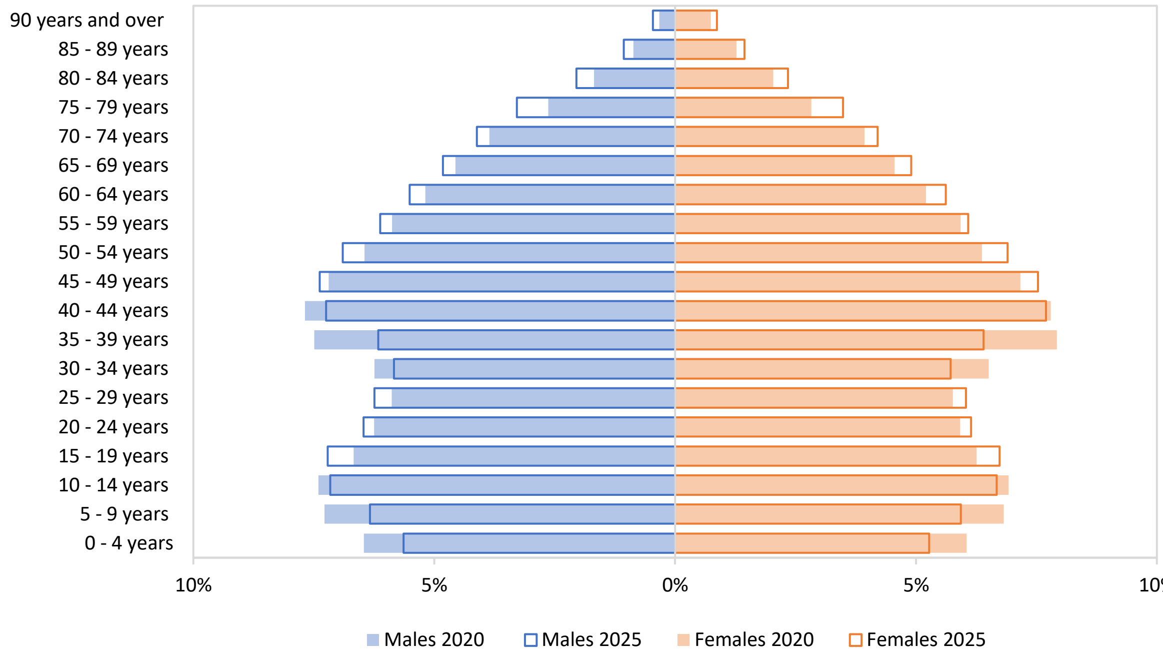
The ageing of the Irish population is illustrated by the 'elderly' (those aged 65 and over) increasing as a share of the population while those aged under 15 decreasing as a share of the population. Figure 5 illustrates the age structure of the Irish population in 2020 and 2025 from the CSO M2F2 population

[33] With regard to international healthcare comparison, the 14 other EU member states prior to expansion in May 2004 are often used as it is argued that they exhibit a broadly similar level of economic development. Noting as per Figure 3 this is now 'EU14' due to the United Kingdom's exit from the European Union.

[34] The age-old dependency ratio is a measure of the population aged 65 and over relative to those aged 20-64 and gives an indication of the beneficiary elderly population relative to the contributing population of working age.

projection scenario (Central Statistics Office, 2021a). During this period, the population is projected to grow by 5.5%, from 4,895,831 in 2020 to 5,166,177 in 2025. The share of the population aged 65 years and older is projected to increase from 14.6% to 16.3%, while the share of the population aged under 15 is projected to decrease from 20.4% to 18.5%. The share of the population aged between 15 and 64 years is projected to stay approximately the same (at around 65%) during the period.

Figure 5. Ireland's population by five-year old age groups and sex in 2020 and 2025, as a share of total population.



Source: CSO M2F2 population projection scenario.

By 2036, as shares of the total population, the rate of those aged 65 and over and those aged under 15 will have nearly reversed from 2016 shares. The share of the population aged under 15 will decrease from 21% in 2016 to 15% in 2036 and the population aged 65 and over will grow from 13% in 2016 to 20% in 2036[35]. This is broadly in line with ESRI projections out to 2035, where it is projected that the share of the population aged 65 and over will grow from 14% in 2018 to 20% in 2035, while the population aged under 15 will decline from 21% in 2018 to 16% in 2035 (Keegan et al., 2020). By 2051, the share of the population under 15 will stay unchanged compared to 2036 levels at 15%, while the share of the population aged 65 and over will increase to 26%[35].

[35] CSO M2F2 projection scenario.

5. Methodology

This paper utilises the previously discussed available data on expenditure by age[36]. In addition to this, Keegan et al.'s (2020) estimated age specific expenditure for outpatient care, emergency department care and acute adult in-patient psychiatric care are used. In areas where information on age specific expenditure is currently lacking, expenditure age profiles are created by using available age specific utilisation (Brick et al., 2020; Department of Health, 2019; Wren et al., 2017) and estimated utilisation needs (May et al., 2020). Finally, in service areas where age specific information (expenditure, utilisation or need) is currently limited, total service area expenditure is projected forward with total population growth, or where there is a concentration of utilisation within an age cohort, service area expenditure is projected using the respective age specific growth rate.

An overview of the HSE operational service areas modelled in this paper, and the areas modelled in the IGEES 2019 paper (Connors et al., 2019) and the Fiscal Council's 2020 LTSR (Irish Fiscal Advisory Council, 2020b) are presented in Table 3. The operational service areas listed are those considered to be impacted by demographic change[37]. These service areas are broadly similar to those considered in previous work undertaken by the DoH, modelling the demographic impact on health expenditure (Department of Health, 2014). Three areas previously modelled by the DoH (Department of Health, 2014); Emergency Management, Environmental Health and Health & Wellbeing, are not included in this exercise as they represent public health services which in the main are not considered to have a direct link to the age structure or size of the population in the short term. The objective of Emergency Management services is "*to ensure that essential patient facing services face minimal impact due to unforeseen external events and severe weather*" (Health Service Executive, 2019: p. 3). The Environmental Health Service works to control and prevent environmental factors on population health, involving work around e.g. tobacco control, drinking water and food safety (Health Service Executive, 2018, 2021a). Health & Wellbeing works with key priority areas to support people and communities to improve their health and wellbeing (Health Service Executive, 2018, 2021b), see Appendix A for more information on the Health & Wellbeing programme.

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[36] In-patient care and day patient care expenditure in acute hospitals and age specific expenditure in PCRS (General Medical Services Scheme, Drugs Payment Scheme, Long-Term Illness Scheme, Community Ophthalmic Services Scheme and Dental Treatment Services Scheme).

[37] Healthcare expenditure in areas where patients utilise services is considered to be impacted by demographic change.

Table 3. HSE operational service areas included, modelling approach, and population projections used in IGEES (2019), the Irish Fiscal Advisory Council's (2020) LTSR paper and this paper IGEES (2021).

HSE Operational Service Area	IGEES (2019)	Fiscal Council (2020)	IGEES (2021)
Acute Hospitals – In-patient and day patient care	Exp. by age group	Exp. by age group	Exp. by age group
Acute Hospitals – Emergency department and outpatient care	Not included	Total pop. growth	Exp. by age group
PCRS – Schemes with administrative age cost data	Exp. by age group	Exp. by age group	Exp. by age group
PCRS – Schemes lacking administrative age cost data	Not included	Total pop. growth	Total pop. growth
Disability Services	Not included	Total pop. growth	Utilisation by age group
Older Persons' Services	Growth in 65+ pop.	Growth in 65+ pop.	Utilisation by age group
Nursing Home Support Scheme	Previous IGEES work	Applicants' age profiles and average LOS	Utilisation by age group
Mental Health	Not included	Total pop. growth	Total pop. growth
Primary Care	Not included	Total pop. growth	Total pop. growth
Local Demand Led Schemes	Not included	Total pop. growth	Total pop. growth
National Ambulance Service	Not included	Total pop. growth	Total pop. growth
Social Inclusion	Not included	Total pop. growth	Total pop. growth
Palliative Care	Not included	Total pop. growth	Projected deaths with palliative care need in 2019
National Screening Service	Not included	Total pop. growth	Growth in age groups screened
National Cancer Control Programme	Not included	Total pop. growth	Total pop. growth
Population Projections			
	CSO M2F2 scenario	Fiscal Council demographic and migration models	Adjusted CSO

This paper adds to previous IGEES modelling exercises (Connors et al., 2016; Connors et al., 2019) of health expenditure by modelling more areas in general and with greater use of age specific expenditure.

The demographic impact in service areas is estimated in the following:

Expenditure Profiles

- Acute Hospital expenditure (Keegan et al., 2020),
- PCRS age specific expenditure available in the Public Health Information System

Utilisation Profiles

- Disability Services (Brick et al., 2020)
- Older Persons' Services (Department of Health, 2019; Wren et al., 2017)
- Nursing Home Support Scheme (Department of Health, 2019)

Need Profiles

- Palliative Care (May et al., 2020)[38]

Total population growth

- PCRS expenditure without age specific information[39]
- Mental Health[40]
- Primary Care
- Local Demand Led Schemes
- National Ambulance Service
- Social Inclusion
- National Cancer Control Programme
- Diabetic Retina Screen (National Screening Service)

Age cohort specific growth

- National Screening Service:
  - Breast Check – growth in female population aged 50-69 years
  - Cervical Screen – growth in female population aged 25-65 years
  - Bowel Screen – growth in population aged 60-69 years

5.1 Population Projections

Population projections were created using the CSO 2019 population estimate as the base. This base population is projected forward using a demographic component method (Central Statistics Office, 2021b). This projection method calculates the surviving population from the base year to which gross migration and emigration flows are added. Projected births are calculated by applying age specific fertility rates to the female population aged 15-49, dividing into males and females and adjusting downward for infant mortality. This projected population then becomes the base population for the following year, and the process continues out to 2025. The CSO's assumptions around mortality and fertility developments and distribution of migrants by age and sex are used (Central Statistics Office, 2021c, 2021d, 2021e). The distribution of migrants by age is based on observed flows during the inter-censal period between 2011 and 2016, and the sex distribution of migrants is derived from recorded migration flows between 1997 and 2016 (Central Statistics Office, 2021e).

The CSO population estimate reflects the population estimate at April 1st, 2019. An end-of-the year 2019 population estimate was calculated by:

- Applying 75%[41] of the annual 2019 survival rates,
- 75% of the annual births in 2019, and

[38] Palliative care is modelled using the age distribution of projected deaths with palliative care needs in 2019 as estimated by May et al., (2020).

[39] Forthcoming IGEES work on the High-Tech Drug scheme may be able to inform more detailed age cost estimates in this area in the future.

[40] 19.3% of this expenditure is estimated to be acute adult in-patient psychiatric care and is modelled with the expenditure profiles as estimated by Keegan et al. (2020), see Data section for details.

[41] Assuming an even distribution of deaths throughout the year.

- 75% of the CSO 2020 immigration and emigration estimates[42] (Central Statistics Office, 2020a)

The end-of-the year population in 2019 is projected forward to end-of-the year 2020 by applying the annual survival rates, births and immigration and emigration flow assumptions. This process continues until the end-of-the year 2025 population is projected.

Migration assumptions are typically the main source of error in population projections (Irish Fiscal Advisory Council, 2020a) and Ireland's net migration tends to be strongly correlated with the economic cycle (Irish Fiscal Advisory Council, 2020a). Both the size and age structure of the Irish population have been particularly sensitive to international migration as migrants tend to be of working age (Keegan et al., 2020). Ten-year historical trends show that the large majority (80%) of net migration happens in the 15-44 year age group (Keegan et al., 2020). Positive net migration can therefore potentially dampen the effects of ageing (Irish Fiscal Advisory Council, 2020a). International migration is dependent not only on the Irish economic cycle, but also international economic conditions (Keegan et al., 2020). Given the volatility of migration and the economic and societal impact of Covid-19, the CSO's population projection assumptions around annual net migration are adjusted in this paper.

Impact of Covid-19

Beyond the immediate effects on population health, Covid-19 has had wide ranging impacts on society and the economy. Travel was limited between countries and regions of the world in an effort to limit the spread of the virus. This, along with the global economic downturn in the wake of Covid-19, will likely have impacted on Irish net migration flows in 2020 and 2021.

Migration

Both the ESRI and the Fiscal Council assume a significant reduction in annual net migration flows as a result of the Covid-19 pandemic. In their projections of the Irish population from 2019 to 2035 (central scenario)[43], the ESRI assume a decline of net migration from the 2019 level of +33,700 to +5,000 by 2022, and then assume a constant net migration of +10,000 annually thereafter (Keegan et al., 2020). The Fiscal Council, in turn, assume net migration flows of +6,700 in 2020, +16,000 in 2021 and +16,500 annually between 2022 and 2025 (Irish Fiscal Advisory Council, 2020c).

The annual allocations of Personal Public Service Numbers (PPSN)[44] can give an indication of immigration levels into Ireland as new residents are required to apply for a PPSN to access public services and information. The total number of PPSN allocations between 2016 and 2020 are shown in Table 4. In 2020, 132,001 individuals received a PPSN, representing a reduction of 33% from the 2019 level of 196,177. With the number of births in 2020 at 55,959, as compared to 59,796 in 2019 (Central Statistics Office, 2021f), the 2020 reduction in PPSN allocations indicates a substantial decrease in immigration in 2020.

[42] Assuming an even distribution of migration throughout the year.

[43] A low and high migration scenario are also included in the report.

[44] A personal public service number is a unique reference number required to access public services and information in Ireland. https://www.gov.ie/en/service/12e6de-get-a-personal-public-service-pps-number/

Table 4. Annual Personal Public Service Number (PPSN) Allocations 2016-2020.

Year	PPSN Allocations	
	N	Annual Change (%)
2016	181,025	
2017	188,956	+4
2018	194,537	+3
2019	196,177	+1
2020	132,001	-33

Source: Department of Social Protection.

The immigration and emigration numbers applied in this analysis are consistent with the DoF Stability Programme Update 2021, where the migration estimates for 2020 and 2021 have been adjusted to take account of the impact of Covid-19. These are subject to change along with economic forecast updates.

Mortality

Excess mortality are deaths that occur that are over and above what could be expected (Eurostat, 2021). The CSO analysed excess mortality between March and September 2020 using RIP.ie[45] death notices but highlight that the estimates are experimental and are subject to change (Central Statistics Office, 2020b). The CSO further highlight that measuring excess mortality is not straightforward and adjustments are likely required to account for changes in vehicular activity and influenza as well as changes in population age structure or other confounding factors (Central Statistics Office, 2020b).

To assess the potential impact of Covid-19 excess mortality on current population projections, a preliminary Covid-19 mortality analysis was undertaken as part of this paper. Drawing on the estimations of weekly mortality by EuroMOMO[46], an analysis was undertaken where age and sex specific Covid-19 deaths[47] that occurred during weeks with estimated high excess mortality[48] were removed from the population projections. The results showed a marginal impact on demographic cost pressures for the projection period. Considering the uncertainties around excess mortality from Covid-19 and the results of the Covid-19 mortality analysis, no adjustment of Covid-19 deaths was made for this paper.

[45] RIP.ie is an Irish obituary website for publication of death notices.

[46] The European Mortality Monitoring (EuroMOMO) Project provide a real-time public health mortality monitoring system with the objective of detecting and measuring excess deaths related to influenza and other public health threats across participating countries in Europe. EuroMOMO began as a project supported by the Directorate General for Health and Consumer Protection of the European Commission during 2008-2011. Since 2016, the EuroMOMO network is supported by and works closely with the European Centre for Disease Prevention and Control and the World Health Organization Regional Office for Europe. https://www.euromomo.eu/about-us/history/

[47] Sourced from HPSC.

[48] This refers to weekly time series data. Excess mortality is estimated against baseline mortality which is modelled on historical mortality data. https://www.euromomo.eu/how-it-works/methods/

5.2 Data

The projection time period for this analysis is 2020-2025. The base year used is 2019, because of the impact of the Covid-19 pandemic on health service delivery and expenditure. The additional financial resources required to respond to Covid-19 were estimated to be €2,303m in 2020 (Department of Public Expenditure and Reform, 2020e) with €1,726m allocated for Covid-19 support in 2021. Covid-19 related expenditure is not modelled in this paper and future Covid-19 expenditure requirements should be considered separately. In May 2021, the HSE experienced a cyber-attack. Additional expenditure required as a result of the attack is not considered in this analysis.

The total gross current expenditure by HSE operational service areas modelled in this paper are provided in Table 5. In expenditure terms, gross acute hospital care represents the largest HSE operational service area in the health budget, followed by PCRS. It should be noted that Disability services is scheduled to be transferred to the Department for Children, Equality, Disability, Integration and Youth in 2021.

Table 5. HSE gross current expenditure by operational service area in 2019.

HSE Operational Service Area	Gross Expenditure (€m)	Share of Gross Expenditure (%)
Acute Hospitals	6,365.8	39
Primary Care Reimbursement Service	2,974.7	18
Disability Services	2,038.6	12
Older Persons' Services	1,293.5	8
Nursing Home Support Scheme	989.9	6
Mental Health	1,005.7	6
Primary Care	912.7	6
Local Demand Led Schemes	262.8	2
National Ambulance Service	170.9	1
Social Inclusion	164.0	1
Palliative Care	96.0	0.6
National Screening Service	81.6	0.5
National Cancer Control Programme	6.6	0.04
Total	**16,362.7**	**100**

Source: HSE Consolidated Financial Intelligence system.

Table 6 provides an overview of the service areas with age specific information and the source for this material.

- The source material used to generate the Acute Hospital expenditure profiles is based on acute expenditure profiles developed by Keegan et al. (2020) and these profiles were provided by the authors for this analysis. Table 4.4 in Keegan et al. (2020) provides a description of the underlying data sources used to generate these profiles. The Acute Hospital profiles refer to 2018 and covered approximately 88.6% of total gross Acute Hospital expenditure. The same age- and sex distribution is assumed for 2019 and applied to the 2019 gross acute hospital expenditure (€6,365.8m).
- Acute Hospital Adult In-patient Psychiatric profiles refer to 2018 and this activity is funded under the Mental Health operational service area. In 2018, Acute Adult In-patient Psychiatric expenditure was estimated at €179.3m[49] and represented c. 19.3% of total mental health expenditure in 2018, as reported in the HSE Consolidated Financial Intelligence system. The same share of Acute Adult In-patient Psychiatric expenditure was assumed for 2019, giving an estimate for Acute Adult In-patient Psychiatric expenditure of €194m (19.3% of €1,005.7m). The same age- and sex distribution is assumed for 2019 and applied to this estimated gross expenditure (€194m).
- PCRS age specific expenditure amounted to €1,795.8m in 2019, representing c. 60% of total PCRS expenditure (€2,974.7m).

Expenditure profiles were created using utilisation/need profiles. The expenditure profiles were created by scaling the total expenditure against the share of utilisation or need by age and sex:

- The Palliative Care need profile gives the age and sex distribution of projected deaths in 2019 with palliative care needs as estimated by May et al. (2020). The age and sex specific need distribution was combined with the total gross expenditure for palliative care (€96m).
- The utilisation profile for NHSS is derived from the 2019 DoH Long-Stay Activity Statistics. The age and sex specific utilisation distribution was combined with the total gross expenditure for NHSS (€989.9m).

Different utilisation profiles were applied to sub-activity areas within OPS (Home Support and Residential Care) and Disability Services (Residential Care and Day Services). The source material for these profiles are outlined in the following and the application of these profiles is discussed in the following sections.

- The source material used to generate the Home Support expenditure profiles are derived from utilisation profiles presented in Wren et al. (2017) and provided by the authors for this analysis with cost information provided by the HSE.
- Information on utilisation of Residential Care from the 2019 DoH Long-Stay Activity Statistics[50] (Department of Health, 2019), are used to generate expenditure profiles for Residential Care including Short-stay and Transitional Care in OPS with cost information provided by the HSE.

[49] This refers to the units included in the CSO System of Health Accounts expenditure category relating to acute adult in-patient units. This includes 29 public acute adult HSE and HSE funded units.
[50] The data gives residents in long-stay beds by age and sex at end of the year, 31st of Dec 2019.

- The source material used to generate the Disability expenditure profiles are derived from utilisation profiles presented in Brick et al.(2020) and provided by the authors for this analysis with cost information provided by the HSE.

Table 6. Age profiles (expenditure, need and utilisation) by HSE operational area and the source material for these profiles.

HSE Operational Service Area	Age Group	Source
Expenditure profiles		
Acute Hospitals	0-4…90+	Keegan et al. 2020
Acute Adult In-Patient Service	<20, 20-24…85+	Keegan et al. 2020
Primary Care Reimbursement Service	0-4…85+	Primary Health Information System
Need profiles		
Palliative Care	0-4…85+	May et al. 2019
Utilisation profiles		
NHSS	<40, 40-64, 65…99+	DoH Long-Stay Activity Statistics 2019
OPS – Home Support	65…95+	Wren et al. 2017
OPS – Short-stay & Transitional Care	<40, 40-64…95+	DoH Long-Stay Activity Statistics 2019
OPS – Residential Care	<40, 40-64, 65…99+	DoH Long-Stay Activity Statistics 2019
Disability Services – Residential Care	0-4…65[1], 0-4…85+[2]	Brick et al. 2020
Disability Services – Day Services	0-4…65[1], 0-4…85+[2]	Brick et al. 2020

1 Specialist disability services among people with physical and sensory disability
2 Specialist disability services among people with intellectual disability

Older Persons' Services

Older Persons' Services is made up of Home Support, Short-stay and Transitional Care, Residential Care, Day Services and 'Other' Services. Day Services (or Day Care) include Nursing and Therapy Support, Personal Care services such as showering, chiropody and social activities. 'Other' Services include Meals on Wheels, Respite Care, Carer Support, Dementia Support and Administration. Total gross expenditure on OPS, as received from the HSE, was c. €888m in 2019. Home Support accounted for c. €439m, Short-stay and Transitional Care for c. €37m, Residential Care for c. €311m, Day Services for c. €33m and 'Other' Services for c. €68m. The residual expenditure of c. €405.5m (€1,293.5m minus €888m) was applied to each service area according to their respective share of the €888m expenditure. The expenditure in each area was combined with the respective utilisation profile as outlined in Table 6. The Home Support utilisation profile was applied to the Day Services and 'Other' Services expenditure (approximately 11% of total OPS expenditure).

Disability Services

HSE funded Disability Services consist of Residential Care, Day Services, Respite Care, Personal Assistance (PA) and Home Support, Multidisciplinary Support and 'Other' Community Services and Support. Together, Residential Care and Day Services accounted for c. 85% of total Disability Service expenditure. Total gross expenditure on Disability Services as received from the HSE was €1,913.3m in 2019. Residential Care accounted for c. €1,185.4m, Day Services for c. €433m, Respite Care for c. €66m, PA and Home Support for c. €85m, Multidisciplinary Support for c. €89m and 'Other' Community Services and Support for c. €55m. The residual expenditure of c. €125m (€2,038.6m minus

€1,913.3m) was applied to each service area according to their respective share of the €1,913.3m expenditure. The expenditure in each area was combined with the respective utilisation profile as outlined in Table 6. The Day Service utilisation profile was applied to Respite Care, PA and Home Support, Multidisciplinary Support and 'Other' Community Services and Support. Together these areas accounted for approximately 15% of total Disability Service expenditure.

5.3. Analysis

In service areas with age specific data, a cell-based modelling method is used. First, per capita expenditure by age cohort in the base year is calculated and these are then combined with the respective age cohort population projections. Healthcare utilisation and costs are assumed to be constant over the projection period.

For each service area, the annual demographic cost pressure in each year y is given by the sum of the product of per capita expenditure and the projected population for each sex specific age cohort sa, see equation 1.

Equation 1.

$$Total\ expenditure_y = \Sigma(Per\ capita\ expenditure_{sa} \times\ Population\ projection_{y,sa})$$

For service areas where there is no age specific information, expenditure is modelled by applying the total population growth rate, or the cohort specific growth rate, to the total expenditure within the service area.

Sensitivity Analysis

Two scenarios where the population projections are varied to reflect the uncertainty of the assumptions around net migration are specified for the period 2022 to 2025. In scenario one, CSO's M1 migration scenario is applied, reflecting an annual net migration of +30,000 (Central Statistics Office, 2021e). In scenario two, the CSO's M2 migration scenario is applied, reflecting an annual net migration of +20,000 (Central Statistics Office, 2021e). The mortality and fertility rates are not varied, as the marginal error of projecting from the population estimates is likely far greater than any marginal changes to these rates.

6. Results

The annual demographic cost pressures by HSE operational service area are shown in Table 7. Acute hospital services represent the highest demographic pressures throughout. Acute Hospital Care is also the service area with the largest share of expenditure in the health budget (see Table 5) and it is also the area with the most granular level of age specific expenditure data in the health system. The Acute Hospital age specific in-patient and day patient profiles are complexity adjusted[51] and therefore account for the relative intensity of resource use across the age distribution (Brick & Keegan, 2020; Keegan et al., 2020). In-patients are positively related to the complexity-adjustment, i.e. older people consume more resources, in addition to using the services more often (Brick & Keegan, 2020; Keegan et al., 2020). PCRS increases have the second largest per annum increases of all operational areas in 2020 and 2021, while OPS have the second largest per annum increases between 2022 and 2025. The increases for OPS and NHSS are each larger than for Disability Services. Palliative Care represents a relatively small area of the health budget, compared to the other service areas modelled, however it was modelled using more granular data than other areas. The remaining service areas currently lack age specific expenditure and were increased using the total population growth or the growth in specific age groups (Breast Check, Cervical Screen and Bowel Screen of the National Screening Service).

Table 7. Annual demographic cost pressures 2020-2025 (€m) by HSE operational area.

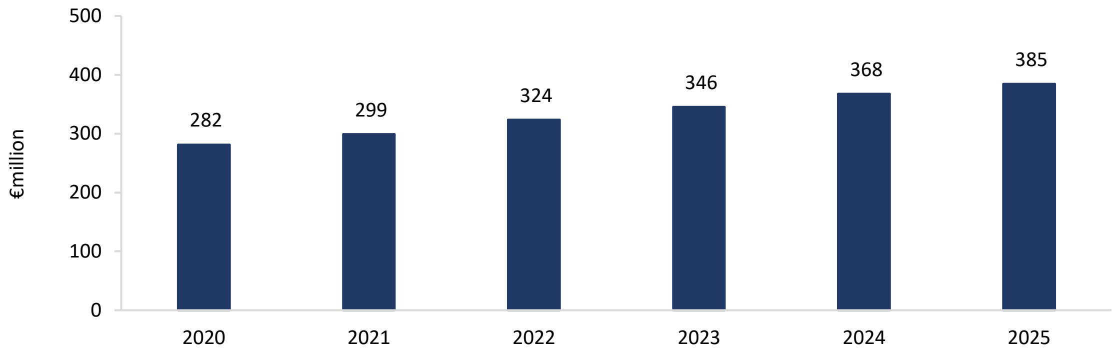
HSE Operational Service Area	2020 €m	2021 €m	2022 €m	2023 €m	2024 €m	2025 €m
Acute Hospitals	104	107	117	125	135	140
Primary Care Reimbursement Service	50	53	55	58	61	63
Disability Services	22	23	25	26	27	28
Older Persons' Services	47	52	56	60	63	67
Nursing Home Support Scheme	34	39	43	47	50	54
Mental Health	8	9	10	10	11	12
Primary Care	7	7	8	9	9	10
Local Demand Led Schemes	2	2	2	2	3	3
National Ambulance Service	1	1	1	2	2	2
Social Inclusion	1	1	1	2	2	2
Palliative Care	2	3	4	4	4	4
National Screening Service	1	1	1	1	1	1
National Cancer Control Programme	0.05	0.05	0.06	0.06	0.07	0.07
Total	**282**	**299**	**324**	**346**	**368**	**385**

The total per annum demographic expenditure pressures are estimated at €282m in 2020, €299m in 2021, €324m in 2022, €346m in 2023, €368m in 2024 and reaching €385m in 2025, see Figure 6. The average annual increase in expenditure for the period is 1.94%. The annual percentage increases for

[51] The discharges are complexity weighted through the assignment of relative values for each discharge. The relative values are captured in the Diagnosis-Related Groups (DRGs) which is a type of reimbursement system for hospitals. The relative value is defined as the average cost per discharge for the assigned DRG expressed as a proportion of the average cost per discharge across all DRGs (Brick & Keegan, 20220).

each service area are shown in Table 1B in Appendix B. The service area specific growth rates reflect the degree to which expenditure was modelled with disaggregated demographic data. The service areas modelled with the total population growth do not account for differences in utilisation of services by age and sex and differences in the composition of the projected population. In effect, these areas have lower growth rates compared to the areas modelled using the cell-based method, applying age- and sex- specific profiles to projected population age- and sex cohorts.

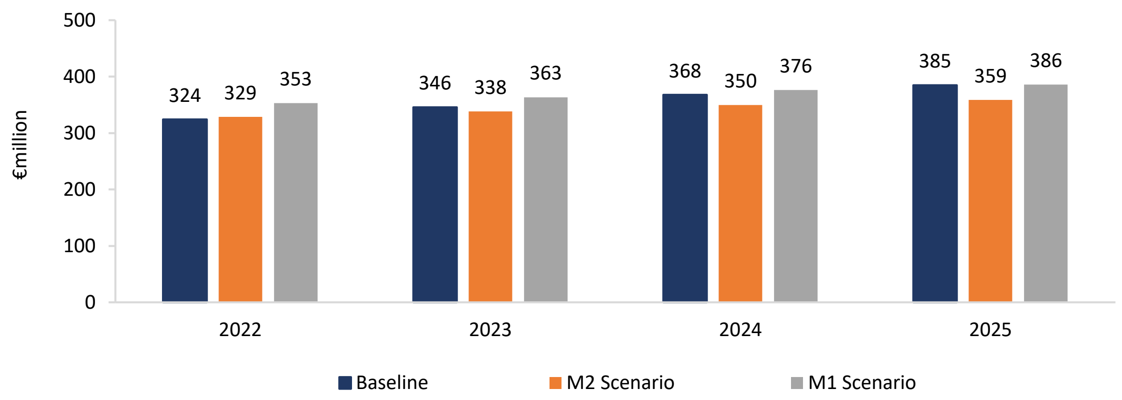
Figure 6. Annual total demographic cost pressures 2020-2025 (€m).



Sensitivity Analysis

The result of the sensitivity analysis is shown in Figure 7. The annual demographic cost increases are similar throughout the period. Assuming an annual net migration of +30,000 (M1 scenario) for the period 2022 to 2025 results in higher demographic cost increases compared to the baseline scenario throughout, ranging from €353m in 2022 to €386m in 2025. Comparing scenario M2 (annual net migration of +20,000) with the baseline scenario, the demographic cost increase is slightly higher in 2022 (€329 compared with €324m), but lower in 2023 to 2025, with increases ranging from €338m in 2023 to €359m in 2025. The per annum cost increases by HSE operational service areas for the M2 and M1 migration scenarios are provided in Table 1C and 2C in Appendix C.

Figure 7. Annual demographic cost pressures 2022-2025 (€m) under baseline population projection, and M2 and M1 population projection scenarios.



7. Discussion

This work has provided estimates of the additional funding required to maintain 'Existing Levels of Service' out to 2025 when accounting only for a growing and ageing population. Under the baseline scenario, the annual demographic increases required are estimated at €324m for 2022, increasing to €385m in 2025. These estimates reflect the expenditure required to maintain ELS in the base year, in a no policy scenario, as such any savings that might arise from a change in the model of care are excluded. The base year expenditure levels are projected forward, without any consideration to whether the level is adequate to meet demand. Research points to unmet need/demand across health services, for acute hospital care, home support, long-term residential care, general practice care and public health nursing and community therapy (Wren et al., 2017), and disability services (National Disability Authority, 2018). Realising any existing unmet demand in the health system would inevitably manifest in greater health expenditure in the absence of policy changes in how services are delivered.

The different service areas in this paper are modelled using varying levels of age disaggregation and due to data limitations, certain areas are modelled using the growth in the total population. In effect, the estimated growth rates reflect the level of disaggregation used, limiting the ability to compare growth rates between services areas. Wren et al. 2017 (section 3.3.8) highlight that using data at the most disaggregated level possible is important to ensure that projections are sensitive to changes in the demographic composition of the population. The higher annual increases in OPS compared to PCRS indicate the effects of the growing population aged 65 and over, when using age specific expenditure. Utilisation of OPS is concentrated in the population aged over 65, which is projected to grow at a higher rate compared to the growth of the total population. However, the majority of the older persons' services were projected by single year of age, while c. 60% of the PCRS expenditure was projected by five-year age groups with the remaining PCRS expenditure modelled with total population growth. This may underestimate the demographic increase in the PCRS expenditure.

The constructed age profiles for disability services reflect the number of recipients of services by age group and were constructed using a top-down method, and in effect, the same utilisation pattern is assumed across all individuals. However, the level of severity likely plays an important role in spending requirements. Bruton et al. (2019) found that utilisation of multidisciplinary services tends to increase with intellectual disability level of severity. Similarly, the age profiles for residential care for older people (NHSS and OPS) were constructed using a top-down method, assuming the same utilisation pattern across individuals. However, differences in residents' complexities and care needs are important when considering spending requirements in this area (Department of Health, 2015).

The sensitivity analysis shows that varying the net migration assumptions of +20,000 and +30,000 per annum respectively, doesn't impact on the annual demographic increases substantially. When considering net migration it is important to note that the majority of migrants tend to be of working age, between 15 and 44 years of age, (Keegan et al., 2020), and can therefore contribute to increased tax revenue in the economy (Irish Fiscal Advisory Council, 2020a).

The annual demographic cost pressures estimated in this paper are higher throughout compared to the IGEES 2019 estimates for the period (Connors et al., 2019). This is expected since the service areas modelled in this paper are greater (thirteen compared to four areas). In addition, a greater amount of age specific expenditure was used in this paper, which was possible because of the work undertaken by the ESRI under the Joint Research Programme with the DoH. The entirety of acute hospital care expenditure was modelled using age and sex expenditure profiles as estimated in Keegan et al. (2020). In addition, age- and sex specific expenditure profiles could be created using utilisation rates for older persons' services, NHSS and disability services. The projected number of deaths by age and sex with palliative care need in 2019 as estimated by May et al. (2020) were used to inform expenditure profiles for palliative care. Finally, the remaining expenditure was modelled with total population growth.

The annual demographic cost pressures estimated in this analysis are lower than those estimated by the Fiscal Council (2020) in their long-term sustainability report (Irish Fiscal Advisory Council, 2020b). This can be expected as the Fiscal Council model inflationary pressures from pay and prices, in addition to the demographic impact (Irish Fiscal Advisory Council, 2020b). The estimated demographic costs in the Fiscal Council's model therefore capture the compound effect of the inflationary and demographic impact. Demographic cost pressure is applied to the preceding year's base. If the base year has increased due to price inflation (pay and non-pay), then the estimated demographic cost pressure will be greater. This interaction effect is compounded over time. The demographic cost pressure estimated in the current analysis does not capture any inflationary impacts.

In their modelling of acute hospital expenditure (in-patient, day patient, outpatient and emergency department care), the ESRI estimate that between €1,293.8m and €1,956.8m – or between c.12% and 14% – of the total €10,760.6m - €14,363.3m nominal growth in expenditure from 2018 to 2035 is attributable to demographic changes (Keegan et al., 2020). Decomposing the demographic driver, Keegan et al. 2020 find that population age structure has a greater impact on expenditure than population growth (€837.3m - €1305.9m compared with €456.5m - €650.9m) for these service areas. Keegan et al. (2020) find that inflationary pressures from pay and prices are the dominant drivers of future public acute hospital expenditure.

The ESRI and the Fiscal Council's analyses highlight the importance of considering the effects of pay and prices in future health expenditure requirements. Pay is the dominant driver in Keegan et al's (2020) projections, reflecting the labour-intensive nature of the health sector. The Fiscal Council model non-pay prices using a premium of one percentage point added to the GNP deflator, to reflect increases in prices from technological costs (Irish Fiscal Advisory Council, 2020a). This points to the importance of considering the non-demographic determinants on Irish health expenditure and analysing the price component in addition to the volume component analysed in this paper. Such considerations form a fundamental part of the estimates discussion and is a potential area for future research.

Limitations

This work has provided an update of the impact of demographic change on ELS in Health out to 2025. ELS assumes no policy change and the expenditure pressures estimated in this paper therefore do not reflect any changes in models of care, e.g. to establish a statutory home support scheme, as set out in the Programme for Government, (Department of the Taoiseach, 2020). While there hasn't been an improvement in the demographic administrative expenditure data in the health system, the ESRI have undertaken extensive work under the Joint Research Programme with the DoH to improve the knowledge base of the demographic impact on healthcare demand and expenditure. Drawing on this work, it has been possible to use more age specific data in this analysis. However, the lack of data in certain areas remains a significant limitation, in particular in the non-acute sector. Data limitations in mental health services has restricted previous demand analyses in this area (Wren et al., 2017). A limitation to this paper is that the population projections are less accurate at this point in time, reflecting the end of the inter-censal period. However, population projections were produced out to 2025 using the CSO 2019 population estimate and using net migration assumptions that account for the impact of the Covid-19 pandemic. Another limitation is that no additional Covid-19 expenditure allocated over the projection period were considered.

The impact of changing demographics on health service capacity, or a further breakdown of pressures into pay and non-pay expenditure was beyond the scope of this analysis. In health, there are various factors that impact utilisation, beyond demographics (age and sex), such as disease prevalence and individual behavioural aspects (Andersen, 1995). In projections of the pure demographic pressure, costs and utilisation patterns (reflecting disease prevalence and behavioural aspects) are held constant. Changes in utilisation patterns are likely more important to consider in long-term projections, where changes over the years may occur. This is partly reflected by applying assumptions around the relationship between life expectancy and morbidity developments in healthy ageing scenarios often applied in long-term projections. However, in the current short-term projection of the pure demographic impact on health expenditure, utilisation patterns (and the factors influencing utilisation) in the population are held constant over the projection period.

Implications for policy and future research

This paper has estimated the 'pure' demographic effect, considering changes in the size and age structure of the population on expenditure requirements to maintain ELS in the short term. The size and age structure of the population is recognised as one of the drivers of healthcare expenditure. While other drivers likely explain differences in healthcare expenditure *between* countries to a higher degree (Wren & Fitzpatrick, 2020), demographics is an important determinant for healthcare expenditure *within* countries, reflecting the higher prevalence of disease at older ages (European Commission Directorate-General for Economic and Financial Affairs, 2018, 2021).

In the Sláintecare report, a commitment towards population-based resource allocation is made: '*A resource allocation model is required that allows for equity of access to health services across different geographic areas, taking into account population need, demographics, deprivation and other measures'* (Houses of the Oireachtas Committee on the Future of Healthcare, 2017: p. 21). These type of funding models, where funding is allocated prospectively based on population characteristics are used in various countries globally (Penno et al., 2013). Population-based resource allocation funding models use mathematical formulas to determine the funding for a specified population within a geographical area or a healthcare organisation (Smith, 2008). The formula consists of demographic, socioeconomic and other characteristics that determines the 'per capita' funding of the population (Rice & Smith, 2001). Age is the fundamental starting point in any funding formula, and sex and socioeconomic factor(s) are generally included (Rice & Smith, 2001). In practice, historical expenditure of healthcare utilisation by these characteristics are often analysed to construct a funding formula (Buck & Dixon, 2013; Rice & Smith, 2001). This can be achieved by linking individual administrative healthcare cost data through an Individual Health Identifier (IHI) with socioeconomic variables, e.g. with an index of deprivation like in New Zealand (Ministry of Health, 2016). However, there are various applications of population-based funding formulae, e.g. in the level of refinement of the socioeconomic factors (Penno et al., 2013), but where the objective in centralised public sector systems is to distribute funding according to population need (Rice & Smith, 2001). Implementing a population-based funding model would link expenditure to population characteristics to estimate its future need for healthcare and could improve transparency and predictability in the allocation of funding. The implementation of Irish IHIs is an important aspect of improving future analyses of healthcare utilisation and expenditure.

On the supply side, future research could estimate the impact of inflationary pressures (pay and prices) on ELS. c Detailed analyses and projections by the ESRI have shown that inflationary pressures, and in particular pay, represents the largest share of increases in public acute hospital expenditure (Keegan et al., 2020). Work is currently underway as part of the Joint Research Programme in Healthcare Reform with the ESRI projecting expenditure in the non-acute sector. This work will be an important contribution to the evidence base that can inform future IGEES work in this area.

This analysis projects the impact of changing demographics on ELS, assuming a no policy change. However, changes in the delivery of services may be warranted to accommodate for demand pressures from changing demographics. In addition, assessing the productivity of the Irish health system is an area of potential future research. Hospital productivity could be an area of investigation, where there is a rich body of international research to potentially draw from (e.g. Ali et al., 2019; Aragon Aragon et al., 2017; Castelli et al., 2015; Medin et al., 2013). However, the extent to which research is possible is dependent on the availability of data in the health system.

Developing the Irish health information system, with IHIs and electronic health records across service areas would enable better analyses of demographic and other pressures in health. This would allow for better resource, capacity and workforce planning (Walsh et al., 2021).

Conclusion

Demographics is one of the drivers of healthcare expenditure (albeit not the largest one) and is considered in the estimates process. Due to a growing and ageing population, additional expenditure will be needed to maintain Existing Levels of Service (referred to as 'demographic cost pressures'). This paper estimated demographic cost pressures of €324m in 2022, reaching €385m in 2025. These cost pressures are higher than those estimated previously by IGEES in 2019 (€175m in 2022 and €186m average annual 2023-2026). This is because age specific expenditure could be estimated using intelligence from the ESRI and the DoH's Joint Research Programme. The demographic cost pressures estimated in this paper are lower than those estimated by the Irish Fiscal Advisory Council in 2020 (the Fiscal Council estimate the demographic cost pressure as €381m in 2022). This is because the Fiscal Council consider inflationary impacts from pay and prices, whereas this paper, focusing on the demographics only, does not. Estimates from the Fiscal Council on a like-for-like basis would be closer to €300 million per annum over the same period[52].

The limited age specific expenditure data in the health system is a limitation to analysing the demographic impact on health expenditure. Progress in this area, and in particular, the implementation of Irish IHIs would facilitate future analyses. However, the knowledge base is expected to grow due to the ongoing work from the ESRI and the DoH's Research Programme in Healthcare Reform. Furthermore, this work will also inform future IGEES analysis with regard to non-demographic drivers.

[52] Personal communication with the Fiscal Council, 1 June 2021.

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Appendix

Appendix A

HSE Health & Wellbeing
https://www.hse.ie/eng/about/who/healthwellbeing/our-priority-programmes/

Priority Programmes

- Healthy Eating and Active Living Programme
- Tobacco Free Ireland Programme
- Alcohol Programme
- Healthy Childhood Programme
- Sexual Health & Crisis Pregnancy Programme
- Mental Health and Wellbeing Programme
- Staff Health and Wellbeing Programme
- Positive Ageing Programme
- Healthcare Associated Infection – Antimicrobial Resistance

Appendix B

Table 1B. Percentage annual demographic cost pressures 2020-2025 by HSE operational service area, baseline scenario.

HSE Operational Service Area	2020	2021	2022	2023	2024	2025	Annual Avg.
	%	%	%	%	%	%	%
Acute Hospitals	1.64	1.65	1.77	1.87	1.97	2.01	1.82
Primary Care Reimbursement Service	1.70	1.74	1.78	1.85	1.91	1.93	1.82
Disability Services	1.10	1.11	1.19	1.25	1.29	1.30	1.21
Older Persons' Services	3.66	3.91	4.05	4.11	4.18	4.27	4.03
Nursing Home Support Scheme	2.90	3.37	3.70	3.87	4.02	4.21	3.68
Mental Health	0.83	0.86	0.94	1.01	1.06	1.09	0.96
Primary Care	0.77	0.79	0.86	0.92	0.97	1.00	0.89
Local Demand Led Schemes	0.77	0.79	0.86	0.92	0.97	1.00	0.89
National Ambulance Service	0.77	0.79	0.86	0.92	0.97	1.00	0.89
Social Inclusion	0.77	0.79	0.86	0.92	0.97	1.00	0.89
Palliative Care	3.12	3.08	3.30	3.59	3.72	3.65	3.41
National Screening Service	1.22	1.27	1.34	1.43	1.43	1.45	1.36
National Cancer Control Programme	0.77	0.79	0.86	0.92	0.97	1.00	0.89
Total	**1.72**	**1.8**	**1.91**	**2.00**	**2.09**	**2.14**	**1.94**

Appendix C

Table 1C. Annual demographic cost pressures 2020-2025 (€m) by HSE operational service area. For sensitivity analysis M2 (net migration +20,000) applied to the period 2022-2025.

HSE Operational Service Area	2020	2021	2022	2023	2024	2025
	€m	€m	€m	€m	€m	€m
Acute Hospitals	104	107	119	123	128	130
Primary Care Reimbursement Service	50	53	56	57	58	58
Disability Services	22	23	25	25	25	24
Older Persons' Services	47	52	57	59	62	66
Nursing Home Support Scheme	34	39	44	46	49	53
Mental Health	8	9	10	10	10	9
Primary Care	7	7	8	8	8	8
Local Demand Led Schemes	2	2	2	2	2	2
National Ambulance Service	1	1	2	2	1	1
Social Inclusion	1	1	1	1	1	1
Palliative Care	2	3	4	4	4	4
National Screening Service	1	1	1	1	1	1
National Cancer Control Programme	0.05	0.05	0.06	0.06	0.06	0.06
Total	**282**	**299**	**329**	**338**	**350**	**359**

Table 2C. Annual demographic cost pressures 2020-2025 (€m) by HSE operational service area for sensitivity analysis M1 (net migration +30,000) applied to the period 2022-2025.

HSE Operational Service Area	2020	2021	2022	2023	2024	2025
	€m	€m	€m	€m	€m	€m
Acute Hospitals	104	107	128	132	138	141
Primary Care Reimbursement Service	50	53	60	61	62	63
Disability Services	22	23	29	29	29	29
Older Persons' Services	47	52	57	60	63	67
Nursing Home Support Scheme	34	39	44	47	50	54
Mental Health	8	9	12	12	12	12
Primary Care	7	7	10	10	10	10
Local Demand Led Schemes	2	2	3	3	3	3
National Ambulance Service	1	1	2	2	2	2
Social Inclusion	1	1	2	2	2	2
Palliative Care	2	3	4	4	4	4
National Screening Service	1	1	1	1	1	1
National Cancer Control Programme	0.05	0.05	0.07	0.07	0.07	0.07
Total	**282**	**299**	**353**	**363**	**376**	**386**

Quality Assurance process

To ensure accuracy and methodological rigour, the author engaged in the following quality assurance process.

- ☑ Internal/Departmental
  - ☑ Line management
  - ☑ Spending Review Steering group
  - ☑ Other divisions/sections

- ☑ External
  - ☑ Other Government Department
  - ☑ Quality Assurance Group (QAG)
  - ☑ External experts

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