THE IMPORTANCE OF PROXIMITY TO DEATH IN MODELLING COMMUNITY MEDICATION EXPENDITURES FOR OLDER PEOPLE: EVIDENCE FROM NEW ZEALAND

(PROXIMITY TO DEATH AND COMMUNITY MEDICATION EXPENDITURES)

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Abstract

Background

Concerns about the long term sustainability of health care expenditures and in particular prescribing expenditures has become an important policy issue in most developed countries. Previous studies suggest that proximity to death (PTD) has a significant effect on total health care expenditures, with its exclusion leading to an overestimation of likely growth. There are limited studies of pharmaceutical expenditures taking PTD into account.

Objective

This paper presents an empirical analysis of public medication expenditure on older individuals in New Zealand (NZ). The aim of the study is to examine the individual effects of age and proximity to death (PTD) using individual level data.

Methods

This study uses individual level dispensing data from 2008/2009 covering the whole population of medication users age 70 years or more and resident in New Zealand. A case control methodology is used to examine individual cost and medication use for a 12 month period for decedents (cases) and survivors (controls). A random effects two part model, with a Probit and Generalized Linear Model (GLM) is used to explore the effect of age and proximity to death on expenditures.

Results

The impact of proximity to death on prescription expenditure is not as dramatic as studies reporting on Acute and/or long term care. The 12 month decedent to survivor mean expenditure ratio was 1.95, 2.09 for males and 1.82 for females. The additional cost of dying in terms of prescription drugs decreases with age, with those who die at 90 years of age or older consuming fewer drugs on average and having a lower mean expenditure than those who died in their 70s and 80s. The following variables were found to have a decreasing effect on the mean monthly prescription expenditures, a reduction of 2.2% for each additional year of age, 4.2% being in the Mãori ethnic group and 7.8% for Pacific Islanders. Increases in monthly expenditure were associated with being a decedent 32.1%-62.6% (depending on month), being of Asian origin 16.2% or a male 12.6%.

Conclusions

Given the variance reported between survivors and decedents, to improve accuracy future projections should include PTD in their models. Policies targeted at reducing expenditures should not focus on age but on ensuring appropriate and cost effective prescribing especially towards the end of life.

Key points for decision makers:

- Despite prescription medications being the most common medical intervention there is limited evidence on how proximity to death and ageing affect prescribing expenditures for older people.
- In terms of expenditure on prescription medications, proximity to death would appear to be a more important driver than ageing and should therefore be considered in any future expenditure projections.

1 Introduction and background

Concerns about the long term sustainability of increasing healthcare expenditure has become an important policy issue in most developed countries. Such growth is increasing pressure on government budgets, healthcare providers and individuals. Understanding drivers of this growth should enable us to more accurately forecast future expenditures and inform appropriate policies. The New Zealand population over 65 years of age is predicted to more than double in the next two decades similar to the majority of other developed countries [1, 2]. In addition, the working population (15-64) will only increase marginally increase [1, 2] or even decline [2] leading to an increase in the old age dependency ratio of those aged 70 years or more to those aged 15-64 years [3, 2]. As a result of this demographic shift a reduced proportion of the population will be supporting an increased older population. Policy makers in New Zealand and other developed countries with similar ageing populations are concerned about a significant health care cost increase associated with the anticipated population shift.

Studies frequently associate ageing with higher health care costs relative to the younger population [4, 5]. While age may be important to an extent, Fuchs [6] proposed the idea of proximity to death (PTD) having an important positive effect on health care costs. The premise being the closer someone is to death, the more health care resources they use resulting in higher health care expenditure. A higher rate of mortality in older age groups could be a confounder in the age expenditure relationship. Several studies have presented evidence of increased healthcare expenditures for those close to death [7-11]. Other studies have reported that ageing is more important [12], that proximity to death is minor in magnitude [12], or indeed a proxy for disability [13]. Van Baal and Wong [14] suggest that PTD may be a better predictor of expenditure than age as it includes both age and mortality risk. There remains general consensus on a PTD effect, what is contentious is the magnitude.

All these previous studies have focused on hospital or long term care expenditures with little separate analysis of medication expenditures. Public spending on prescription medications is a significant commitment, accounting for approximately 18.7% on average of total healthcare spending in OECD countries (12% in New Zealand)[15]. Traditional predictions of future expenditure using prescription drugs have not taken into account the effect of proximity to death (PTD) on individual expenditures [16]. One Danish study has examined medication expenditure and reported that the effect of ageing on future drug expenditures will be overestimated when not accounting for proximity to death [17]. Given the rising volume and costs of prescribing experienced in developed countries [18], gaining an understanding of what effects health care expenditure in this area will help policy makers to more accurately predict and develop new policies to control future spending on prescription drugs. The aim of this study is to examine the association between age, proximity to death and medication expenditure by examining the expenditures of decedents and survivors.

2 Data and Methods

Prescribing and mortality data for individuals 70 years of age and older were extracted from the New Zealand Ministry of Health Pharmacy Claims Data warehouse for 2007-2010. Each prescription record contains a unique person identifier, date of birth, ethnic group, gender, age, date of dispensing and ingredient cost. Ingredient cost is the amount of New Zealand dollars the state has paid the pharmacist for the medication at 2008/2009 prices and does not include dispensing fees or co-payments made by individuals. Mortality records include a unique person identifier, the date of death, age at death and place of death. Unlike previous studies examining Health Care Expenditure (HCE) which used samples, this study uses a national cohort.

The prescribing and mortality records were merged using an anonymised version of the unique health identifier (National health index NHI) to create one dataset including survivors from 2008/2009 who lived beyond 2009 and those who died in 2009 (decedents). Prescribing data are over two years, 2008-2009 in order to gain a full 12 months of observations for decedents. Survivors are those who were not in their last year of life in 2008. Mortality data was used from 2009 to identify decedents and to ensure survivors are not in their last year of life.

In order to gain an insight into the differences between decedents and non-decedents (survivors) a matched case-control study methodology was used. The mortality dataset was utilized to identify decedents in 2009 as cases, and match them 1:1 based on age, gender and ethnic group to controls (survivors) from 2008. Data for survivors was calculated for the year January to December 2008. Coarsened exact matching (CEM) was used, this involved three steps: First the matching variables were coarsened into broader groups (similar to creating a histogram by putting the variables into categories or bins) e.g. Age into 5 year bands; Secondly data were exactly matched using the matching variables, which involves sorting the observations into strata, each with unique values of the matching variables; Thirdly Strata containing only control units were discarded; strata with case and control units were retained. A detailed description of CEM and its merits over other matching methods is given by Iacus et al [19]. The total population over 70 years of age considered in the study can be broken down into three groups as shown in Figure 1. A total number of 20,161 decedents or cases matched to 20,161 survivors or controls with only 3 cases not matched, this was due to the very small numbers of older people in certain ethnic groups.

2.1 Econometric specification

Exploratory data analysis was conducted followed by an econometric data analysis which included: two part model (TPM) was estimated using a Probit and GLM; TPM was tested for cross-sectional dependence; TPM was tested for suitability for panel data framework (Likelihood ratio test and F-test).

Monthly expenditure on prescription medicines has a spike at zero and for those individuals who do incur expenditure the distribution is right skewed with non-constant variance. This distribution is typical of health care cost data therefore any regression methods must take account of the skewed data and focus on the population means [20, 21]. If an Ordinary Least Squares (OLS) regression methodology was used with a log transformation to account for the skewness the analysis would not be based on the population means but rather the mean on the log scale. This scale would measure geometric means and require a system of back transformation for interpretation [22-24, 21].

In the study population of 4.2 million monthly expenditure observations 1.6 million (38.7%) have a zero value. The total monthly cost variable is heavily skewed (kurtosis=2,371, skewness=35) and has considerable non-normal kurtosis, if zero values are ignored the skewness is only slightly reduced while kurtosis shows a relatively larger reduction (kurtosis=1,651, skewness=30)[1]. After careful consideration of the data using a modelling strategy the best fitting was a two part model with a Probit model to first identify the likelihood of monthly expenditure by modelling a dictonomous dependent variable for whether or not there was an expenditure in a given month and then a generalized linear model (GLM) was run conditional on the presence of non-zero prescribing expenditure to estimate the monthly medication expenditure of individuals. The two part model assumes that the zero values and the positive values are generated by different independent mechanisms. Duan et al [25] and Jones [26] provide more in-depth discussion of the merits of the two part model.

Given the nature of the panel dataset, a large number of observations over a short 12 month period, we have not concerned ourselves with testing for stationarity. Two tests were conducted to ascertain if panel data methods were appropriate for the two part model as follows. A likelihood ratio test was conducted on the first part of the model to test for panel-level variance equal to zero and concluded that there was no evidence of zero variance. An F-test was conducted on the second part of the model to test if all individual specific effects were equal to zero, this hypothesis was rejected. The following Probit model was run to examine the effects of age, gender, proximity to death and ethnic group on the probability of using medication in a given month.

[1] Normal values: Kurtosis=3, skewness=0.

$$\Pr(Expend. > 0) = \propto + \beta_1 A + \beta_2 G + \beta_3 D + \sum_{t=1}^{23} m_t M_t + \sum_{e=1}^{5} \epsilon_e E_e + \sum_{t=1}^{23} \gamma_t M_t \, D$$

Where A: individual age; G: Male gender; D: decedent; M: months until death or censor; E: Ethnic group; MD: decedent-month interaction term

The second part of the model is a random effects GLM which facilitates the analysis of mean costs while allowing for the non-normal distribution of the data. A major advantage of the GLM is that it models the mean and link (variance) functions on the original scale of cost. The model consists of a distribution function for costs and a link function which describes the scale of the relationship of the covariates with the cost. The various GLMs were assessed using the modified Parks test following Manning and Mullahy [21], Akaike Information Criteria (AIC) [27] and normal probability plots of deviance residuals to ascertain a suitable distribution function. While there is no one test for assessing an appropriate link function the following three tests were run for guidance: Pearson correlation test; Pregibon link test; a modified Hosmer and Lemeshow test. The consistent result from these tests was an inverse gaussian distribution function and a log link.

$$\mathrm{GLM}(\mathrm{Expenditure}) = \propto + \beta_1 + \beta_2 A + \beta_3 G + \beta_4 D + \sum_{t=1}^{11} m_t M_t + \sum_{e=1}^{5} \epsilon_e E_e + \sum_{t=1}^{11} \gamma_t M_t * D$$

The use of a log link function in the GLM means the coefficients act multiplicatively on the mean, by taking the exponential they can be expressed as the percentage increase in the mean monthly medication expenditure per unit increase in the covariate [28]. A random effects model is more appropriate for the dataset over a fixed effects model for a number of reasons, principally the loss of coefficients for time-invariant variables such as gender and ethnic group and the exclusion of individuals with all zero or all positive monthly expenditures. A Breusch-Pagan LM will test for the appropriateness of a random effect model.

The original 26 codes for ethnic groups (see Appendix) were condensed into six, starting with the largest: European, not stated, Mãori, Asian, Pacific Islands and other. Age was split into four five year bands and a 90+ category for exploratory analysis and maintained as a continuous variable for regression analysis. The number of items variable is a count of medicines dispensed in each month, it has a monthly median of 2, a monthly mean of 4 (std dev. 7.12) and a range of 0 to 460.

3 Results

3.1 Descriptive statistics

Table I outlines in more detail the three characteristics - gender, age and ethnic group - that were used to match the decedents (case group) to survivors (control group). Separating the population into survivors and decedents shows the difference in number of items used and ingredient costs of those in their last 12 months of life. Figure 2 shows the mean 12 month expenditure by age group for male and female decedents and survivors. The mean costs for decedents decreases with age, from NZ$2,259 in the 70-75 age group to NZ$864 in the 100+ group, a 62% decrease in cost. The mean cost for survivors increases to a peak of NZ$933 in the 85-89 age group and decreases thereafter. Figure 3 plots the mean number of items used in the 12 month period. The patterns in Figures 2 and 3 show that while mean expenditure for decedents decreases with age group, mean items dispensed peaks in the 80-84 age group and declines thereafter. This would suggest that older decedents use more and less expensive items on average than younger decedents. In contrast the mean cost of survivors increases with age in line with the number of items, but again there is a change in the 85+ age groups where the cost remains level but the number of items continues to increase. While at every age decedents use more items and have a higher mean expenditure than survivors, the additional “cost of dying” decreases with age as demonstrated in Figure 4 which shows the decedent / survivor ratio narrowing as age group increases.

Results given in table II show the matching of the case group of decedents taken from 2009 and followed back to 2008 with a matched control group from 2008. The mean expenditure ratio (decedents/ survivors) in table II shows that decedents are on average 1.95 times more costly than survivors, which ranges from 2.09 for males to 1.82 for females. This ratio declines with age as seen in Figure 4. The all age mean cost per item is similar for both groups while the number of items per individual is 1.95 times more for decedents.

3.2 Medication use

A comparison of the medications dispensed to decedents in the 12th month from death and in the last month before death shows, as expected, a significant increase in medications over the 12 month period. In the last month of life over double the number of items were dispensed to the decedents in comparison to the matched survivors. In the last month of life there is a significant increase in use across most therapeutic groups compared to the 12th month. The largest being the Nervous System (N)[2] with an overall 3.8 times rise driven by large absolute increases in analgesics (N02) (4.6 times), anti-nausea & vertigo agents (N07C and A04) (12.9 times), antipsychotic (N05A) (5.4 times), sedative (N05C) (3.2 times), anti-epilepsy (N03) (4 times) and antidepressant (N06A) (4 times) medications. While medication use increases on average in the last month before death it does not show a dramatic rise or pattern in the preceding months.

3.3Regression analysis

[2] Medications are reported using the WHO Anatomical Therapeutic Chemical (ATC) system

A Breusch-Pagan LM test rejected a null hypothesis of variances across individuals being zero, this would suggest that a random effects model, which takes account of the panel effect, is more appropriate than using an Ordinary Least Squares (OLS) method. Table III sets out the results of a two part model, with the Probit showing the probability of expenditure on prescription medication and the GLM regression the effect on monthly expenditure per individual with the listed explanatory variables. The reference groups being female, of European ethnicity and the 12th month before death or censor. An interaction term with decedent was included for each month and all were found to be significant.

An increase in one year of age has a decreasing effect on mean monthly costs, 2.2% on average, adjusting for the contributions of the other explanatory variables. Decedents have a higher monthly expenditure in every month leading up to death. In terms of ethnic groups, those of Asian origin had considerably higher monthly expenditures, while Mãori and Pacific islanders had lower expenditures. Only Mãori had an increased likelihood of medication use, as seen in part 1 of the model.

Part 1 of the model shows that with 12 months prior to death as the baseline there is a constant upward trend in the likelihood of medication use in months 11 to 1. The proximity effect extends at least 12 months prior to death.

Monthly expenditures for individuals who are dispensed a medication show no consistent increasing trend prior to death other than those who die being consistently 1.3 to 1.4 times greater than survivors with a more noted increase in the last month of life to 1.6 times greater. Even when the decedent time span is expanded to 24 months there is no convergence or surge in use towards the end of life, apart from the last month (data not shown here). But decedents do on average use twice as many items as survivors over the whole period, and are more likely than survivors to have used medication in any given month.

4 Discussion

This study provides evidence of the importance of accounting for proximity to death rather than ageing alone for expenditure on prescription drugs in an older community based population. In fact the regression results show that ageing has a negative effect on prescription expenditure. By comparing prescription expenditures for decedents in the last 12 months of life to a similar group of survivors we can see that decedents cost on average between 1.82 and 2.09 times more. Similar to other studies mean HCE per annum is rising after 70 years of age with a peak in the 80 to 84 year age group and a decline there after in the total population and the survivors control group [29, 11]. The mean number of items used in the 12 month period by survivors increases linearly with age but at a greater rate than expenditure which suggests that while survivors are using more items in these older groups they are relatively cheaper medications. The increases in mean items and cost of survivors with age may be due to increasing rates of chronic illness, as the number of people over 70 years of age reporting one or more chronic illness increases with age [30]. In contrast descendants demonstrate a dramatic decrease in expenditure which is combined with a more staid increase in mean number of items, this is in line with other HCE studies which have reported a decrease in the “cost of dying” with age [31, 32].

The study adds to the existing literature on proximity to death by providing evidence on patterns of prescribing costs. This study reports a similar magnitude for the PTD effect as a Danish study [17] which reported a mean cost ratio of 1.7 for those aged 75 years or more. The Danish study also reports that ageing will increase future drug expenditures but taking PTD into account they conclude that the increase will be relatively small [17]. In contrast a Dutch study examining macro level data suggests that accounting for PTD may not simply reduce future projections of HCE due to growth from other unidentified causes which were not included in previous modelling attempts [14].

Similar to a Spanish study [33] we found age to have a positive influence on the probability of pharmaceutical expenditure, in contrast the Spanish study additionally found a positive association between age and the amount of expenditure but was focused on individual doctors prescribing and excluded PTD. Studies looking at total health care expenditures have reported increasing expenditures with age [34, 12] with some attributing it to proximity to death [10, 31, 35]. This study has focused on prescribing expenditures and found that they do not steadily increase with age for the older population even before accounting for PTD. Instead they show a bell curve peaking in the early 80 years of age and declining thereafter. The effect of proximity to death on prescription expenditures is less than the PTD effect reported in studies looking at total HCE and long term care (LTC) this may in part be due to the high uptake of hospital and long term care services at the end of life and the high volume of preventative medication in use by survivors.

The pattern of decreasing cost ratio of decedents to survivors shown in Figure 4 is similar to other studies [34, 31]. This suggests that, in terms of medication, the cost of dying relative to surviving actually decreases with age. Two other explanatory factors worth considering are the numbers of individuals who die in hospitals or long term care facilities in these age groups and the fact that those who do remain living in the community are potentially healthier.

The fact that decedents on average have a higher use and expenditure in the 12th month and even as far out as the 24th month before death suggests that increased medication use may be a sign of a health crisis and subsequent mortality.

While this study reports mean expenditure for decedents to be double that of survivors, regression models show a smaller increase between the groups for each of the 12 months before death. This result does not demonstrate a clear pattern of increasing cost with proximity to death but that expenditure for decedents is consistently higher with a peak in the last month prior to death. The data suggest that there are other factors driving the higher drug expenditures amongst the older population in addition to proximity to death. More complex country specific issues such as the agreements and bargaining power of the public health system and patent expiry dates should be considered in addition to PTD. The data demonstrate that the proximity of death effect persists beyond the 12 month period studied herein. Previous studies have suggested a distance of up to 6 years for the PTD effect [11].

A previous study looking at the effect of PTD, age and disability on LTC expenditures reported that PTD was acting as a proxy for disability [13] while this current study lacks outcome or disability data it is difficult to argue that disability increases prescription expenditure more than PTD in community prescribing.

In terms of differences in expenditures by ethnic minorities, it could be hypothesized that Mãori and Pacific Islanders who are in the older age groups are the healthiest of their respective groups, based on evidence that suggests members of these ethnic groups are more likely to have poorer health and lower life expectancies [36, 37]. An alternative hypothesis for these lower expenditures could be reduced up take of medications or impaired access by these ethnic groups [38, 39].

Life expectancies are increasing in general and evidence suggests that these additional years are being lived in good health [40, 41]. In order to use these results to more accurately model future data we need to consider increases and convergences in life expectancies. If current trends in life expectancy continue the average 70 year old in 2059 will be further from death than a 70 year old in 2008. As proximity to death results in increased prescribing costs in all age groups it is important to account for the shift in mortality rates in each age group which increasing life expectancies will bring. Converging life expectancies between men and woman (woman outlived men by some 3.7 years in 2010 [42]) would mean couples will be potentially living longer together which should have a positive effect on health outcomes and ultimately a negative effect on health care expenditures.

The implications of these findings do not just apply to policies to control future expenditures. Cost effectiveness analysis relies on future projections which often do not take into account PTD leading to an over estimation of the cost effectiveness ratio [43, 44].

4.1 Strengths and Limitations

This study focuses on a key expenditure component of total health care costs, examining the services that make up total health care costs is important to fully understand the effect of ageing [31]. Some of the studies discussed in this paper used potentially non-representative samples such as those taken from private health insurance or hospital datasets. The strength of this study lies in its use of population data which is automatically collected by the health care system every time a prescription is dispensed, therefore there is no recall or prestige biases involved and no sampling issues.

A limitation of the study is the possible confounding from the large numbers of older people who die in hospitals or long term care, with those living in the community at older age cohorts the potentially healthier of their age group. Estimates suggest that New Zealand has a higher proportion of its older population in LTC than most OECD countries, with estimates of up to 9.2% [45] . Further evidence for this hypothesis is also present in the decline of medication use with age in the older groups. Based on previous hospital based studies [31, 46, 29] which included pharmaceuticals as part of total health care expenditure we would expect the inclusion of such medications to increase the expenditure gap between decedents and survivors.

According to population estimates the over 70 population was 371,950 for 2008 [47], therefore the prescribing dataset used in this study is potentially missing 3.5% of the total population in this age group. This potential 3.5% would comprise of people over 70 who did not die or did not receive any prescription medicines in 2008/2009. In addition the dataset lacks information on potential confounders such as medical history for both decedent and survivor groups, e.g. diagnoses, severity of any illness, disability, smoking, alcohol etc. The study does not contain any information on the use of over the counter (OTC) medicines which may or may not have an impact on the cost of public prescribing. It’s likely that the future burden of morbidity and patterns of medication use will be altered by new and improved preventative and curative treatments which may be developed or price reductions, patent expiries and the lifestyle changes of individuals.

5 Conclusion

This study primarily investigated the relationship between expenditure on prescription medication, proximity to death and age, using a population of 349,174 individuals, 70 years of age or more, over a 12 month period. The analysis found that the additional “cost of dying” is on average twice that of a similar group of survivors. There is a notable increase in decedent prescribing during the last month of life; while all other months are consistently higher they do not demonstrate an increasing pattern towards death. Regression analysis suggests that while age has a positive influence on the probability of expenditure, it has a negative effect on monthly expenditures in line with exploratory analysis which shows lower monthly expenditures for the oldest age groups. The results show a positive effect of PTD on prescription expenditure in line with some previous evidence. Compared to studies examining long-term care and acute care costs the magnitude of the effect of PTD is considerably lower. Given the variance between survivors and decedents future projections should include PTD in their models. Policies aimed at reducing expenditures should not focus on age but on ensuring appropriate and cost effective prescribing especially towards the end of life.

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7 Conflict of interest

No conflicts to be declared.

8 Author contributions

Patrick V. Moore designed the study, conducted the data analysis and prepared the manuscript. Kathleen Bennett was involved in the study design and preparation of the manuscript. Charles Normand was involved in the study design and review of the manuscript. All authors preformed a critical review of the manuscript content and approved its final version. Patrick V. Moore acts as guarantor of the overall content of this article.

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Figure 1 Participant Flowchart

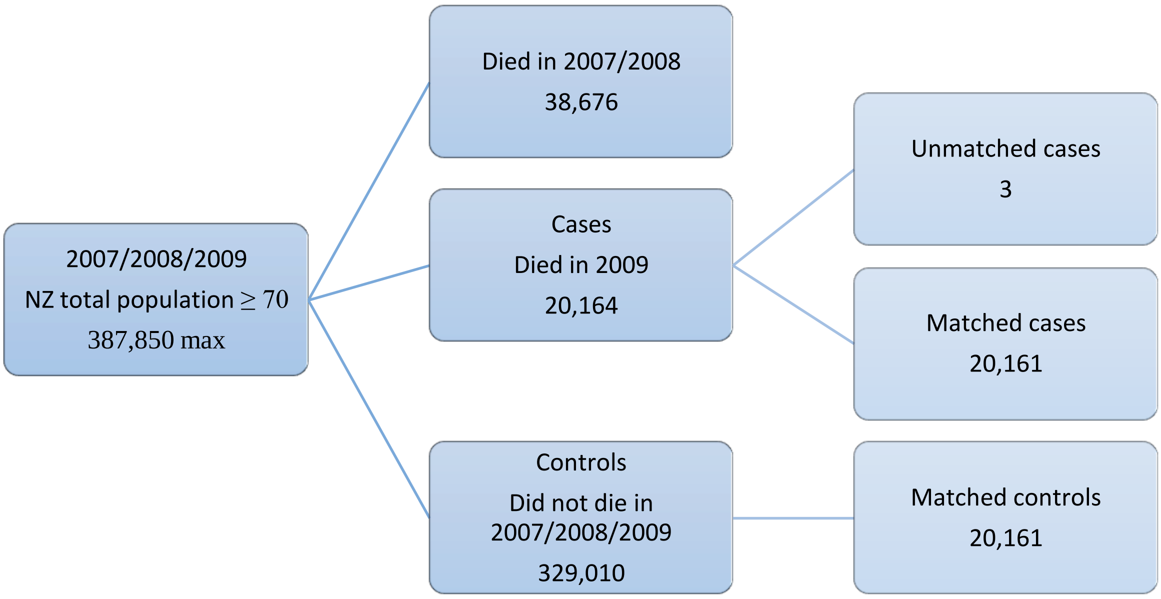

Figure 2 Mean expenditure per individual by age group 2008/2009

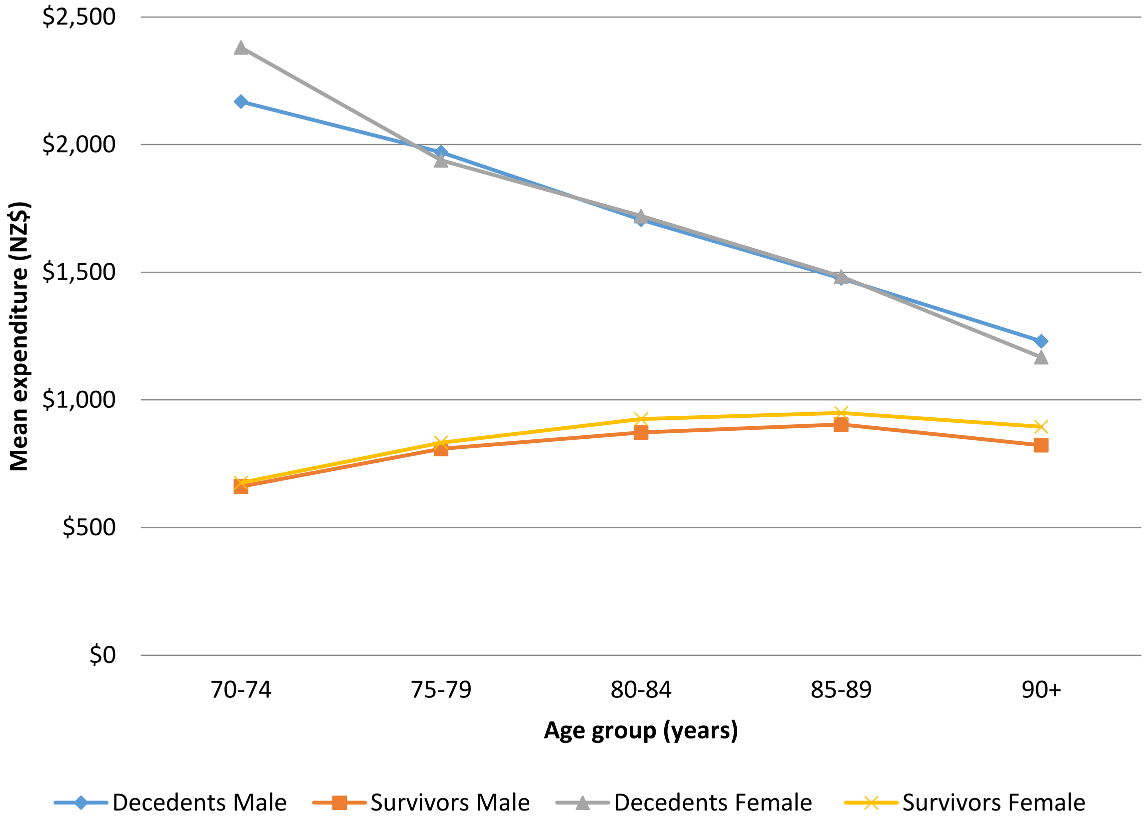

Figure 3 Mean number of items per individual by age group 2008/2009

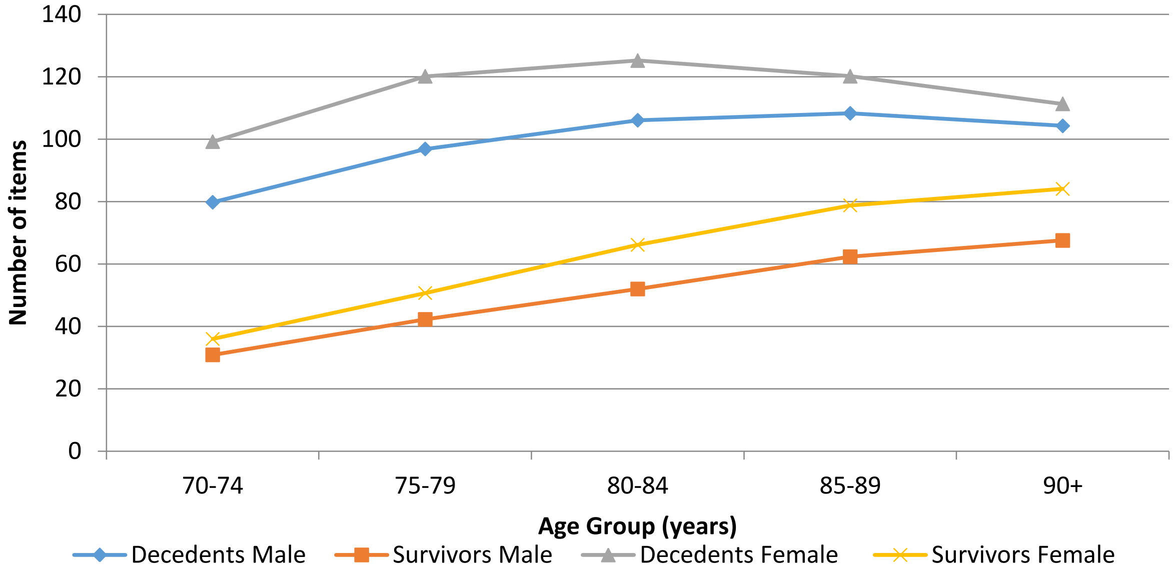

Figure 4 Decedent / survivor cost ratio by age group

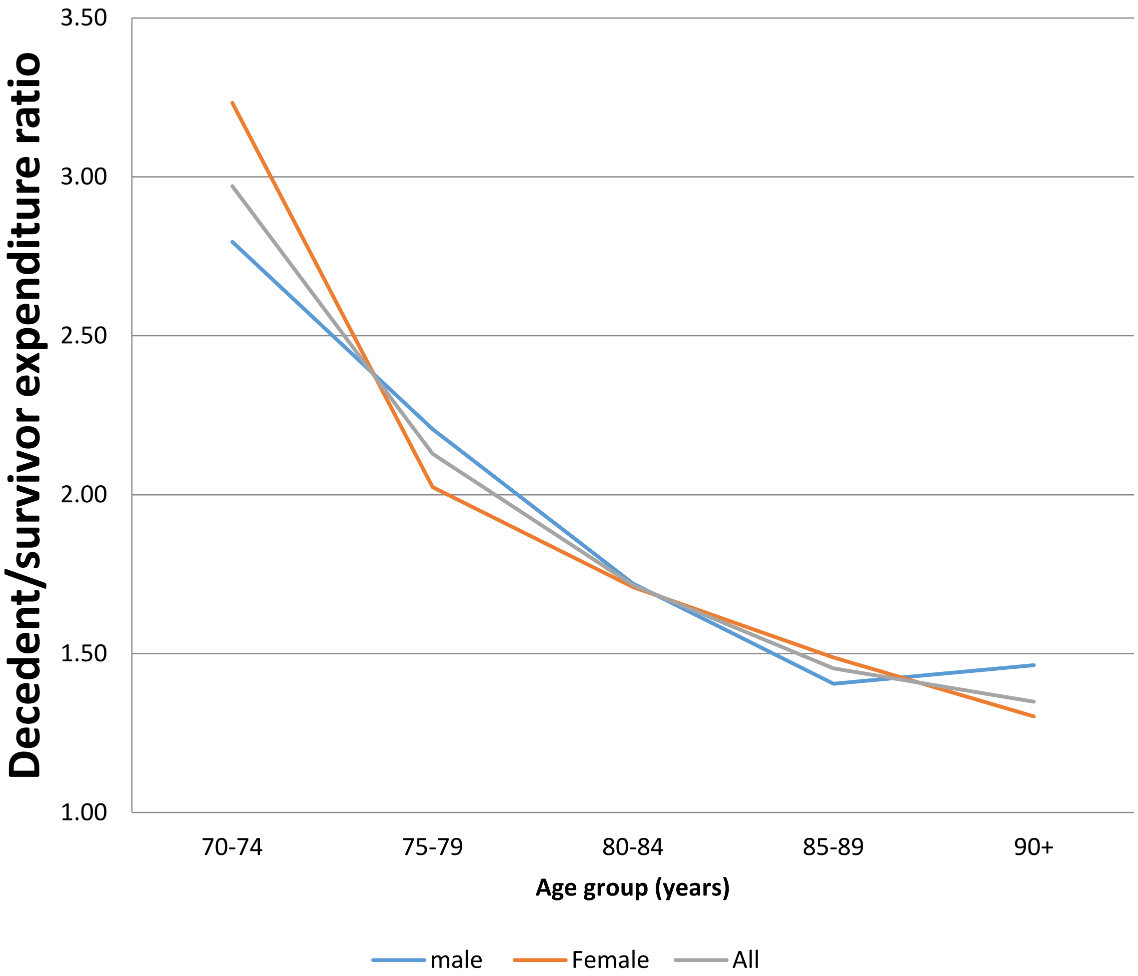

Table I Characteristics of total population and decedents

	Characteristic	Total population	Decedents
Gender	Male (%)	141,365 (43%)	9,306 (46%)
	Female (%)	187,632 (57%)	10,855 (54%)
Age	Mean (SD)	76.5 (5.9)	81.9 (7.1)
	Median (range)	75 (70-111)	82 (70-107)
Ethnicity	European (%)	267,594 (81.3%)	17,503 (86.8%)
	Mãori (%)	12,673 (3.9%)	1,112 (5.5%)
	Pacific peoples (%)	5,893 (1.8%)	364 (1.8%)
	Asian (%)	10,076 (3.1%)	312 (1.6%)
	Other (%)	880 (0.3%)	30 (0.2%)
	Not stated (%)	31,894 (9.7%)	843 (4.2%)

Table II Ingredient expenditures for 12 months prior to death or censored (1:1 coarsened exact matching on age, gender, ethnic group)

	Nr of individuals	Total annual expenditure (standard deviation) (NZ$)	Mean expenditure per individual (standard error) (NZ$)	Median expenditure per individual (NZ$)	Mean nr of items per individual (95%CI)	Average expenditure per prescription (NZ$)	Mean expenditure ratio (Decedents /Survivors)	Median expenditure ratio (Decedents /Survivors)
Cases	20,161	20,749,092 (2,030)	1,029.17 (14.30)	614.41	109 [108-110]	9.47	1.95	1.74
Female	10,855	10,284,171 (1,973)	947.41 (18.94)	601.11	115 [113-117]	8.23	1.82	1.62
Male	9,306	10,464,921 (2,091)	1,124.53 (21.67)	633.96	102 [100-104]	11.19	2.09	1.89
Controls	20,161	10,642,978 (928)	527.90 (6.54)	352.45	57 [56-58]	9.35		
Female	10,855	5,644,264 (885)	519.97 (8.50)	370.50	66 [64-67]	8.06		
Male	9,306	4,998,714 (976)	537.15 (10.12)	334.67	47 [46-49]	11.48		

Table III Probit and Generalized linear model (GLM) of monthly prescribing expenditures for decedents assuming an inverse Gaussian distribution with a log link.

Covariates	Part 1 - Probit		Part 2 - GLM	
	Coefficient	Standard. error	Coefficient	Standard. error
age	***0.0470	0.0003	***0.9783	1.0002
Male	***-0.2342	0.0039	***1.1259	1.0027
Mãori	***0.0481	0.0101	***0.9576	1.0070
Pacific Islands	***-0.4024	0.0146	***0.9220	1.0109
Asian	***-0.5673	0.0113	***1.1618	1.0101
Other	***-0.2762	0.0376	***1.0949	1.0300
Not stated	***-0.4657	0.0066	***0.7838	1.0045
1 month	***0.2490	0.0037	***1.0418	1.0066
2 months	***0.2383	0.0037	***1.0341	1.0065
3 months	***0.1077	0.0036	**0.9848	1.0065
4 months	***0.1402	0.0036	1.0017	1.0066
5 months	0.1187	0.0036	1.0098	1.0066
6 months	***0.0097	0.0036	***0.9754	1.0066
7 months	***0.0644	0.0036	***0.9693	1.0065
8 months	***0.0272	0.0036	***0.9787	1.0066
9 months	*0.0065	0.0036	***0.9715	1.0066
10 months	***-0.0641	0.0036	***0.9345	1.0066
11 months	0.0142	0.0036	**0.9836	1.0066
Decedent*1 month	***0.8849	0.0168	***1.6260	1.0200
Decedent* 2 months	***0.8467	0.0167	***1.3774	1.0185
Decedent*3months	***0.8269	0.0161	***1.4068	1.0185

Decedent*4 months	***0.7046	0.0158	***1.3481	1.0184
Decedent*5months	***0.6400	0.0155	***1.3205	1.0184
Decedent*6months	***0.7008	0.0153	***1.4282	1.0189
Decedent*7months	***0.5749	0.0150	***1.4185	1.0188
Decedent*8 months	***0.5739	0.0149	***1.3882	1.0188
Decedent*9months	***0.5478	0.0148	***1.3856	1.0188
Decedent*10months	***0.5708	0.0146	***1.4300	1.0188
Decedent*11months	***0.4561	0.0145	***1.3586	1.0189
Constant	***-3.0798	0.0263	***391.4	1.0181
Nr of observations	4,190,088		2,568,273	
		Log likelihood	-16,255,102	
		AIC	12.6584	

*significant at the 90% level

**significant at the 95% level

***significant at the 99% level

Appendix – Condensed Ethnic groups

Original Ethnic group	Original code	Condensed ethnic group
European not further defined	10	European
New Zealand European	11	
Other European	12	
New Zealand Maori	21	Maori
Cook Island Maori	32	
Pacific Island not further defined	30	Pacific Islands
Samoan	31	
Tongan	33	
Niuean	34	
Tokelauan	45	
Fijian	36	
Other Pacific Island (not listed)	37	
Asian not further defined	40	Asian
South east Asian	41	
Chinese	42	
Indian	43	
Other Asian	44	
Middle Eastern	51	Other
Latin American/Hispanic	52	
African	53	
Other	54/61	
Not known/not stated	94/99	Not stated/known
Refuse to answer	95	
Response unidentifiable	97	