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

Cláudia Koeppel Berenstein
Roberto Nascimento Rodrigues
Carla Jorge Machado

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 impact of this transition on the health system.

The discussion about the rising cost of health expenditures relative to the Gross National Product (GNP) and strategies to reduce expenditures is the focus of many analyses (Zweifel et al, 1999, Reinhardt, 2003) in the developed countries, especially in the United States, which will over the next three decades, experience a major demographic shift as the baby boomers - the largest birth cohort in its history - grows older (Rice, Fineman, 2004).

In Brazil, these concerns have not yet caught the attention of researchers. However, the consequences of the aging population will soon have to be faced, as the pace of the aging population process has occurred faster, than that of the more developed countries. For instance, while the developed countries took almost one century to complete their fertility transition, in Brazil the 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 life expectancy 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). However, the rise in longevity does not necessarily imply an improvement in the

population's health. The epidemiologic transition and improvements in medical technology have contributed to an increase in duration of morbidity, and part of the additional years of life, that resulted from a drop in mortality rates, are lived in unhealthy conditions and impairment (Olshansky, 1991).

In the specific case of health, there is evidence that the Brazilian health care has faced a competition for resources, since the treatment of diseases that are characteristic of the oldest group are competing with the unmet demands to treat diseases of the younger age groups. In addition, since chronic diseases that are characteristic of the elderly require longer treatment, 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 who have 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.

Despite the fact that the quantitative dimension of population aging is well known, understanding the impact of an aging population on the nation's health is far less clear (Manton, 1991). Some of the most studied factors to explain the expenditures 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, 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 rise in 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 been seen as a 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. In

addition to those hypotheses, 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 there is a concentration of people dying in old age, proximity to death would be the factor behind age that explains the rise in the expenditures.

As shown by Zweifel et al. (1999), if the rise 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 itself cannot be a principal driver of cost at an individual level (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 inhabitants. Health expenditure projections are also made considering whether death effects are a determinant factor or not. The issue of whether or not high expenditures are related to a single hospitalization or repeated hospitalizations for the same cause is also analyzed.

Data and methods

In this paper information from data called "*Autorizações de Internação Hospitalar*" (AIH) was used. This data set is released by the public health system in Brazil, and covers 72% of the entire population in the country (Nunes, 2004). The data contains personal information about the patient, such as sex, age and birth date, as well as data about the procedures used in the hospitalization and the concomitant costs. 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.

As the AIH is organized by payment data we needed to use all the information from 2004, 2005 and 2006 to get only those individuals who had their last hospitalization in 2005, and look for their information 365 days before. We had, initially, 2,435,497 observations, 988,749 for males and 1,446,748 for females. The duplicated data were excluded from the analysis. We considered as duplicated data the observation with the same zip code, birth date, sex, residence, procedure, days of hospitalization, day of admittance and day of discharge. We had to eliminate 687 observations for males and 776 for females, resulting in a final database of 998,062 observations for males and 1,445,972 for females.

With these observations we proceeded to the linkage of individuals. The linkage was done in a deterministic form, i.e., two hospitalizations were only considered as being from the same individual if all the conditions established applied to them. As we are only interested in the last year of life, we restricted our data base to include only those who had had their last hospitalization in 2005, and whose observations related to hospitalizations that occurred within 365 days of their final hospitalization.

After linking the observations and keeping only those who had the last hospitalization in 2005, the database had 373.610 males and 594.108 females. However some of the observations did not include diagnosis, residence or the expenditure of the hospitalization. After excluding those observations, the final database was comprised of 373.423 males and 593.846 females. Table 1 summarizes the information about the data.

Table 1: Number of hospitalizations and individuals observed in the data by sex, Minas Gerais 2004/ 2005

	Male	Female
Hospitalizations	520,728	757,491
Individuals	373,423	593,846
Survivors	349,661	574,848
Decedents	23,762	18,998
Source: AIH 2004/2005		

The linkage of individuals is important so we can verify the length of time between the hospitalization and death. With that information we are able to verify the effect of proximity to death. To analyze the effect of proximity to death we are using the hospitalizations expenditure instead of the individuals' expenditures (i. e., in the database each observation is related to an hospitalization instead of an individual with many hospitalizations) since with the hospitalization we can show how costs vary when the individual is closer to death.

The analysis of the effects of age and proximity to death in the health expenditure were done with an OLS regression 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. To correct the problem of lack of independence between observations in the model, as some hospitalizations pertained to the same individual, we used a cluster by individual in the OLS regressions.

Model 1: Model for the whole sample

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

Model 2: Naive Model (not considering death effects)

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

Model 3: Model for survivors

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

Model 4: Model for decedents

$$Y_4 = \beta_0 + \beta_1 age + \beta_2 (agesq/1000) + \beta_3 sex + \beta_4 age * sex + \beta_5 dayshosp + \beta_6 TtD + \varepsilon_i$$

Where:

Y_1 and Y_2 are the health expenditure of hospitalization;

Y_3 is the health expenditure of hospitalization just for those who survived;

Y_4 is the health expenditure of hospitalization just for those who died;

age is the age of the patient;

agesq/1000 is the age square of the patient divided by 1000;

sex is a dummy variable for males;

*age*sex* is an interaction between age and sex;

dayshosp is the number of days a person stayed at the hospital;

death is a dummy variable for decedents;

*death*age* is an interaction between death and age;

TtD is time to death and it measures the span in months between the hospitalization and the date of death.

The parameters from Models 1 and 2 were used to make health expenditures projections in order to contrast these forecasts when considering the effect of proximity to death. The contrast between Models 3 and 4 can be used to access the different effects of the sociodemographic variables in the model according to whether or not the patient is close to death. The interactions in the models account for differences in the division of health expenditures both between genders and by survival status.

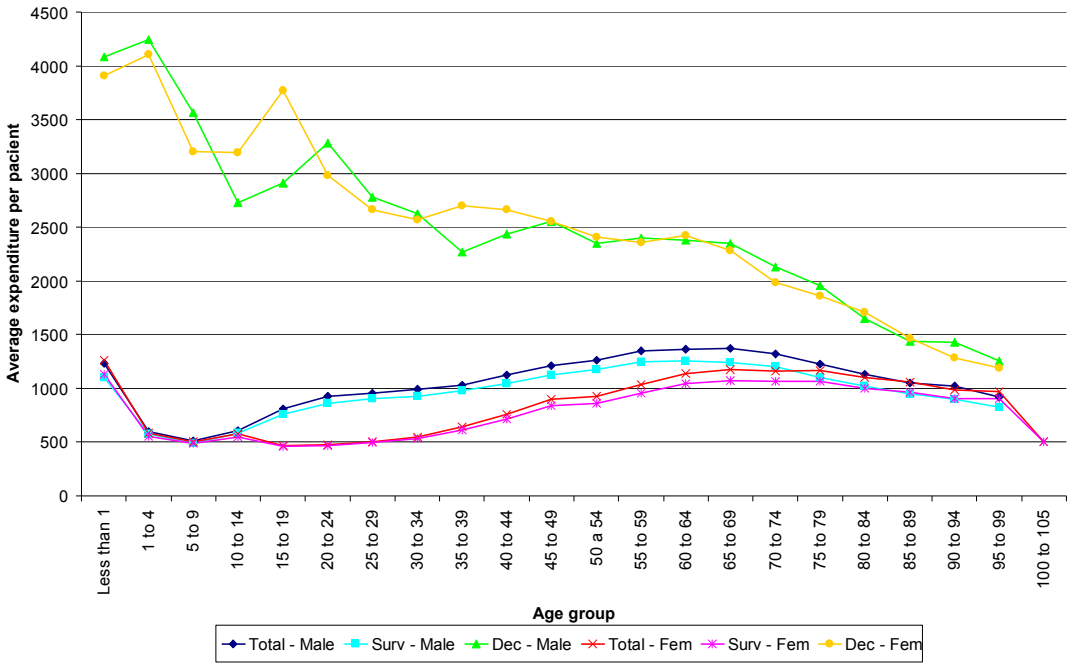
To make the projections of health expenditure we used the total population projection of Minas Gerais 2020 made by IBGE. As we don't have the population projection by age we applied Brazil's age structure of 2020 in the total population of the state. As we are using only the population that was hospitalized we then calculated the proportion of individuals that should be hospitalized in that year, based in trends of hospitalization from 1998 and 2006. Also, the hospitalizations that results in death were calculated based in the trends

between 1998 and 2006. The distribution of time to death was kept the same as observed in 2004/2005 since we only have this period of observation with such information. With these results, we further recalculate expenditures following Models 1 and 2 and we also made a calculation that takes into account the changing on the life expectancy between 2050 and 2020. Since we don't have the trends for each year we calculated the differences between the life expectancy at age 0 between the years. So for example, the expenditure of a 60 year old man will be assigned the age of 60 minus the difference in the life expectancy in the 2020 demographic structure. 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 do not express the real projections for the State since we are using the age structure of Brazil in 2020 that is most likely to be different than the one expected for Minas Gerais.

Results

When we analyzed the average expenditure per patient according to sex, life status and age we verified that the expenditure for those who are dying is always higher than for survivors. The average expenditure for decedents shows a negative correlation with age, but for survivors, it increases with age until the 70's for men and 80's for women, hence the gap between decedents and survivors expenditures is very large in the beginning of life and decreases with age (graph 1). This inverse relation between expenditure and costs has been observed in other analysis. McGrail et al (2000) show that, in Canada, the gap between decedent's expenditures and survivors expenditures tends to decrease with age since the expenditures for survivors increases with age and for decedents it decreases. One explanation for this is that as people age the hospital costs tends to be substituted by non hospital costs. As pointed out by Levinsky et al (2001), this is directly related to the cost-benefit factor of doing a more aggressive intervention and there is a family and medical decision of not doing risky operations in older people.

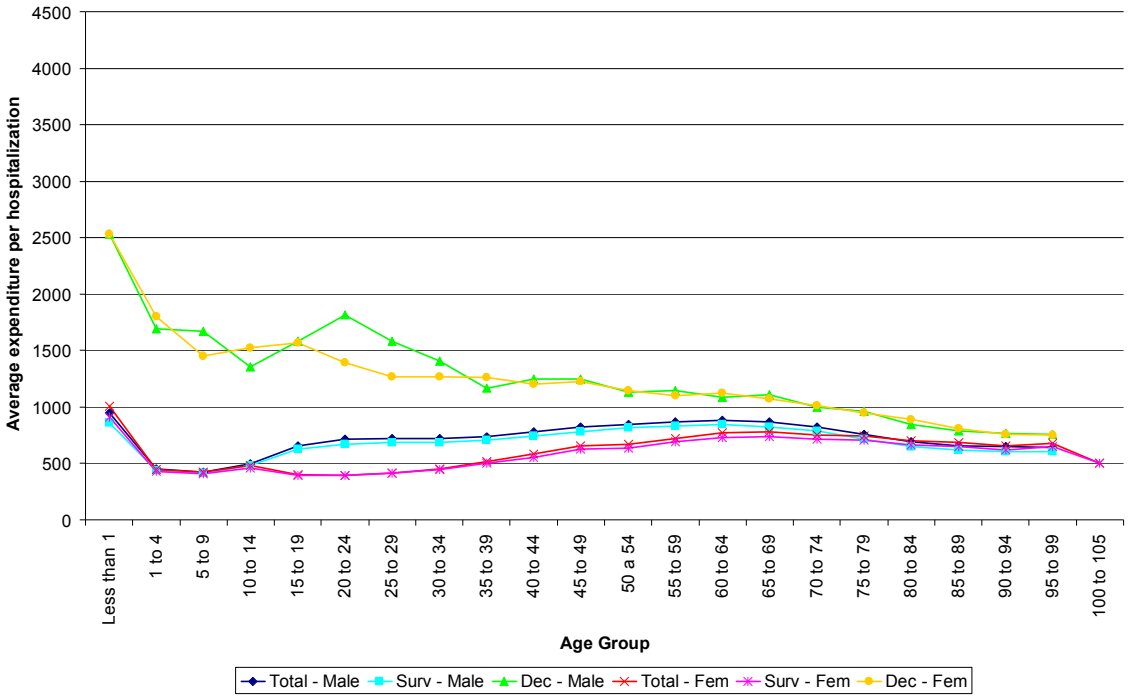
Graph 1: Average Expenditure per patient by sex, life status and age, Minas Gerais, 2004/2005



Source: AIH 2004/2005

One possible explanation for the higher expenditure for the decedents is that those who are close to death tend to be hospitalized more. If we control the average expenditure by number of hospitalization we can see that the gap between decedents and survivors decreases, but still remains as shown in graph 02.

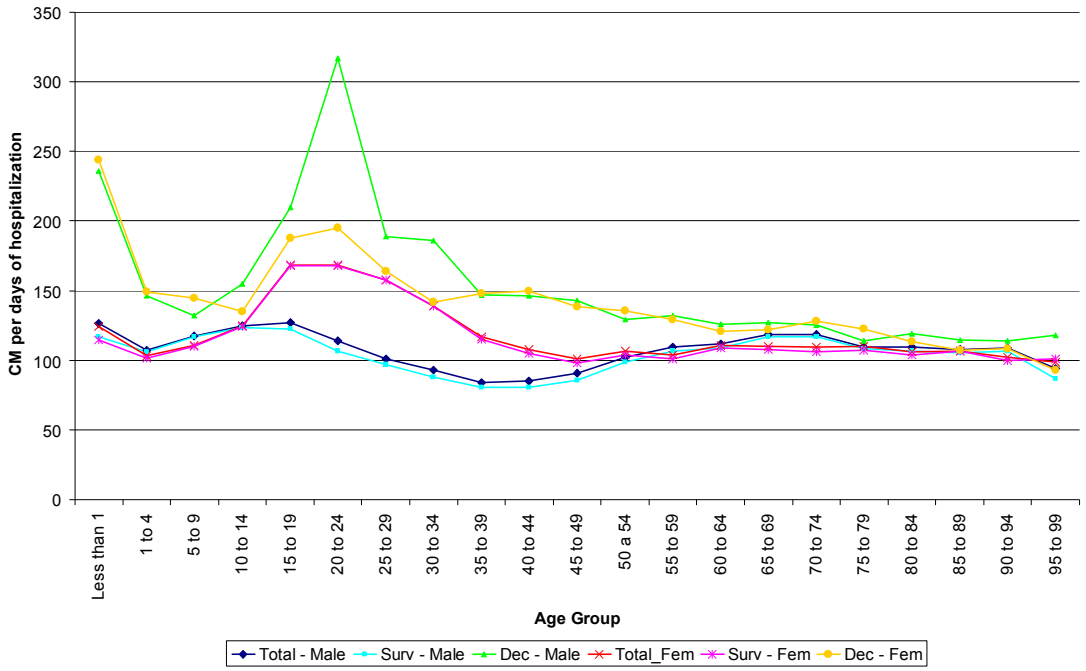
Graph 2: Average Expenditure per hospitalization by sex, life status and age, Minas Gerais, 2004/2005



Source: AIH 2004/2005

Another variable that can interfere in the expenditure is the number of days a person was hospitalized. Controlling by that, we can see that in the younger ages there is still a gap between decedents and survivors, meaning that hospitalizations for those who are close to death are usually more expensive. After the age of 60 the difference between decedents and survivors is not very different (Graph 3). As stated before, there is evidence that when a person is young all the efforts are done to save his life, but heroic acts to save a life of an elder person are rarely done. So what could be happening to explain the higher expenditures for decedents in those ages is only a longer stay at the hospital and in the younger ages this would be also associated to higher costs. As we can see in table 2, in the younger ages, the difference between the average numbers of days that a decedent and a survivor stayed at the hospital is larger in the younger ages.

Graph 3: Average expenditure by days of hospitalization according to sex, life status and age, Minas Gerais, 2004/2005



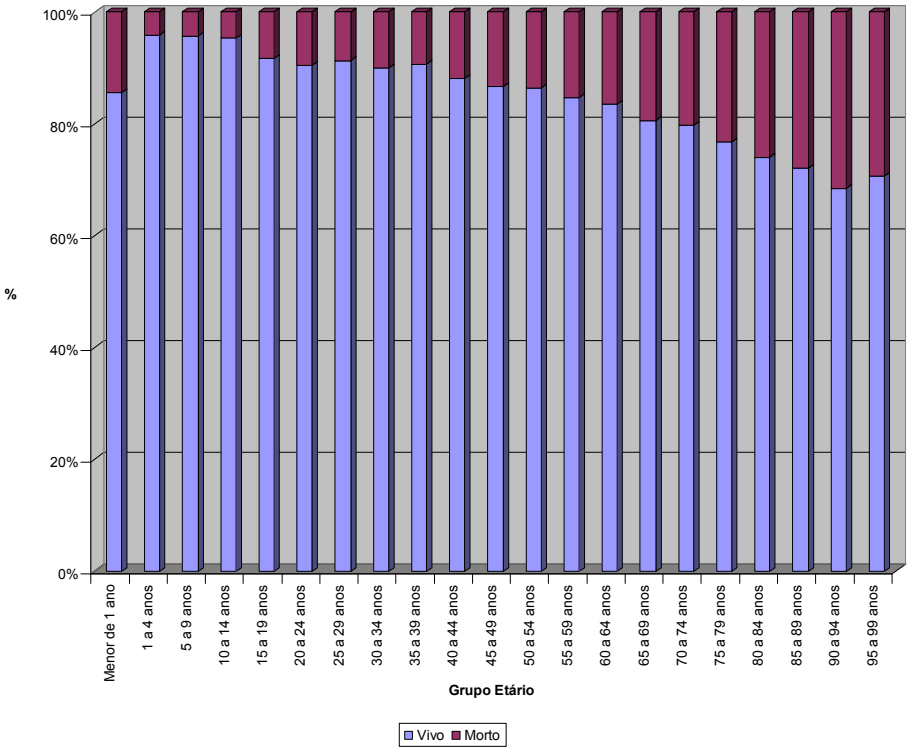
Source: AIH 2004/2005

Table 2: Average numbers of days of hospitalization by age, both sexes, Minas Gerais, 2004/2005

Age	Survivor	Decedent
Less than 1	9.62	16.73
1 to 4	5.46	28.31
5 to 9	4.32	25.12
10 to 14	4.58	20.10
15 to 19	3.37	15.85
20 to 24	3.67	11.80
25 to 29	4.35	15.22
30 to 34	5.56	15.36
35 to 39	7.63	16.50
40 to 44	9.38	17.09
45 to 49	10.61	18.07
50 to 54	10.00	17.96
55 to 59	10.63	18.15
60 to 64	10.58	19.36
65 to 69	10.29	18.59
70 to 74	10.17	16.28
75 to 79	10.03	16.20
80 and more	9.30	13.52
Source: AIH 2004/2005		

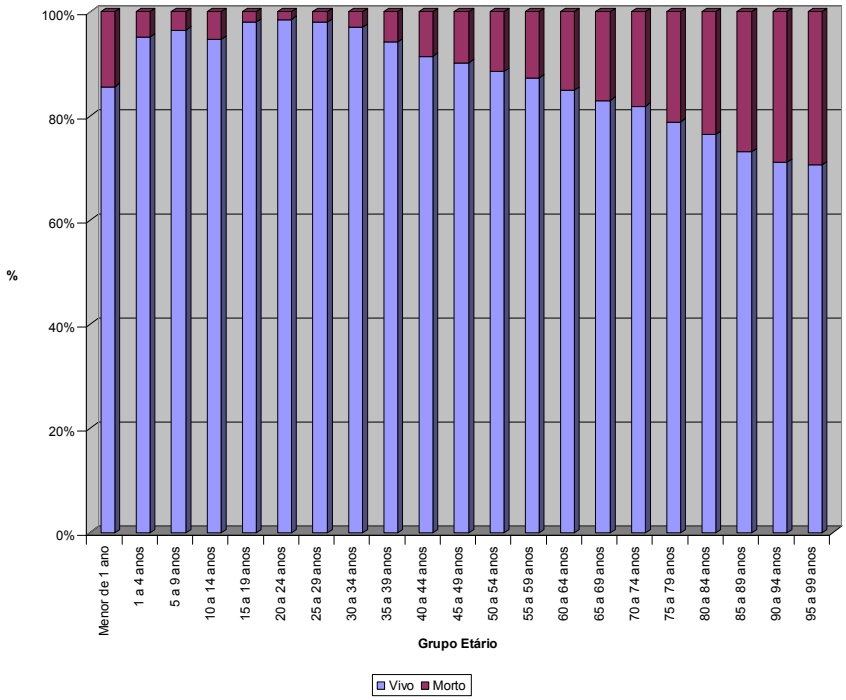
Even though the gap between decedents and survivors is very large in the younger ages, the decedents represent just a small part of the total expenditure in those age groups. Since people usually die in older ages, the contribution of decedents in the older ages is more expressive, as we can see in Graphs 4 and 5.

Graph 4: Percentage of expenditure in each age group by life status, male, Minas Gerais, 2004/2005



Source: AIH 2004/2005

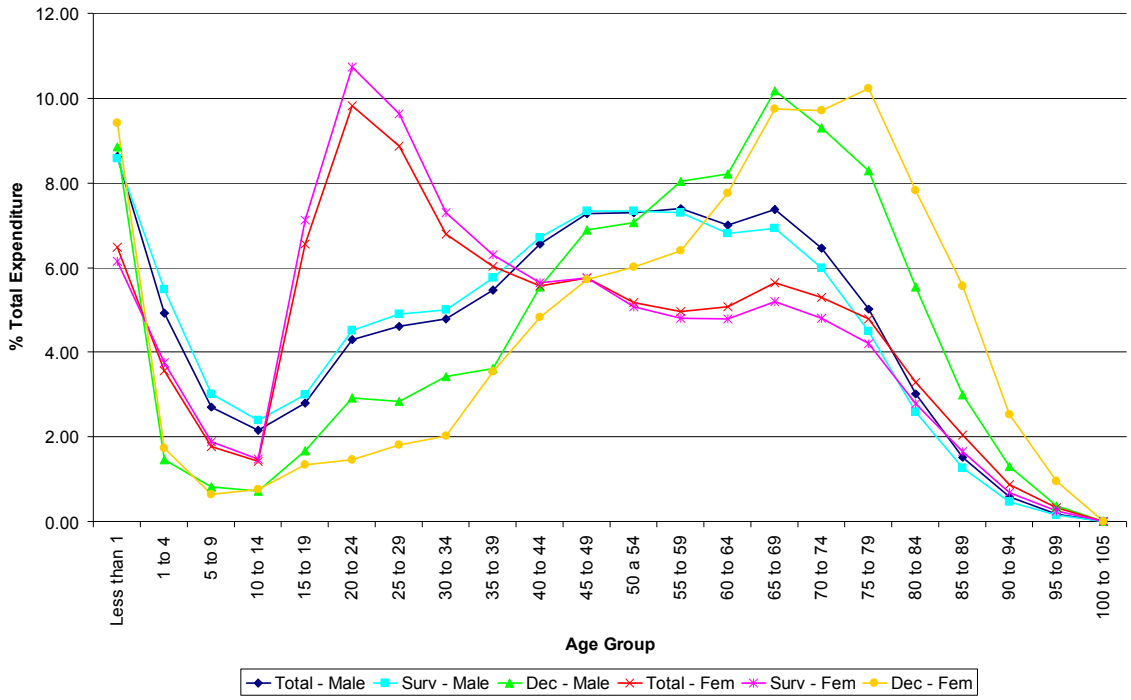
Graph 5: Percentage of expenditure in each age group by life status, female, Minas Gerais, 2004/2005



Source: AIH 2004/2005

Since Minas Gerais has still a young population, the majority of the expenditure is not concentrated yet in the older groups, especially for women. In Graph 6 we show the percentage spent for each age group related to the total expenditure in each life status in a year. For females we can see that the majority of expenditure is done in the reproductive ages. As for men, the majority of expenditures are concentrated in the ages of 45 and 70 years. For decedents, the majority of expenditures occurs in the age of 65 to 69 for males and 80 to 84 for females.

Graph 6: Percentage of the expenditure spent by each age group related to the total expenditure in the life status according to sex, life status and age, Minas Gerais 2004/2005



Source: AIH 2004/2005

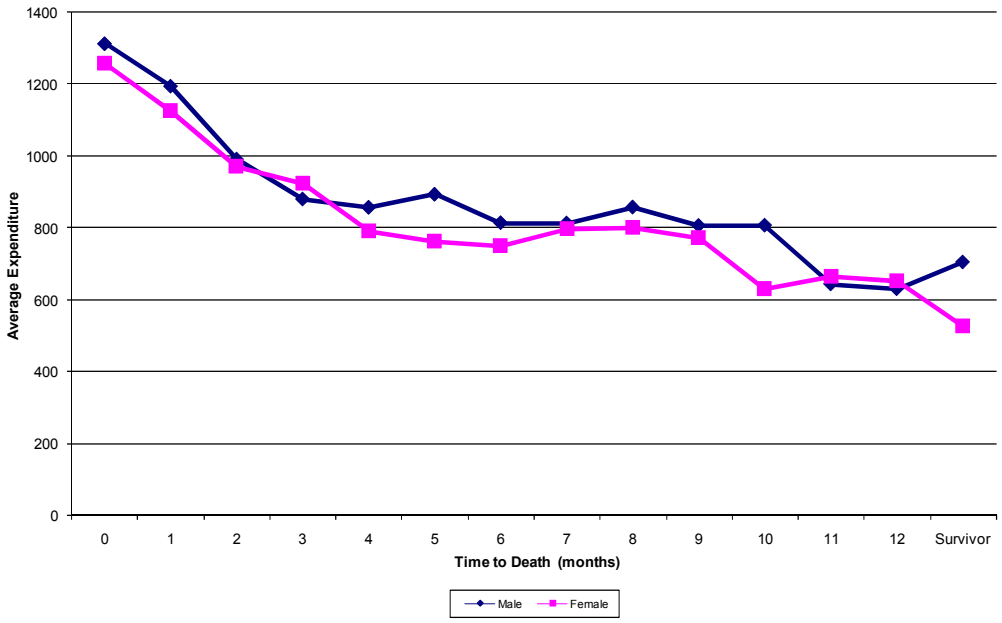
It is important to understand what constitutes the majority of health expenditure for each person. When we analyzed the causes of hospitalization we could see that both for survivors and decedents, in the case of more than 2 hospitalizations, it was verified that in more than 70 percent of the cases, 50 percent or more of the expenditures in the last year were related to re-hospitalizations due to the same cause, according to the ICD-10 (table 3). This result indicates that people could be coming back to hospitals due to non-cured diseases or complications of some disease.

Table 3: Proportion of observations where hospitalizations due to the same cause are responsible for the majority of the expenditure in one year – Minas Gerais, 2004/2005

Number of hospitalization	Male		Female	
	Survivor	Decedent	Survivor	Decedent
1	100.00	100.00	100.00	100.00
2	48.18	40.38	50.99	36.20
3	83.62	79.83	82.73	78.34
4	83.28	76.31	81.91	75.29
5	79.15	70.88	78.17	70.00
6	79.43	75.32	80.70	68.88
7	79.53	65.02	79.72	72.25
8	83.45	74.14	82.25	68.24
9	81.78	82.43	85.19	75.00
10+	83.01	81.10	88.21	81.18
Source: AIH 2004/ 2005				

Analyzing the effect of time to death, we can see that the closer to death the hospitalization occurred, the more expensive it tended to be as shown in Graph 7.

Graph 7: Average Expenditure per Hospitalization according to time to death in Minas Gerais, 2004/2005



Source: AIH 2004/2005

The regressions based on the four models show a negative effect of age, and the coefficient is much larger when we consider only the decedents (model 4), meaning that the older a person is when he dies, the less expensive the costs would be 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 as showed before in graph 7. The days of hospitalization are more expensive for decedents than for survivors, but sex and the interaction between age and sex was not significant for the decedents as shown in table 4.

Table 4: Coefficients and standard errors, according to each model, Minas Gerais (Brazil), 2004/2005

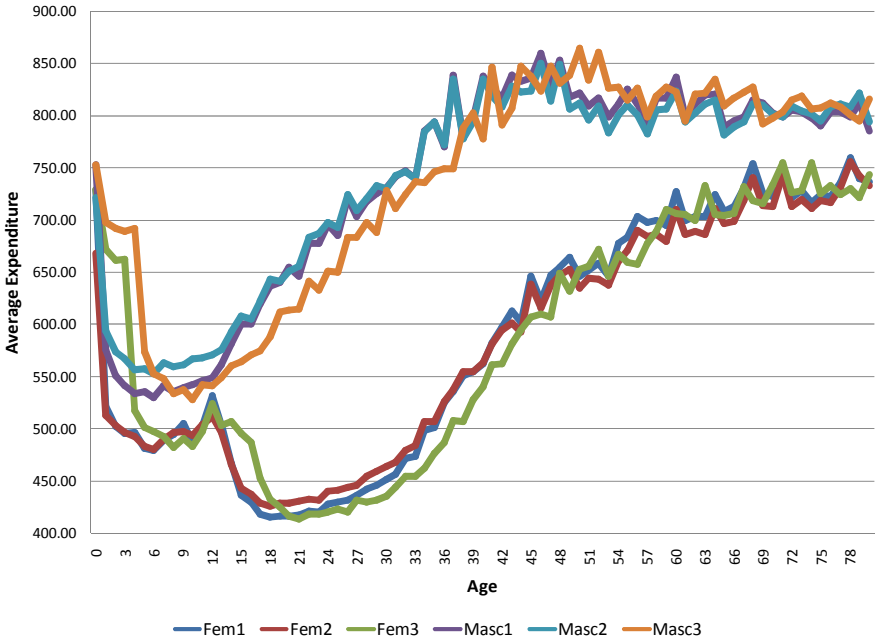
Variables	Model 1 - Whole pop Coef (se)		Model 2 - Naïve Coef (se)		Model 3 - Survivors Coef (se)		Model 4 - Decedents Coef (se)	
Age	-1.09 *	(0.20)	-0.63 *	(0.19)	-0.37 *	(0.18)	-25.06 *	(1.67)
(Age squared)/1000	32.52 *	(2.10)	27.56 *	(1.99)	23.45 *	(1.92)	134.45 *	(13.95)
sex	51.48 *	(4.44)	76.41 *	(4.57)	55.52 *	(4.22)	21.83 NS	(58.15)
age*sex	0.14 NS	(0.10)	-0.01 **	(0.10)	0.24 *	(0.10)	-0.01 NS	(0.83)
dayshosp	40.83 *	(0.30)	41.10 *	(0.30)	39.88 *	(0.27)	56.97 *	(3.82)
death	532.63 *	(37.77)	-	-	-	-	-	-
death*age	-14.54 *	(0.45)	-	-	-	-	-	-
TtD	-62.38 *	(1.87)	-	-	-	-	-60.98 *	-1.95514
Const	1,138.81 *	(24.60)	335.41 *	(3.89)	320.83 *	(3.60)	1,700.63 *	(65.52)

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

Source: AIH 2004/2005

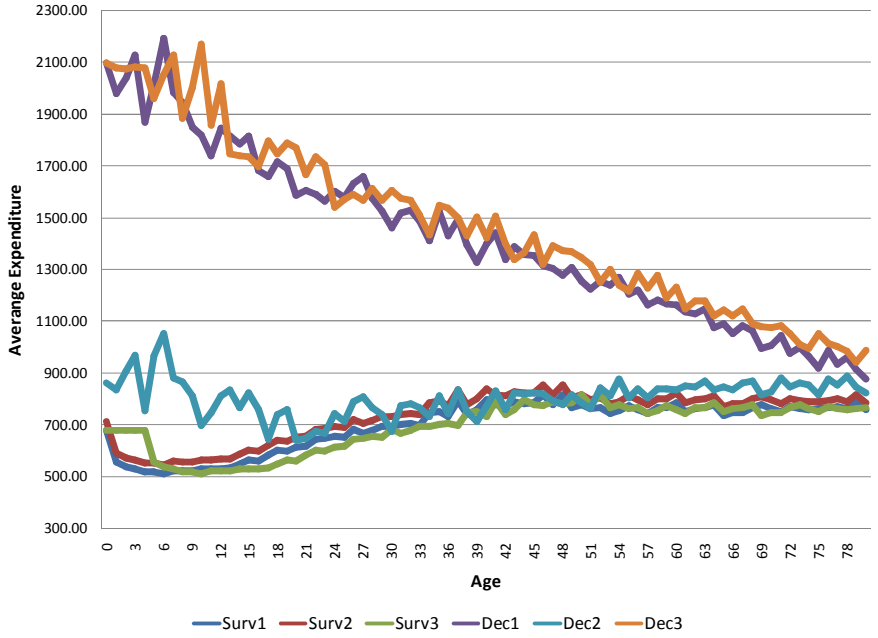
Using the parameters of model 1 (not naive) model 2 (naive) and an adaptation of model 2 using the changing in life expectancy (which we will call 3) we simulated a projection of the expenditure to 2020. In graph 8 we show the results without considering the survival status and in graphs 9 and 10 the differences by survival status are shown.

Graph 8: Difference in Average Expenditure for both sexes without considering survival status by age, Minas Gerais, 2020



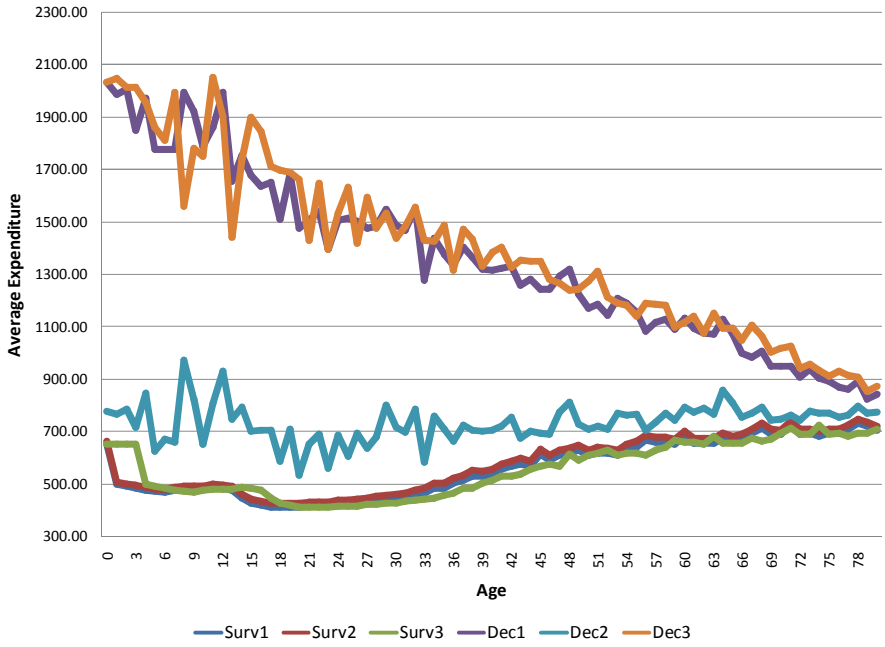
Source: AIH 2004/2005

Graph 9: Projected Average Expenditure, considering or not the death effects, Male, Minas Gerais, 2020



Source: AIH2004/2005, IBGE

Graph 10: Projected Average Expenditure, considering or not the death effects, Female, Minas Gerais, 2020



Source: AIH2004/2005, IBGE

In graph 8 we can see that there is almost no difference between models 1 and 2. However when we take into account the changing in life expectancy we can see that the predictions for younger ages are lower than in the other models. In the older ages, the three models show similar predictions.

In graph 9 and 10 we can see that, for both sexes there is a big difference between the naive model and the others. As shown by other authors when young people die usually the expenditure is very high and this is not taken into consideration in the naive model. Since there is not many people dying in such ages, the difference in the models is not as big when we do not separate by survival status (graph 8). In the case of survivors the projection that took into account the changing in life expectancy shows the lower values in the younger ages, which explains the differences in those groups in graph 8.

Conclusion

The aging of population brings many challenges to society. One of them is to prepare its health care system and deal with its expenditures. In this study we show that taking into account the effects of proximity to death and changing in life expectancy generates less expensive projections for the young groups but high expenditures for the elder just like the other models. As the population is aging we are soon going to face a concentration of people in those ages and accurate projections about the effects of ageing, proximity to death and other variables should be helpful to prepare the policy makers to deal with this new scenario. The results presented here must be interpreted with caution. The analysis was restricted to hospitalization data; however the expenditure with hospitalization represents a large part of the government investment in health. To have more accurate projections we should also analyze the expenditure in the other health sectors and insert the effect of technology in the prices, since it has been shown that this is also an important variable in health expenditure.

Bibliography

BREYER, F., FELDER, S. Life expectancy and health care expenditures: A new calculation for Germany using the costs of dying. Health Policy 75, p. 178-186, 2006

CARVALHO, J. A. M, GARCIA, R. A. The aging process in the Brazilian population: a demographic approach**.** ***Cad. Saúde Pública***. [online]. June 2003, vol.19, no.3 [cited 29 July 2006], p.725-733. Available from World Wide Web: <http://www.scielosp.org/scielo.php?script=sci_arttext&pid=S0102311X2003000300005&lng=en&nrm=iso>. ISSN 0102-311X.

CUTLER, D. M., SHEINER, L. **Demographics and Medical Care Spending:** Standard and non-standard effects. Working Paper 6866. Cambridge, MA.: National Bureau of Economic Research, 1998.

FUCHS, V. R. **Health Care for the elderly:** how much? Who will pay for it? Working Paper 6755. Cambridge, MA.: National Bureau of Economic Research,1998.

GRAY, A. Population Ageing and Health Care Expenditure. **Ageing Horizons**, n. 2, p. 15 – 20, 2005.

HIMSWORTH, R.L., GOLDACRE, M.J. Does time spent in hospital in the final 15 years of life increase with age at death? A population based study. **British Medical Journal (BMJ)**, 319, p. 1338 – 1339. 1999. Available in http://www.bmj.com/cgi/reprint/ 319/7221/1338.

HOGAN, C., LUNNEY, J., GABEL, J. LYNN, J. Medicare beneficiares' cost of care in the last year of life. **Health Affairs**, n. 20 (4), p. 188 – 195, 2001.

IBGE **Indicadores Sociodemográficos Prospectivos para o Brasil 1991-2030**, out, 2006. Available in http://www.ibge.gov.br/home/estatistica/populacao/projecao_da_ populacao/publicacao_UNFPA.pdf.

JACOBZONE, S., OXLEY, H. Ageing and Health care costs. **International Politics and Society**, January 2002. Available in: < http://fesportal.fes.de/pls/portal30/docs/ folder/ipg/ipg1_2002/artjacobzone.

LEVINSKY, N. G., YU, W., ASH, A., MOSKOWITZ, M., GAZELLE, G., SAYNINA, O., EMANUEL, E. J. Influence of age on Medicare expenditures and medical care in the last year of life. **Journal of the American Medical Association**, 286(11), p. 1349–1355, 2001

LUBITZ, J., RILEY, G. F. Trends in Medicare payments in the last year of life. **The New England Journal of Medicine,** 328(15), pp. 1092–1096, 1993

MANTON, K. G. Changing concepts of morbidity and mortality in the Elderly Population. Milbank **Memorial Fund Quarterly / Health and Society** 60, p. 183 – 244. 1982

MCGRAIL, K., GREEN, B., BARER, M. L., EVANS, R. G., HERTZMAN, C., NORMAND, C. Age, costs of acute and long-term care and proximity to death: Evidence for 1987–88 and 1994–95 in British Columbia. **Age Ageing**, 29(3), pp. 249–253, 2000

MILLER, T. Increasing longevity and Medicare expenditures. **Demography**, v. 38, n. 2, p. 215-226, 2001.

NUNES, A. O envelhecimento populacional e as despesas do Sistema Único de Saúde. **Os Novos Idosos Brasileiros. Muito além dos 60?** Ed. A. Camarano. Rio de Janeiro: IPEA, 2004.

OLSHANSKY, S. J., RUDBERG, M. A., CARNES, B.A., CASSEL, C. K., BRODY, J. A. Trading off longer life for worsening health. **Journal of Aging and Health** 3, p. 194 – 216. 1991

PAN AMERICAN HEALTH ORGANIZATION. SABE – Survey Salud y Bienestar de la Población Adulta Mayor, 2000

PERL, T. T. Centenarians prove the compression of morbidity hypothesis, but what about the rest of us who are genetically less fortunate? **Medical Hypotheses** 49, p. 405 – 407. 1997.

REINHARDT, U. E. Does the aging of the population really drive the demand for health care? **Health Affairs** vol.22, Iss. 6. Nov/Dec 2003.

RICE, D. P., FINEMAN, N. Economic Implications of increased longevity in the United States. **Annual Rev. Public. Health.** 25 p 457 – 473. 2004

SESHAMANI, M.,GRAY, A. Time to death and health expenditure: an improved model for the impact of demographic change on health care costs. **Age and Ageing** 33 p 556 – 561, 2004

STOOKER, T., VAN ACHT, J. W., VAN BARNEVELD, E. M., VAN VLIET, R. C., VAN HOUT, B. A., HESSING, D. J., BUSSCHBACH, J. J. Costs in the last year of life in The Netherlands. **Inquiry**, 38 (1), p. 73–80, 2001.

WONG, L. L. R., CARVALHO, J. A. M. O rápido processo de envelhecimento populacional no Brasil: sérios desafios para as políticas públicas. **Revista Brasileira de Estudos de População, v. 23, n. 1, p. 5-26**. São Paulo, jan/jun. 2006. Available in http://www.scielo.br/pdf/rbepop/v23n1/v23n 1a02.pdf.

ZWEIFEL, P., FELDER, S., MEIERS, M. Ageing of population and health care expenditure: A red herring? **Health Economics**, 8, p. 485 - 496, 1999.