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Counting the time lived, the time left or illness? Age, proximity to death, morbidity and prescribing expenditures

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ABSTRACT

The objective is to understand what really drives prescription expenditure at the end of life in order to inform future expenditure projections and service planning. To achieve this objective an empirical analysis of public medication expenditure on the older population (individuals ≥ 70 years of age) in Ireland (n = 231,780) was undertaken. A two part model is used to analysis the individual effects of age, proximity to death (PTD) and morbidity using individual patient-level data from administrative pharmacy records for 2006–2009 covering the population of community medication users. Decedents (n = 14,084) consistently use more medications and incur larger expenditures than similar survivors, especially in the last 6 months of life. The data show a positive and statistically significant impact of PTD on prescribing expenditures with minimal effect for age alone even accounting for patient morbidities. Nevertheless improved measures of morbidity are required to fully test the hypothesis that age and PTD are proxies for morbidity. The evidence presented refutes age as a driver of prescription expenditure and highlights the importance of accounting for mortality in future expenditure projections.

1. Introduction and background

Growth in healthcare expenditures and in particular, prescribing expenditures increases pressure on government budgets, healthcare providers and individuals. Understanding drivers of this growth should enable forecasting of more accurate future expenditures and inform appropriate policies to reduce expenditures.

Studies frequently associate ageing with higher health care costs relative to the younger population (Anderson and Hussey, 2000; Gregersen, 2014; Miller, 2001; Reinhardt, 2000; Westerhout, 2006). The elderly population is estimated to cost between 30% and 50% of total health care expenditure in OECD countries (Jacobzone, 2002). Anderson and Hussey (2000) examined health care expenditure and income across eight industrial countries and estimated that the average person aged 65 years or more costs between 2.7 and 4.8 times more than the average person aged 0–64 years.

In 2009 Ireland had a predominantly urban population of approximately 4.4 million of which 0.34 million (7.6%) were 70 years or older (CSO, 2013). Similar to other developed countries the Irish population over 70 years of age is predicted to almost double by 2031 along with increases in the age dependency ratio (CSO, 2013). Coinciding with the beginnings of this demographic shift Ireland has witnessed a large increase in public pharmaceutical expenditures with annual growth in real per capita expenditure on pharmaceuticals at 8.5% in the decade to 2009 (OECD average 3.5%) (OECD, 2011) and an economic recession beginning in 2008. At the time of this study those aged 70 years or older had access to free medications (A co-payment was introduced in 2010, this is currently €2.50 per item up to a maximum of €20 per family per month in 2016). The over 70s accounted for 49.6% of the annual public expenditure on prescription medication (Primary Care Reimbursement Service (PCRS), 2010).

While ageing is frequently associated with higher health care costs (Dormont et al., 2006) some commentators fail to acknowledge that part of these higher costs reflect the greater number of people close to death in this age group as well as age related health care needs. Individuals health care needs are higher as they approach death, with more than a quarter of all acute health care costs

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incurred in the last year of life (Polder et al., 2006; Wanless, 2002). However individuals in their last year of life may not necessarily be the oldest. There appears to be general consensus that PTD has an effect on healthcare expenditures in acute and long term health care (Comas-Herrera et al., 2007; McGrail et al., 2000; Payne et al., 2007; Seshamani and Gray, 2004b; Werblow et al., 2007; Zweifel et al., 1999). What is less known is the extent of the effect. Previous studies have focused on hospital or long term care expenditures with little separate analysis of medication expenditures. Wanless (2002) highlighted the need to consider all healthcare utilisation in relation to age, proximity to death and other factors.

The literature proposes three main possibilities on ageing and health, all assume increasing longevity, Gruenberg's (1977) "Failure of success" theory envisages the proportion of life spent in ill health increasing as longevity increases, an expansion of morbidity. In contrast to this Fries (1980) "compression of morbidity" theory proposes that people will live longer healthier lives with a limited period of illness at the end of life. A third possibility is put forward by Manton (1982), who found the other two theories inadequate to explain mortality trends in the USA. His hypothesis is of a "dynamic equilibrium" where morbidity increases due to rising levels of chronic conditions and disabilities amongst the older population while serious disability would decrease. Morbidity would seem an important component of any examination of PTD, although disentangling the two in the last years of life may not be possible.

While attempts have been made to predict future expenditure on prescriptions (Bennett et al., 2009) there currently appears to be few studies on the impact of ageing on future drug expenditure taking proximity to death into account (Kildemoes et al., 2006; Seshamani and Gray, 2004c). The aim of this study is to examine the importance of proximity to death, ageing and morbidity for public expenditure on prescription medication and report the implications for expenditure projections. Given the rising volume and costs of prescribing experienced in developed countries, gaining an understanding of what effects health care expenditure in this area will assist policy makers to more accurately predict and develop new policies to control future spending on prescription drugs.

2. Data and methods

2.1. Data

Community prescribing for 2006–2009 inclusive and mortality data from 2009 to 2012 for individuals aged 70 years or more in the Republic of Ireland were extracted from the Health Service Executive Primary Care Reimbursement Service (HSE-PCRS). This time period was used to guarantee a full 36 months of observations for decedents and to ensure the comparison survivors are not in their last three years of life. The prescription dispensing data contain records of all medications dispensed to individuals in the community. It does not include medicines that are only prescribed in hospital, such as chemotherapy agents but it does include medications which may be initiated in hospital but continued in the community such as anti-rejection drugs for transplant patients, immunostimulants, medicines used in conjunction with chemotherapy or hormonal therapy. The following variables were extracted: a unique person identifier; date of birth; region, gender; age; date of claim; details of medication dispensed and ingredient cost. The ingredient cost is the ex-factory price plus the wholesale mark-up and is the price negotiated for all regions between the state health agency (The Health Service Executive HSE) and manufacturers. Ingredient cost is the amount reimbursed to pharmacists for medications dispensed but does not include a dispensing fee which varies based on overall quantities dispensed by an individual pharmacy, the time of day and nature of the medication. The linked mortality records include a unique person identifier and the date of death. Unlike previous studies examining Health Care Expenditure (HCE) which employed samples, the time period of this study has been selected to facilitate the use of a national cohort.

In order to gain an insight into the differences between decedents and survivors a matched case-control study methodology was used. Decedents (cases) aged at least 72 years at the start of 2009 were selected to ensure they had access to free medication for the duration of the expenditure study 2006–2009, and were matched 1:1 based on age, gender and region to survivors (controls). Previous research has suggested that there may be regional and gender variances in health service use (Conway et al., 2014; Wren, 2011). Appendix Fig. A1 shows a participant flowchart. [INSERT LINK TO ONLINE APPENDIX] Controls (survivors) are those individuals who were in receipt of medication in 2009 and who did not die in the subsequent three years (2010–2012). A descriptive analysis of the monthly expenditures of both cases and controls was undertaken and the mean monthly expenditures and medication usage of survivors and decedents were compared.

To provide more detailed information regarding the health and social circumstances of the community dwelling population aged 70 or more which was not available from prescribing records data from the Irish Longitudinal Study of Ageing (TILDA) was used. The first wave of TILDA provides a cross section of nationally representative health, social and economic data on the Irish population aged 50 years or more (n = 8174) with 2307 participants aged 70 or more in 2009/2010 and its methodology is described in detail elsewhere (Kenny et al., 2010; Barrett et al., 2011). All prevalence results from TILDA were weighted using age, sex and educational attainment to be representative of the total population using the 2011 Census.

In addition a number of population scenarios from the Central Statistics Office (CSO) online database Statbank (CSO, 2013) were used, based on the 2011 Census population figures, to estimate future population taking births, deaths and migration into account (see Appendix for a brief description). All analysis were conducted using Stata version 12 (Stata Corp., College Station, Texas). Ethical approval was received for this study from the Health Policy and Management Research Ethics Committee, Trinity College Dublin.

2.2. Model specification

The primary outcome was monthly individual expenditure on community prescription medication for a 36 month period ending in 2009 (month of death in 2009 or matched month for survivors), which is highly skewed with non-constant variance and a large number of zeros. Methods employed must account for the skewed distribution of the data and the large numbers of zeros (zero-inflation) (Blough and Ramsey, 2000; Manning and Mullahy, 2001). Based on the literature examining expenditure data a two part model (TPM) using a Probit and generalized linear model (GLM) was considered appropriate. The Probit was used to identify those who had any expenditure and the GLM to model those positive expenditures. The following Probit model was run to examine the effects of age, gender, proximity to death and region on the probability of using medication in a given month.

$$\Pr(Expend. > 0) = \propto + \beta_1 A + \beta_2 A^2 + \beta_3 AG + \beta_4 G + \beta_5 D + \sum_{t=1}^{35} m_t M_t + \sum_{e=1}^{7} \varepsilon_e R + \sum_{t=1}^{35} \gamma_t M_t D$$

Where A: individual age; A^2: Age squared; AG: Age gender interaction; G: Male gender (1), Female (0); D: decedent (1); M: months until death or censor; R: Region; M_t D: decedent-month interaction term. To account for the nonlinearity of age an age squared variable