To Live and Die: What is driving up the cost of hospitalization in Brazil?

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1 Introduction

The rise in longevity for the older population and the rapid decrease in fertility rates in Brazil have resulted in changes in the population's morbidity-mortality profiles and in its health expenditures. The proportion of the population aged 60 years and older is increasing very fast, compared to other age groups and, in addition, individuals are also living longer life cycles (Carvalho, Garcia, 2003), bringing a concern about the impacts of this transition on the health system.

The discussion about the rising cost of health expenditures relatively to the Gross National Product (GNP) and strategies to reduce expenditures are the focus of many analyses (Zweifel et al, 1999, Reinhardt, 2003) in the developed countries. In Brazil, those concerns are amplified because the pace of the aging population process has occurred faster, as compared to the more developed countries. For instance, while the developed countries took almost one century to complete their fertility transition, in Brazil fertility rate decreased 60% from 1970 to 2000 (Wong, Carvalho, 2006). More recently, the mortality decrease among the population aged 60 years and older led to a rise in longevity. The expectation of life at birth increased from 66,9 years in 1991 to 70,4 years in 2000, and it is expected to reach 78,3 years in 2030 (IBGE, 2006). The rise in longevity, however, does not necessarily imply an improvement in population's health. The epidemiologic transition and improvement of the medical technology has contributed to an increase in morbidity duration and part of the additional years of life resulted from a drop in mortality rates are lived in unhealthy conditions and impairment.

In the specific case of health, since the aging population is the one that utilizes more health services, there is evidence that Brazilian health system has faced with competition for resources, since the treatment of diseases that are characteristic of the oldest group are competing with the unsolved demands to treat diseases of the younger age groups. In addition, since chronic diseases that are characteristic of the aged require longer treatments, there is a concern that health expenditures will rise, overtaxing the public health care system. As stated by Wong and Carvalho (2006), the rise in health care costs is associated with the proportion of the aged population with chronic conditions, and according to the Pan American Health Organization (2000), 75 percent to 80 percent of the population aged 60 years and older in Latin America has at least one chronic disease.

It is not clear; however, which factors have more influence in health expenditures. Some of the most studied factors are: number of people in each age group, number of people with incapacity(ies) or poor health, number of people in the last year of life (proximity to death), treatment costs, treatment intensity, and availability of new technologies and utilization of home care (Gray, 2005; Cutler, Sheiner, 1998; Hogan et al, 2001).

Among all these factors, three hypotheses have been stated to explain rising health expenditures: the rising of expenditures due to advancing age, the technological pressures and the proximity to death. The rise of health expenditures due to age is explained by the fact that older individuals use more health care services than younger individuals. Therefore, the rise in longevity has being seen as determinant of the increase of health care expenditures (Miller, 2001). On the other hand, Fuchs (1998) and Jacobzone, Oxley (2002) say that technology is the driving force behind the increase in expenditures. However, these conclusions have since been questioned. More recent research suggests that health expenditures are more likely driven by proximity to death, and not age per se (Lubitz, Riley, 1993, Himsworth, Goldacre, 1999, Seshamani, Gray, 2004).

As shown by Zweifel et al. (1999), if the rising in health expenditures is directly associated with age, then population aging may drive up future per capita health care expenditures. If, however, proximity to death, independent of age, is a decisive factor, then aging cannot be a principal cost driver in the future at the level of the individual (Zweifel et al, 1999). Furthermore, if the costs in the period immediately before death are indeed high, then mortality can be a promising risk adjuster in capitation payment schemes for health care plans (Stooker et al, 2001).

The goal of the present study is to measure the effect of the variables "age" and "proximity to death" in the health care expenditures for the Brazilian case, using specifically the case of Minas Gerais, the second most populated state in Brazil, with 19 million habitants. Specific issues like whether or not high expenditures are related to a single hospitalization or repeated hospitalizations for the same cause are also analyzed. Finally we do an exercise projecting the health expenditure for the population in 2020. With this exercise we are able to verify what would be the difference in the projections by considering or not the proximity to death.

Data and methods

In this paper information of the data called "*Autorizações de Internação Hospitalar*" (AIH) were used. This data set is released by the public health system in Brazil, and covers 72% of the entire population in the country. The data contains personal information about the patient, such as sex, age, birth date, as well as data about the procedures used in the hospitalization and the concomitant cost. Unfortunately, the data is not longitudinal and, therefore, the patients cannot be followed over time. As an alternative, one can use the matching of information from each hospitalization during two years (2004/2005), based on data linkage methodology. As there is no unique information such as social security number or name, the matching was done with variables that, per se, would not identify the individual in a unique form, but that together could identify the same person in different hospitalizations. The variables used for the linkage were zip code, birth date and sex.

OLS regressions were used to verify the effect of proximity to death on hospitalization costs while controlling for other individual characteristics. Four sets of models, based in the study of Breyer and Felder (2006), were used to analyze the health care expenditures.

Model 1: Model with death effect

$$Y_1 = \beta_0 + \beta_1 age + \beta_2 (agesq/1000) + \beta_3 sex + \beta_4 age * sex + \beta_5 dayshosp + \beta_6 death + \beta_7 death * age + \beta_8 TtD + \varepsilon$$

Model 2: Model for survivors

$$Y_2 = \beta_0 + \beta_1 age + \beta_2 (agesq/1000) + \beta_3 sex + \beta_4 age * sex + \beta_5 dayshosp + \varepsilon$$

Model 3: Model for decedents

$$Y_3 = \beta_0 + \beta_1 age + \beta_2 (agesq/1000) + \beta_3 sex + \beta_4 age * sex + \beta_5 dayshosp + \beta_6 TtD + \varepsilon$$

Model 4: Naïve Model (Model without death effects)

$$Y_4 = \beta_0 + \beta_1 age + \beta_2 (agesq/1000) + \beta_3 sex + \beta_4 age * sex + \beta_5 dayshosp + \varepsilon$$

Where:

Y_1 represents the health expenditure in the hospitalization; *age* is the age of the patient; agesq/1000 is the age square divided by 1000; age*sex and death*age are interactions to account for differences in the division of health expenditures both between genders and by survival status; *dayshosp* shows how many days the patient was hospitalized; *death* indicates whether the patient died or not; *TtD* is the time to death measure in months until death, in the cases where the patient survived until the end of observation we set TtD=13[1]; Y_2 is the health care expenditure for hospitalizations concerning only the survivors; Y_3 is the health expenditure for hospitalizations concerning only the decedents; and Y_4 is the health expenditure for the whole hospitalizations when we do not consider the death effects.

The parameters from Models 1 and 4 were also used to make health expenditures projections in order to contrast these forecasts when considering the effect of proximity to death. The contrast between Models 2 and 3 can be used to assess the different effects of the socio-demographic variables in the model according to whether or not the patient is close to death

To make the projections of health expenditure we used the total population projection of Minas Gerais 2020 made by IBGE. As we the population by age we applied Brazil's age structure of 2020 in the total population of the state. As we are using only the population that was hospitalized we then calculated the proportion of individuals that should be hospitalized in that year. With these results, we further recalculate

[1] In the study of Breyer and Felder (2006) they set for survivors TtD=43, since they had 42 months of observation.

expenditures following Models 1 and 4. It is important to point out that this is an exercise to verify differences in the projections using or not the proximity to death and we are using the age structure of Brazil in 2020 that is most likely to be different than the one expected for Minas Gerais.

Some Results

Both for survivors and decedents, in the case of re-hospitalizations, it was verified that more than 50 percent of the expenditures in the last year were related to re-hospitalizations due to the same cause, according to the ICD-10.

Age shows a negative effect in all the models, however it is important to point out that if we consider only the decedents the coefficient is much larger than in the other models, meaning that the older a person die, the less expensive would be the costs in the last hospitalizations, as shown by other studies. We could also verify that death increases the costs and as shown by the variable time to death (TtD) the hospitalizations that occurred closer to death are more expensive. We can also see this result in graph 1.

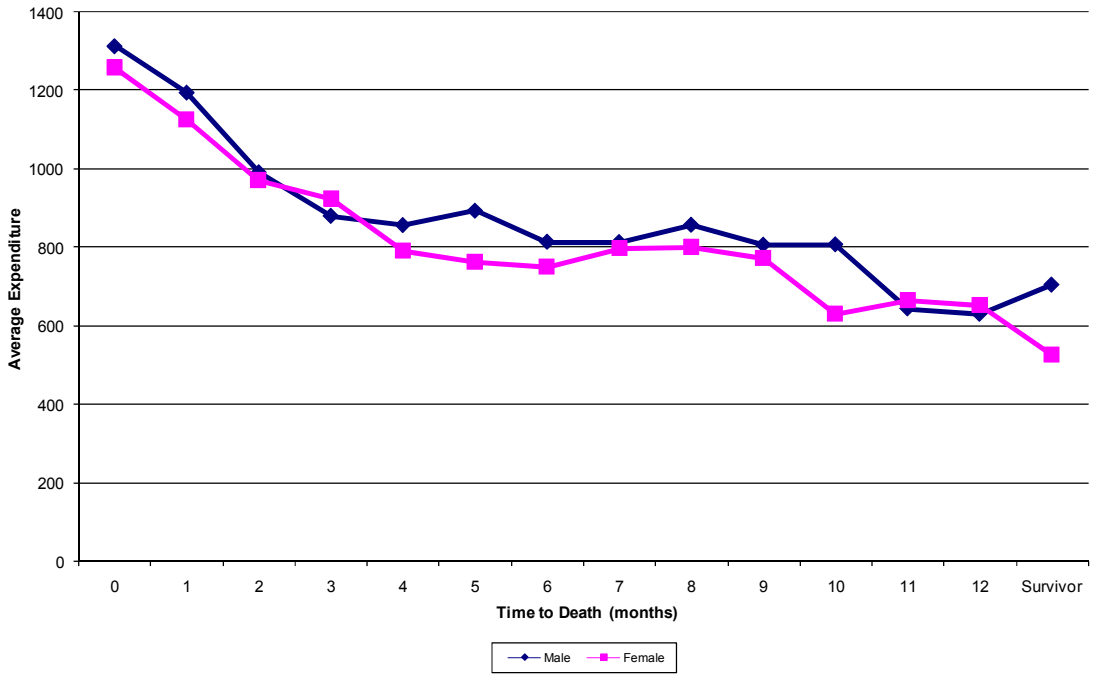
Table 1: Coefficients and standard errors, according to each model, Minas Gerais (Brazil), 2004/2005

Variables	Model 1 Coef (se)	Model 2 Coef (se)	Model 3 Coef (se)	Model 4 Coef (se)
Age	-1.07252 * (0.15)	-0.35507 * (0.15)	-24.9715 * (1.01)	-0.60745 * (0.15)
(Age square)/1000	32.33748 * (1.66)	23.33613 * (1.64)	133.5881 * (9.41)	27.37228 * (1.65)
sex	51.78556 * (3.79)	55.76923 * (3.66)	24.88995 NS (34.38)	76.75265 * (3.81)
age*sex	0.131663 NS (0.08)	0.229833 * (0.08)	-0.04978 NS (0.54)	-0.02095 NS (0.08)
dayshosp	40.84808 * (0.06)	39.89483 * (0.06)	56.95147 * (0.41)	41.11524 * (0.06)
death	532.6665 * (18.21)	- -	- -	- -
death*age	-14.56 * (0.18)	- -	- -	- -
TtD	-62.5125 * (1.28)	- -	-61.1139 (2.03)	- -

* significance p < .05, **p < .1, NS not significant

Source: AIH 2004/2005

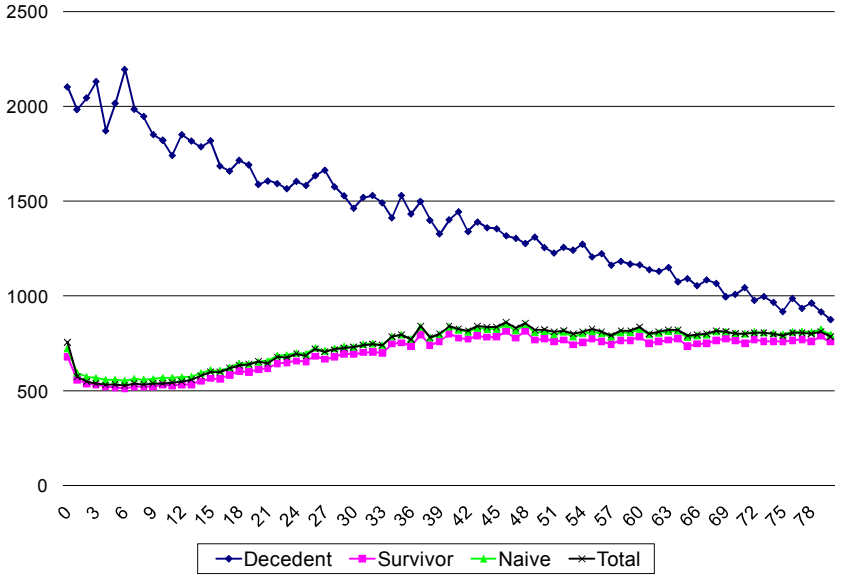
Graph 1: Average Expenditure per Hospitalization in MG, 2004/2005 according to time to death



Source: AIH 2004/2005

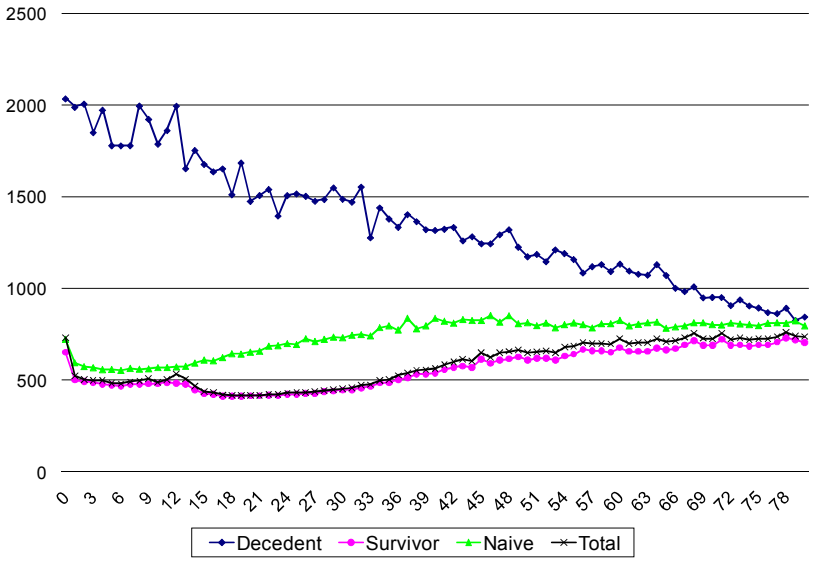
Using the parameters of model 1 and 4 we simulated a projection of the expenditure to 2020. In graphs 2 and 3 we show the results for the average expenditures using those models.

Graph 2: Projected Average Expenditure, considering or not the death effects, Male, MG, 2020



Source: AIH2004/2005, IBGE

Graph 3: Projected Average Expenditure, considering or not the death effects, Female, MG, 2020



Source: AIH2004/2005, IBGE

It is possible to verify that for males the projections were not very different, however for females we can see that the naïve projection had higher values. With these results we can conclude that if we do not take into account the effects of proximity to death, the health expenditure projections could be inaccurate. As it is also shown by other studies when we considered the proximity to death the projection of expenditures was not as high as the projection based only in the changing of the age structured.

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