

An actuarial perspective on healthcare expenditure in the last year of life

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ABSTRACT

The aim of this paper is to investigate the expenditure incurred by health insurers arising from the provision of benefits during the 12 months preceding a beneficiary's death. Concern is expressed in parts of the international literature about the extent of resources directed towards those at the end of life, particularly given increased longevity and technological advancement. Two types of investigation are discussed: first, a comparison of costs in the last year of life with costs in earlier years prior to death and, second, a comparison of decedent and survivor costs within a calendar year. Within each investigation, further detailed analyses were performed with particular emphasis on the distribution of last-year-of-life costs by age and category of expenditure. A South African dataset is used to illustrate the suggested methodology. The average cost in the last year of life is found to be 3.3 times higher than the average cost in the second last year of life. Average decedent costs are found to be 17.85 times higher than average survivor costs in 2012, on a risk-adjusted basis. The majority of these costs (83.35% in 2012) form part of the Prescribed Minimum Benefit package.

KEYWORDS

Medical schemes, last year of life, decedent costs

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1. INTRODUCTION

1.1 There exists an extensive international body of research focusing on the examination of healthcare expenditures incurred by health-insurance beneficiaries in their last year of life. Timmer & Kovar (1971) published one of the earliest studies on healthcare costs in the last year of life in the United States of America (US). More than four decades later, this topic is still of great interest to members of the global healthcare industry.

1.2 These studies have been driven by concerns over the effect of ageing (leading to the postponement of death) on healthcare expenditure (Breyer & Felder, 2006) as well as the need to predict future expenditure in light of technological advancements and the increase in demand for medical care (Stearns & Norton, 2004). Much of the international research indicates a general concern over medical resources being directed towards health-insurance beneficiaries in their last years of life (Scitovsky, 1994).

1.3 Two main areas surrounding healthcare costs in the last year of life are examined here. The first involves the determination of average healthcare costs in the last year of life. The average last-year-of-life costs are compared with the average costs in preceding years before death with the aim of investigating the relationships that exist between them. This part of the investigation also makes similar comparisons according to category of healthcare expenditure and age at death. In addition, the effectiveness of a morbidity-grouper system¹ is considered for the prediction of healthcare resource utilisation in the last year of life. The grouper system considered is the Adjusted Clinical Groups (ACGs) system. ACGs are a series of mutually-exclusive, health-status categories defined by morbidity, age, and sex. They are based on the premise that the level of resources necessary for delivering appropriate healthcare to a population is correlated with the illness burden of that population (The Johns Hopkins University Bloomberg School of Public Health, 2009).²

1.4 The second area investigated examines the relationship between the healthcare costs of those beneficiaries dying (decedent costs) and those surviving (survivor costs) in a particular calendar year. The investigation also compares decedent and survivor costs by age and category of expenditure.

1.5 This research is of interest to actuaries working on health-insurance benefit design and managed care, particularly interventions targeted at high-risk members and palliative care.

1 A morbidity grouper splits beneficiaries into clinically-meaningful groups that are statistically homogenous in terms of expected consumption of healthcare goods and services.

2 Prior versions of this research were presented at the Actuarial Society Convention and the International Congress of Actuaries. <https://cas.confex.com/cas/ica14/webprogram/Session5767.html>; www.africanagenda.com/convention2012registration/assets/pdf/papers/Kathryn%20Dreyer,%20Shivani%20Ramjee%20-%20HEALTHCARE%20EXPENDITURE%20IN%20THE%20LAST%20YEAR.pdf

In addition, this research should also be of interest to health-insurance regulators considering potential benefit packages and the costs thereof.

1.6 In section 2, background into last-year-of-life costs in the South African context is provided. Section 3 contains a description of the data used in the study. The methodology that was used is presented and compared to international studies in section 4. Section 5 comprises the main findings of the study. In section 6, these results are discussed.

2. LAST-YEAR-OF-LIFE COSTS IN SOUTH AFRICAN MEDICAL SCHEMES

2.1 The largest body of research done on healthcare costs in the last year of life relates to Medicare expenditure. Medicare is public health insurance provided to US citizens over the age of 65. It also provides cover for individuals of any age suffering from End-Stage Renal Disease and certain other disabilities (Econex, 2010). There are two main reasons why the results obtained from Medicare studies may not be directly applicable to South African medical schemes. First, a large proportion of medical scheme beneficiaries are under 65. Second, the range of benefits covered by medical schemes differs from those provided by Medicare.

2.2 Moodley & McLeod (2001) analysed healthcare costs in the last year of life using South African medical scheme data. However, legislation governing medical schemes in South Africa has changed significantly since that research was done.

2.3 The Medical Schemes Act No. 131 of 1998 was implemented after the period of investigation in Moodley & McLeod (op. cit.). The first key feature to note is that Annexure A of the Regulations in Terms of the Medical Schemes Act No. 131, ensures the mandatory provision of Prescribed Minimum Benefits (PMBs) by all medical schemes. The PMB package covers 270 diagnosis and treatment pairs, a chronic disease list and emergency conditions in full. One of the aims of the PMB legislation is to ensure adequate coverage at the end of life.

2.4 The second key feature, outlined by the Medical Schemes Act No. 131 (section 29 (1)(n)), prohibits medical schemes from denying cover and adjusting contributions based on age, sex and past or present state of health. This feature, combined with the voluntary nature of medical scheme membership, potentially allows for anti-selection against medical schemes by individuals who are old and sick (Doherty & McLeod, 2002). The scope for anti-selection is expected to increase healthcare expenditure by medical schemes in the last year of life. This is because individuals are more likely to demand cover when their expected healthcare costs are high. Schemes are unable to mitigate against this risk by either declining cover or charging a higher price.

2.5 Section 1(1) of the Medical Schemes Act No. 131 does help to mitigate this risk by defining the business of medical schemes as one which “undertakes liability in return for a

premium or contribution to make provision for the obtaining of any relevant health service". This definition limits the provision of health insurance by any financial institution other than a medical scheme. In addition, many working-age members of medical schemes are required to have medical scheme cover as a condition of employment. This increases the number of younger and healthier beneficiaries covered by the schemes, thereby improving the risk pool that medical schemes are exposed to.

3. DATA

The data used in this investigation were provided by Medscheme, South Africa's largest managed care service provider and third largest medical scheme administrator (Medscheme, 2012). The data pertain to 18 medical schemes administered by Medscheme. The schemes and their beneficiaries are de-identified in order to ensure anonymity. The data provide information on more than three million beneficiaries during the six-year period from the beginning of January 2008 to the end of December 2013.³ The number of beneficiaries that are considered in the investigation is substantial, bearing in mind that there are currently approximately 8.8 million individuals covered by medical schemes in South Africa (Council for Medical Schemes, 2014). The large number of beneficiaries ensures that robust conclusions can be drawn from the results obtained (Calfó, Smith & Zezza, 2008).

3.1 Entire Risk Pool Data

3.1.1 Summary exposure data and claims data were provided for the entire risk pool covered by Medscheme-administered medical schemes. Exposure months were provided by treatment year, scheme code, year of birth, gender and province. The amounts claimed by beneficiaries are recorded in groups according to scheme code, treatment year, year of birth, gender, province, category of expenditure, Hospital-Account-Summary (HAS) indicator and by whether or not the claims are considered PMBs. The HAS indicator records whether or not the beneficiary was treated in a hospital.

3.1.2 Figure 1 illustrates total exposure according to age on 1 January for the calendar year in question. It is observed that the shape of the distribution is broadly the same for each year.

3.1.3 The age distribution displays the key features expected in the South African medical scheme environment: anti-selection out of the system in the early adult years, followed by incremental increases by age category reflecting the impact of medical scheme cover as a condition of employment, coverage declining in the later years as people start to retire and discontinue their medical coverage, and the impact of mortality.

3 Note that data pertaining to 2013 decedents have only been used to calculate the end-of-life costs relating to 2012 and earlier. All claims after the end of 2012 have been removed, as well as all demographic data of those decedents that only joined the scheme in 2013. Last-year-of-life costs and exposure falling within 2013 have not been included in any of the analyses. This is due to the fact that some of the beneficiaries surviving to the end of 2013 are expected to die during 2014, and thus a portion of their 2013 costs should be considered as last-year-of-life costs. However, no data were obtained for 2014, and so the true total last-year-of-life costs and exposure in 2013 are unknown.

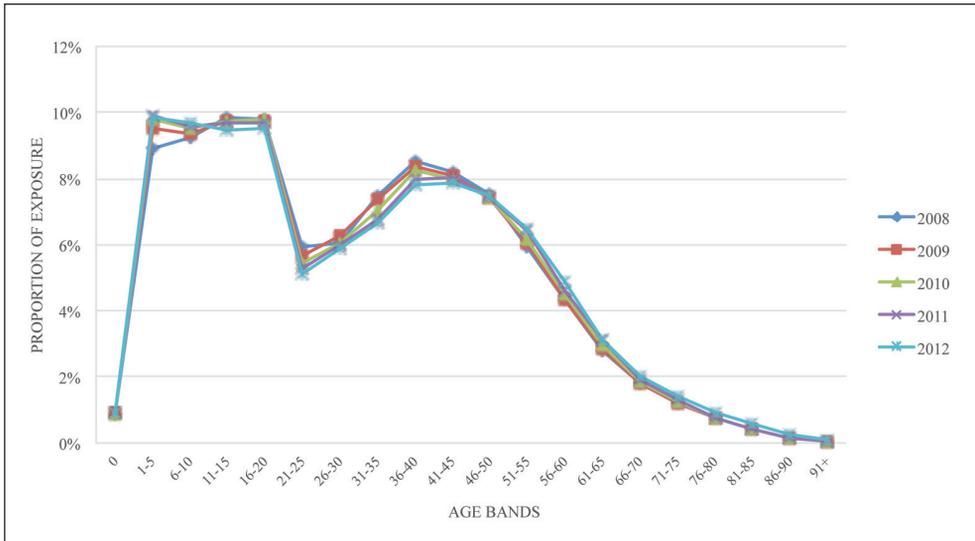


FIGURE 1. Distribution of exposure according to age on 1 January for the entire risk pool of beneficiaries

3.2 Decedent Data

3.2.1 There were 65 475 beneficiaries who died during the five-year study period (decedents). Unlike the data for the entire risk pool, which were provided in summary format, detailed demographic records were made available for decedents. The demographic data provided included the decedent’s birth date, gender, deceased date and province in which they lived. Dates when each decedent joined and left the medical scheme were also provided. Note that where the decedent was covered by a medical scheme until death, the date the decedent left the medical scheme was recorded as the end of the month of death.

3.2.2 Claims data were grouped per treatment month, scheme code, category of expenditure, HAS indicator and by whether or not the claims were PMBs.

3.2.3 Prior studies investigated a wide range of relationships between costs in the last year of life and other variables. The most common relationships investigated were between costs in the last year of life and beneficiaries’ age at death and gender as well as determination of the most costly categories of healthcare expenditure (Moodley & McLeod, op. cit.; Wickstrøm, Serup-Hansen & Kristiansen, 2002; Scitovsky, 2005; Breyer & Felder, op. cit.). A number of research papers went a step further and differentiated the costs in the last year of life according to cause of death. This was done by ascertaining cause of death from mortality data on the individuals in the study group. (Polder, Barendregt & van Oers, 2006; Liu & Yang, 2002; McCall, 1984; Scitovsky, 2005; Calfo, Smith & Zezza, op. cit.; Roos, Montgomery & Roos, 1987; Hogan et al., 2001; Emanuel et al., 2002). Emanuel et al. (2002) and McCall (op. cit.) were able to compare healthcare costs in the last year of life among different geographical locations. In addition, Hogan et al. (op. cit.) were able to compare healthcare costs in the last year of life between different race groups.

3.2.4 Cause of death is not typically captured by medical schemes in South Africa. Theoretically, the cause of death could be surmised from claims data but substantial additional analyses would be required. In this study, no investigation by geographical location or race was undertaken.

3.2.5 Due to the monthly nature of the data, the calculated exposure period is subject to possible over- or under-estimation, depending on the assumptions made in the calculation method. Figure 2 depicts the exposure in the last year of life for decedents by age group (where age is at the first of January for the year in which the beneficiary died). The number of recorded deaths (and the associated exposure) increased in each year. This is likely to represent an increase in the administrative accuracy of the recording of deaths.

3.2.6 It is observed that there is low decedent exposure at younger ages. This is expected, considering the low mortality rates at those ages. Decedent exposure increases with age. The high level of exposure under age 65 is due to the large size of the risk pool at these ages. After age 65 the decedent exposure is driven by rising mortality rates (as opposed to high levels of risk-pool exposure). After age 80 the decedent exposure diminishes quickly because, even though mortality rates are very high at those ages, the exposure in the risk pool is very low.

3.2.7 Data representing each decedent’s Resource Utilisation Band (RUB) were also provided by Medscheme. RUBs are an indication of a beneficiary’s expected future healthcare utilisation and cost and are determined using the Johns Hopkins Adjusted Clinical Groups (ACGs) Case-Mix System. ACGs are a series of mutually-exclusive, health-status categories defined by morbidity, age, and sex. They are based on the premise that the level of resources necessary for delivering appropriate healthcare to a population is correlated with the

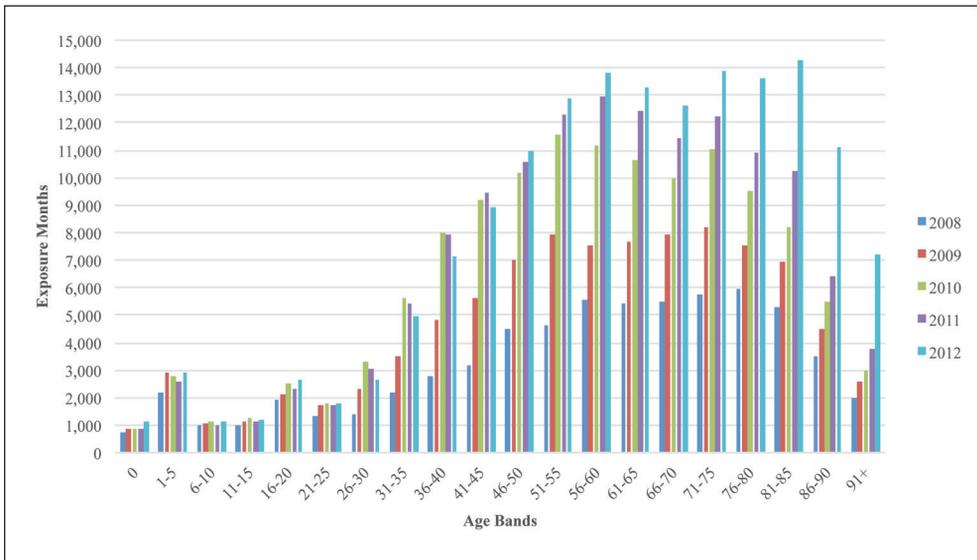


FIGURE 2. Total decedent exposure in the last year of life according to age on 1 January of the year of death

illness burden of that population (The Johns Hopkins University Bloomberg School of Public Health, *op. cit.*). RUB values range from 1 to 5 and are assigned to various combinations of ACGs. Each combination that has the same RUB value is thought to consume a similar level of healthcare costs. The higher the RUB value, the higher the predicted resource utilisation from that beneficiary. RUBs were provided only for beneficiaries who have exposure greater than six months.

3.2.8 Finally, to obtain summary data on those beneficiaries that did not die during the study period (survivors), the relevant decedent data were subtracted from the data pertaining to the entire risk pool.

3.3 Additional Notes on Data

3.3.1 The claims data include both the amount that beneficiaries submitted to the medical schemes for reimbursement (recorded as the claimed amount by Medscheme) as well as the amount the medical scheme actually reimbursed the beneficiary (recorded as the risk amount by Medscheme). The risk amount is always less than or equal to the claimed amount. For the entire risk pool the total claimed amount during the study period is approximately 11.64% higher than the total risk amount. When considering just the decedents, this figure drops to approximately 5.5%. The difference between the claimed amount and risk amount would have had to be covered by beneficiaries (*i.e.* out-of-pocket expenditure). The claimed amount was used in calculating the end-of-life costs throughout the investigation. The reason for this is that it gives a better sense of the costs actually experienced by beneficiaries. However, the liability from a medical scheme perspective, using this basis, would be overstated.

3.3.2 All the claims data need to be adjusted for inflation in order to obtain results in real terms. International studies generally assume that healthcare costs increased in line with the countries' medical inflation (Moodley & McLeod, *op. cit.*; Lubitz & Riley, 1993; 2010; Calfo, Smith & Zezza, *op. cit.*; Hogan *et al.*, *op. cit.*; Emanuel & Emanuel, 1994). In the South African context, this would mean using the medical component of the CPI. However, the basket of medical goods and services that this index is based upon is considerably different from the basket of medical goods and services purchased by medical schemes (Moodley & McLeod, *op. cit.*). The inflation factors used in the calculation of the Risk Equalisation Fund were chosen as a proxy for medical-scheme inflation. These were only available up until 2010, and so the Industry Technical Advisory Panel (ITAP) inflation figures were used for 2011 and 2012. All claims data were adjusted to the end of 2012.

4. METHODOLOGY

4.1 It should be noted that this investigation is a retrospective analysis of costs in the last year of life. The reader should not infer that healthcare has been provided in anticipation of death (Hogan *et al.*, *op. cit.*). Such an inference may only be made in investigations pertaining exclusively to terminally-ill patients. This investigation, however, considers various causes of death and, therefore, does not deal with 'the high cost of dying' but rather with healthcare expenditure at the end of life (Scitovsky, 2005).

4.2 The two different aspects of costs in the last year of life, namely the costs in the last year of life in comparison to earlier years prior to death and the comparison of decedent and survivor costs, are investigated using two different methods.

4.3 Of the research papers reviewed, only Moodley & McLeod (op. cit.) and Roos, Montgomery & Roos (op. cit.) compared the costs in the last year of life to costs in earlier years prior to death. However, the methods used to achieve this differed. Roos, Montgomery & Roos (op. cit.: 234) used least-squares regression to estimate the number of years before death necessary to detect the influence of impending death on healthcare use. Moodley & McLeod (op. cit.) determined the ratios between the average total healthcare costs in the years leading up to death. This is the approach taken in this paper.

4.4 The relationship between decedent and survivor costs within a particular calendar year has been more widely explored (Moodley & McLeod, op. cit.; Scitovsky, 2005; Hogan et al., op. cit.; Calfo, Smith & Zezza, op. cit.; Wickstrøm, Serup-Hansen & Kristiansen, op. cit.; Roos, Montgomery & Roos, op. cit.; Polder, Barendregt & van Oers, op. cit.; McCall, op. cit.; Liu & Yang, op. cit.; Emanuel & Emanuel, 1994). Lubitz & Riley (1993; 2010) also considered trends over time in this relationship.

4.5 By necessity, the two methods utilise different definitions of age and different methodologies for classifying costs. In order to analyse the first aspect, the average healthcare costs in the final years of life within the study period are required and age is defined as the age at death. The second aspect required the calculation of survivor and decedent costs per calendar year in order to examine the relationships between them. Age as at 1 January is used to enable comparison between survivors and decedents. We explore each of these two methods in more detail below.

4.6 Healthcare Costs in the Last Years of Life

4.6.1 The comparison of costs in the last year of life to costs in earlier years began with the determination of the exposure period, in months, before death. As with this investigation's dataset, most international studies did not have the exact day on which the healthcare costs were incurred but rather healthcare costs aggregated by month. Moodley & McLeod (op. cit.) made the assumption that the twelve-month period preceding death should start from the beginning of the month in question. Other investigations assumed costs were uniformly distributed over the month and, thus, the start date of the period was taken as being from the middle of the month in question (Polder, Barendregt & van Oers, op. cit.; Lubitz & Riley 1993; 2010; Calfo, Smith & Zezza, op. cit.).

4.6.2 The first step in the determination of the exposure period was to ascertain the latest date on which each beneficiary discontinued their medical scheme cover. This required the inspection of the beneficiary deceased date and the date on which the beneficiary left the medical scheme (left date). If the left date proved to fall on an earlier date than the deceased date then the left date was taken as the date on which exposure ceased. Otherwise,

the deceased date was used. The next step was to determine the date on which exposure began. If the date on which the beneficiary joined the medical scheme (join date) is later than 1 January 2008, then the join date was taken as the start date of the exposure period. Otherwise, 1 January 2008 was used.

4.6.3 A number of international studies exclude individuals enrolling in or leaving the medical insurance during the period under investigation (Lubitz & Riley 1993; 2010; Emanuel et al. 2002; McCall, *op. cit.*; Roos, Montgomery & Roos, *op. cit.*). This is because it is difficult to allocate the expenditures of such individuals to survivor or decedent costs. Including such individuals (as with this investigation) could result in over- or under-estimation of the survivor and decedent costs. However, high levels of churn in the medical scheme industry result in an unrepresentative dataset if these lives are excluded.

4.6.4 It should be noted that the method of calculating exposure used in this paper is subject to possible over-estimation of the exposure period. This is because the date representing the end of each beneficiary's exposure period was assumed to be the end of the month in which the beneficiary died or left the scheme. As a result of beneficiaries paying their premiums at the start of the month, they have a full month of cover regardless of when during the month they leave the scheme. In addition, the join date was assumed to be the beginning of the month in which the beneficiary joined the medical scheme because the vast majority of join dates fall at the beginning of the month. The assumption merely adjusts the remaining few. These two assumptions are required because the claim amounts are recorded only by treatment month, as discussed above.

4.6.5 The process continued with the division of the exposure period into the respective years prior to death. Anniversaries prior to death, which fall within the exposure period, were determined for each beneficiary. Consistent with the assumptions made above, the anniversaries prior to death were computed from the end of the month of death. Using these anniversary dates, the exposure was calculated for each year prior to death that fell within the study period. For example, a beneficiary who joined the scheme half way through March 2010 and left the scheme, upon death, half way through September 2011 would have contributed exposure from the beginning of March 2010 to the end of September 2011. Therefore, the beneficiary would have had 12 months exposure in their last year of life and 7 months exposure in their second year prior to death. Aggregate exposure was calculated by summing all beneficiaries' exposure months falling within each respective year prior to death.

4.6.6 Once the exposure in each relevant year prior to death had been determined, claimed amounts were allocated among the respective years prior to death. Aggregate healthcare costs in each year prior to death were determined by summing all beneficiaries' claims falling within the respective year prior to death. Finally, average healthcare costs were determined by, first, dividing the aggregate exposure figures by 12 to obtain exposure figures in years. Second, the aggregate healthcare costs for each year prior to death were divided by the respective aggregate exposure in years in order to obtain average healthcare costs per beneficiary per year (Moodley & McLeod, *op. cit.*). A similar process was followed to determine average healthcare costs according to age at death, category of expenditure and RUB level. The only difference to the above method was that aggregate healthcare costs

and exposure were calculated by summing within, respectively, age at death, category of expenditure or RUB level. Finally, the average healthcare costs for the different years prior to death were compared by taking the ratios between them.

4.7 Survivor and Decedent Costs

4.7.1 The analysis of the relationship between survivor and decedent costs also considers the last year of life for each beneficiary, as calculated in section 4.1. It therefore suffers from a similar over-estimation of the true exposure period (and hence under-estimation of average costs).

4.7.2 The method followed to calculate the decedent and survivor costs is best described by considering how healthcare costs were allocated for the various scenarios that arose in the investigation. There were three possible scenarios: firstly, the beneficiary survived both the calendar year being analysed, as well as the subsequent calendar year; secondly, the beneficiary died during the calendar year under consideration; and finally, the beneficiary died in the calendar year subsequent to the year being analysed.

4.7.3 If a beneficiary survived from the calendar year under consideration to the end of the subsequent calendar year, then all the beneficiary's costs in that calendar year were assigned to survivor costs. If a beneficiary died within the calendar year then all the costs relating to that beneficiary were assigned to decedent costs. Finally, if a beneficiary died in the subsequent calendar year to that considered then a portion of the costs arising in that calendar year were assigned to decedent costs and the rest to survivor costs. The above portion was determined by the number of months within the considered calendar year that the beneficiary was in the last year of life. The exposure period within each calendar year, allocated to either the survivor or decedent category, was determined in the same way (Calfo, Smith & Zezza, *op. cit.*; Lubitz & Riley, 1993; 2010). Decedents' costs and exposure periods were then aggregated by summing all decedents' costs and exposures, respectively, within each particular calendar year. Equivalently, aggregate survivor costs and exposure were calculated. Average survivor and decedent costs were then calculated using the same method described in the final paragraph of section 4.1. Ratios were calculated to compare the average survivor and decedent costs within each calendar year.

4.7.4 Furthermore, it is evident from a comparison of Figures 1 and 2 that the respective distributions of survivor and decedent exposure by age vary considerably. In order to make the comparison of average survivor and decedent costs more meaningful, it is necessary to standardise the average costs by age and gender. This has the effect of adjusting the averages as if they were determined from a population with the same age and gender profile. The average cost for each age and gender category was calculated separately for survivors and decedents. The proportion of the exposure in each age and gender category was calculated based on the entire risk pool (i.e. not separately for survivors and decedents). The weighted average cost for survivors was then calculated using the average survivor costs for each age and gender category weighted by the risk-pool exposure in each category. The same was done for decedent costs.

4.7.5 Finally, once the average costs were calculated, they are compared for statistical significance using independent two-sample *t*-tests. The assumptions of this test are

that, first, the two samples are normally distributed, second, that the samples are independent and, third, that the variances are equal. These assumptions were tested and found to be reasonable.

5. RESULTS

5.1 Analysis of Average Costs in the Last Years of Life

5.1.1 The average cost in the last year of life is substantially higher than in the three earlier years prior to death (Table 1).

TABLE 1. Average claimed amount for each year prior to death, as well as the ratio between the average claimed amounts in the successive years prior to death

	Year Prior to Death			
	1st	2nd	3rd	4th
Average Cost (in ZAR)	206 453	62 567	48 775	41 346
Ratio to previous year	3.30	1.28	1.18	

Note: $p < 0.01$ for all t-tests of differences between average costs of successive years before death

5.1.2 This result is further emphasised by considering the ratio between average costs in successive years prior to death. The average cost in the last year of life is 3.3 times higher than the average cost in the second year prior to death. The difference between the average costs in the second, third and fourth years prior to death is smaller, but still statistically significant. These average costs and ratios clearly portray the substantial jump in healthcare expenditure incurred by medical schemes in the last year of life.

5.1.3 The above analysis is examined in more detail by considering the costs in the last year of life according to age at death, category of expenditure and RUB value.

5.2 Analysis of Average Costs in the Last Year of Life according to Age at Death

5.2.1 This analysis considers the distribution of average claim amounts in the last year of life according to age at death (Figure 3).

5.2.2 Average last-year-of-life costs for neonates are significantly higher than other age bands (R816212 as compared to the overall average of R206449). They have been omitted from Figure 3 to enable us to observe differences between other age bands. One of the explanations as to why average neonatal costs are so high is the complicated ethical issues surrounding neonatal healthcare. Often expensive treatments are performed on unhealthy babies that have extremely low chance of survival (Xiang, 2012). At the same time these newborns contribute very little exposure as they often may die within a few months of being born.⁴

5.2.3 The key feature visible in the distribution is the relatively low level of the average last-year-of-life costs for beneficiaries in the 6–10 year old age category through to

4 If the study had been conducted over the last six months of life, the differences between average costs for neonates and the overall average may have been less as this may account better for the very low exposure of neonates.

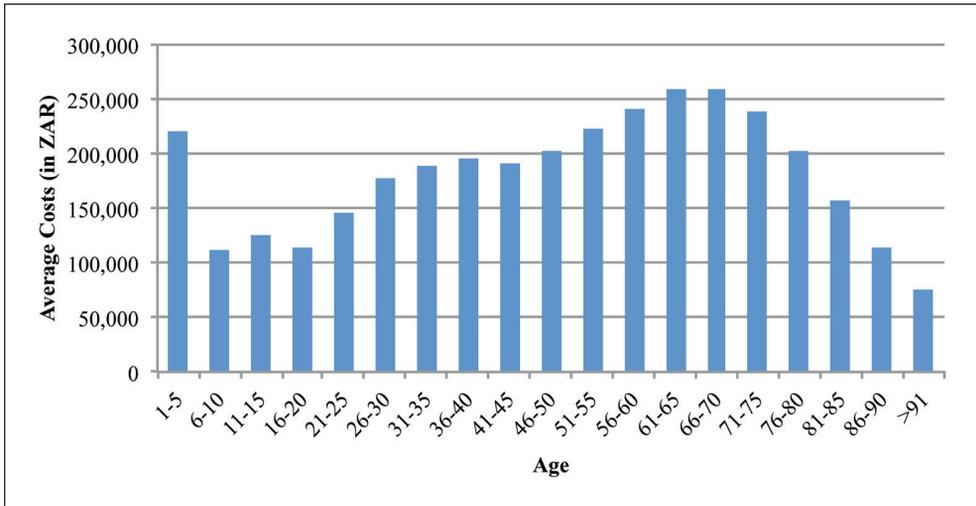


FIGURE 3. Distribution of average last-year-of-life costs according to age at death (excl. neonatal costs)

beneficiaries in their mid-20s. This is possibly because more beneficiaries in this age range die from sudden events as opposed to prolonged illness. Therefore, these beneficiaries would not incur substantial additional medical expenditure before their death. The distribution also illustrates that the average costs increase incrementally by age category until around 70 and thereafter rapidly diminish. This is consistent with a number of Medicare studies (Alemayehu & Warner, 2004; Calfo, Smith & Zezza, op. cit.; Lubitz & Riley, 1993; Scitovsky, 2005).

5.2.4 Scitovsky (2005) attributed this phenomenon to the exclusion of certain categories of expenditure of which the elderly make considerable use from the studies. These expenditures are excluded either because they are not covered by the insurer or because insufficient data are available for their investigation. A common example of such expenditure is nursing home costs (Alemayehu & Warner, op. cit.; Hogan et al., op. cit.; Hoover et al., 2002; Roos, Montgomery & Roos, op. cit.; Scitovsky, 2005). Another potential reason is the typical setting of death; elderly patients may choose to go into frail care rather than to a private hospital. The extent to which these expenditures are reimbursed is unknown. Levinsky et al. (2001) attributed the difference in expenditures between the young and old to the decision reached by many elderly patients, together with their families and doctors, to avoid aggressive healthcare procedures that would have otherwise been used on younger patients. Lives surviving to these older ages may also be more likely to be stable on chronic medication than younger lives.

5.3 Analysis of Average Costs in the Last Year of Life according to Category of Expenditure

5.3.1 Table 2 illustrates the average last-year-of-life costs according to category of expenditure.

TABLE 2. Proportion of average claimed amounts in the 1st and 2nd years prior to death according to category of expenditure as well as the ratios between the average claimed amounts

Category of Expenditure	Years Prior to Death			
	1st		2nd	
	Average Cost	%*	Average Cost	%*
Hospital	121 078	58.65%	26 754	42.76%
Diagnostic specialities (radiology and pathology)	20 757	10.05%	6 468	10.34%
Medical specialist	17 127	8.30%	5 585	8.93%
Auxiliary	17 093	8.28%	4 294	6.86%
Radiation/oncology	13 797	6.68%	7 155	11.44%
High-cost benefits (e.g. transplants, dialysis)	6 633	3.21%	3 397	5.43%
Medicine	6 491	3.14%	6 274	10.03%
Day-to-day (GP, optical, dental)	3 477	1.68%	2 639	4.22%

*Percentage of total average 1st and 2nd year prior to death costs consumed by each category of expenditure

5.3.2 The dominant influence that hospital expenditure has on the last-year-of-life costs is unmistakable: almost 59% of the average total claimed amount in the last-year-of-life is for the direct reimbursement of hospital care (i.e. excluding all of the associated costs). High hospital expenditure is consistent with results obtained in Medicare research (Alemayehu & Warner, 2004; Lubitz & Riley, 2010; McCall, op. cit.). The other significant expenditures observable are costs relating to medical specialists, radiation/oncology, pathology and auxiliary. Auxiliary benefits relate to all medical disciplines that are not general practitioners or medical specialists (for example, physiotherapists). Radiation/oncology accounts for 11.44% of the claimed amount in the second last year of life. Hospital costs, pathology and auxiliary costs held the greatest responsibility for the large jump in average costs between the first and second last years of life.

5.4 Analysis of Average Costs in the Last Year of Life according to RUB Value

5.4.1 The average last-year-of-life cost for each RUB value can be seen in Table 3. RUB 0 is for beneficiaries where there is not sufficient data to allocate them to a category. RUB 1 is for the lowest level of predicted resource use and RUB 5 is for the highest level of predicted resource use.

TABLE 3. Average claimed amount in the last year of life according to RUB category

	RUBs*					
	0	1	2	3	4	5
Average Cost (in ZAR)	54 960	83 000	92 756	138 235	189 838	342 865

Note: $p < 0.01$ for all t-tests of differences between average last-year-of-life costs of the successive RUBs, except between RUBs 1 and 2 ($p = 0.168$).

5.4.2 It is easily observable that average last-year-of-life costs rise with the RUB value from RUB 2 upward.

5.5 Analysis of Survivor and Decedent Costs

5.5.1 As seen in Table 3, the percentages of total costs that decedents consume in each calendar year indicates that decedent's costs form a small but increasing part of the total healthcare expenditure incurred by medical schemes each year. Table 4 also records the average survivor and decedent costs for each of the study period's five years under consideration. It can be seen that average decedent costs in each year far exceed that of average survivor costs, even on a risk-adjusted basis. This result is reinforced by considering the ratio between the average survivor and decedent costs for each year. The average decedent costs are 17.85 times higher than average survivor costs in 2012. In addition, the ratio between average survivor and decedent costs is trending upward over the five-year study period. While the average decedent costs are increasing year-on-year in real terms, the average survivor costs remain relatively stable.

TABLE 4. Percentage of total costs attributed to decedents, average non-standardised and standardised survivor and decedent costs and ratios between them

	Year				
	2008	2009	2010	2011	2012
Percentage	3.93%	5.23%	6.57%	7.14%	7.93%
Non-standardised					
Average decedent cost	166 727	195 251	201 085	214 900	226 547
Average survivor cost	10 910	11 612	11 480	11 531	11 784
Ratio	15.28	16.81	17.52	18.64	19.23
Standardised					
Average decedent cost	136 228	168 798	180 431	185 594	211 314
Average survivor cost	10 944	11 653	11 524	11 578	11 839
Ratio	12.45	14.49	15.66	16.03	17.85

5.5.2 The above analysis is examined in more detail in the discussion that follows by comparing survivor and decedent costs according to age, category of expenditure and treatment of PMBs.

5.6 Analysis of Decedent and Survivor Costs by Age

5.6.1 The distributions of average survivor and decedent costs have also been considered according to age on 1 January for each year of the study period (Figure 4).

5.6.2 The level of the decedent costs are substantially higher than that of the survivor costs for every age category (note the difference in the scale of the axes). At 70 the average decedent costs reach their peak and start to diminish. The average survivor costs, however, continue to rise substantially all the way to around 90 years of age. This indicates

that between ages 70 and 85 decedent expenditure decreased while survivor expenditure increased. Calfo, Smith & Zezza (op. cit.) established an almost identical result in their Medicare investigation but were unable to definitively explain the reason for this.

5.7 Analysis of Decedent and Survivor Costs by Category of Expenditure

5.7.1 Ratios between average survivor and decedent costs are calculated for each category of expenditure and for each calendar year.

5.7.2 It is observed that auxiliary, hospital costs, radiation/oncology, pathology and special benefits are the main causes of the disparity between survivor and decedent costs. These are the same categories that contribute to high claimed amounts in the last year of life. Auxiliary, hospital and pathology are also the main contributors to the large jump in average costs between the first and second last years of life.

5.8 Analysis of Percentage of Decedent Costs provided in the Treatment of PMBs

5.8.1 Given the impact of PMBs on medical scheme benefit design and particularly the way in which they limit the ability of schemes to ration benefits, it makes sense to assess the extent to which decedent costs are categorised at PMBs.

5.8.2 A large proportion of decedent costs, within each year, are incurred by medical schemes in the treatment of PMBs (Table 5). It is also evident that the percentage is increasing over the period, from 61.44% in 2008 to 83.35% in 2012.

5.8.3 This may be due to an under-reporting of PMBs in the earlier years; it is likely that both member and provider awareness of PMBs has increased over time. In addition, PMBs are reimbursed at cost and not limited to medical scheme tariffs. It is thus possible that providers charge higher rates for PMBs than for non-PMBs.

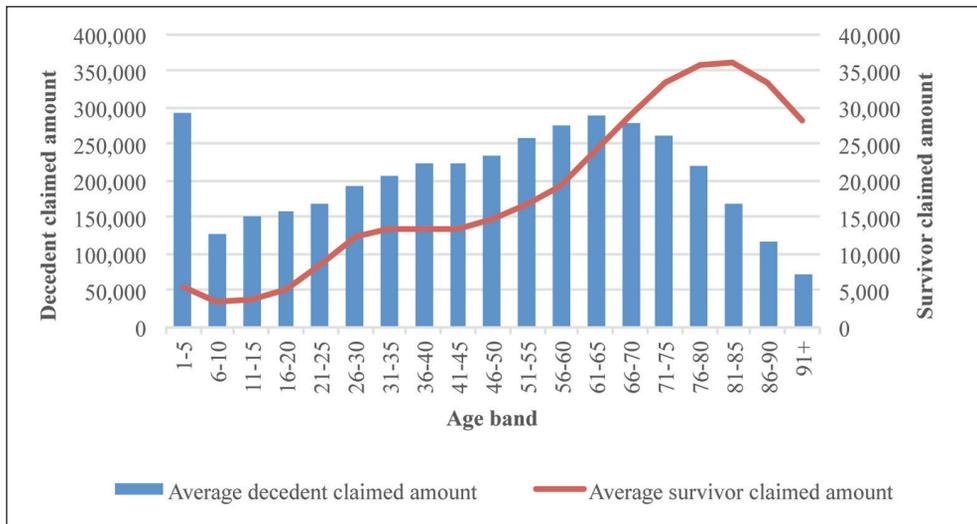


FIGURE 4. Distribution of 2012 decedent and survivor claimed amounts according to age on 1 January

TABLE 5. Percentage of total decedent claim amounts utilised on the provision of PMBs

	Year				
	2008	2009	2010	2011	2012
Percentage	61.44%	69.29%	73.72%	78.06%	83.35%

6. DISCUSSION AND CONCLUSIONS

In this section the key findings are contextualised within the local regulatory environment. The key methodological considerations for those wanting to replicate the analysis on other datasets are noted. The practical implications of the work are also considered.

6.1 High Last-Year-of-Life Costs

6.1.1 The most noteworthy finding in the investigation is the large extent to which average costs in the last year of life exceed average costs in the earlier years prior to death. In addition, it is shown that average decedent costs are at least 15 times greater than average survivor costs. These two findings illustrate the significant medical expenditure that health insurers incur on beneficiaries in their last year of life. These findings also reveal that the significance of costs in the last year of life has increased since the investigation by Moodley & McLeod (op. cit.). This was expected due to changes in the South African regulatory environment that encourage anti-selection (namely open enrolment, community rating and voluntary membership). The voluntary nature of the environment combined with open enrolment and community rating enables members to join the environment if and when they are ill.

6.1.2 It needs to be noted, however, that even though costs in the last year of life are shown to have a financial impact per year of exposure, significant exposure to decedents is still needed to have a substantial overall impact. The fact that costs in the last year of life only constitute between 3.93% and 7.93% of the total yearly expenditure shows that medical schemes currently have limited exposure to the risks imposed by beneficiaries in their last year of life. In addition, between 61.44% and 83.35% of costs in the last year of life are incurred in the treatment of PMBs. Schemes consequently have limited scope to ration these benefits.

6.1.3 The current regulatory environment leaves medical schemes vulnerable to a substantial increase in exposure to beneficiaries in their last year of life as schemes have little protection against anti-selective behaviour. In addition, with PMBs comprising a large percentage of costs in the last year of life, medical schemes are obliged to reimburse the majority of the claims and the scope for rationing is constrained. There may, however, be the potential for schemes to engage more proactively with mechanisms for managing PMB costs such as contracting with designated service providers.

6.2 Key Factors influencing Last-Year-of-Life Costs

Three main factors are observed to have the most notable impact on last-year-of-life costs. These factors are important to consider as they provide themes on which to focus further research. The first, and possibly most influential, factor to consider is the dominant

role of hospital costs. Almost 59% of costs can be attributed solely to the direct expenditure on hospital care. This is not a result restricted to the South African healthcare industry. The second factor to consider is the impact that young beneficiaries have on costs in the last year of life. In particular, neonatal average last-year-of-life costs amounted to R816 212 and are observed to be at least 23.81 times higher for decedents than for survivors during the study period. Finally, it is useful to monitor constantly the number of beneficiaries with an RUB value of 5. These beneficiaries consume an average of R342 865 worth of medical resources in their last year of life.

6.3 The Effectiveness of Disease Grouper Systems

One of the most interesting findings of the investigation is the effectiveness of a disease grouper system (in this case the ACG system) in revealing those beneficiaries whose treatment incurred the highest average healthcare costs in their last year of life. The finding does not prove that the ACG system will always be successful in revealing beneficiaries with high resource utilisation. Instead, it adds to the credibility of disease grouper systems. It does so by providing a retrospective example of the ACG system successfully revealing high-resource beneficiaries who are in their last year of life. Disease grouper systems, such as the ACG system, therefore, provide a potential method of monitoring the high-risk beneficiaries mentioned in the previous sub-section. From a risk-management perspective it may make sense to combine high-risk member management initiatives with palliative-care interventions.

6.4 Key Methodological Notes

6.4.1 This research highlighted a number of key methodological issues to consider when carrying out an analysis of healthcare costs at the end of life. The first issue relates to the calculation of exposure. Where claims information is aggregated by treatment month, exposure also needs to be calculated in months to ensure adherence to the principle of correspondence. This results in either an under- or over-estimation of the exposure period.

6.4.2 An inflation adjustment is required to enable comparison of costs across calendar years. In choosing an inflation factor, attention should be paid to the underlying basket of goods and the perspective from which the index in question has been constructed, either a funder or a consumer perspective.

6.4.3 Complete mortality data are required for the last calendar year included in the analysis. In this study the last year included in the analysis is 2012. Hence, 2013 mortality data were required. Without the additional year of data it is not possible to correctly classify lives as either survivors or decedents.

6.4.4 Lastly, in order to make the comparison of average survivor and decedent costs more meaningful, it is necessary to standardise the average costs by age and gender. Survivor and decedent exposure distributions vary considerably. This makes it necessary to adjust the averages as if they were determined from a population with the same age and gender profile.

6.5 Practical Applications of Research on the Healthcare Costs in the Last Year of Life

6.5.1 The distribution of the healthcare costs of survivors and decedents can be used to aid the pricing of health insurance products. Alemayehu and Warner (2004) made this the focus of their research. In addition, the comparison of the cost in the last year of life with age at death (Figure 4) helps to identify the effects of an aging population on the consumption of healthcare benefits (Breyer & Felder, op. cit.; Calfo, Smith & Zezza, op. cit.; Emanuel & Emanuel, 1994; Felder et al., 2000).

6.5.2 Much of the more recent body of research attempts to use the results obtained on healthcare costs in the last year of life to improve existing models projecting future healthcare costs (Polder, Barendregt & van Oers, op. cit.; Breyer & Felder, op. cit.; Wickstrøm, Serup-Hansen & Kristiansen, op. cit.).

6.5.3 The most pertinent area of application of this research for actuaries relates to rationing and benefit design. This includes consideration of the “place of dying” and the influence that benefit design has on this decision. The possible cost benefits that may arise from greater co-ordination of care for the frail and chronically ill also requires careful consideration.

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