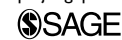


# Past trends and projections of hospital deaths to inform the integration of palliative care in one of the most ageing countries in the world

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## Abstract

**Background:** Monitoring where people die is key to ensure that palliative care is provided in a responsive and integrated way.

**Aim:** To examine trends of place of death and project hospital deaths until 2030 in an ageing country without integrated palliative care.

**Design:** Population-based observational study of mortality with past trends analysis of place of death by gender, age and cause of death. Hospital deaths were projected until 2030, applying three scenarios modelled on 5-year trends (2006–2010).

**Setting/participants:** All adult deaths ( $\geq 18$  years old) that occurred in Portuguese territory from 1988 to 2010.

**Results:** There were 2,364,932 deceased adults in Portugal from 1988 to 2010. Annual numbers of deaths increased 11.1%, from 95,154 in 1988 to 105,691, mainly due to more than doubling deaths from people aged 85+ years. Hospital deaths increased by a mean of 0.8% per year, from 44.7% ( $n=42,571$ ) in 1988 to 61.7% ( $n=65,221$ ) in 2010. This rise was largest for those aged 85+ years (27.8% to 54.0%). Regardless of the scenario considered, and if current trends continue, hospital deaths will increase by more than a quarter until 2030 (minimum 27.7%, maximum 52.1% rise) to at least 83,293 annual hospital deaths, mainly due to the increase in hospital deaths in those aged 85+ years.

**Conclusion:** In one of the most ageing countries in the world, there is a long standing trend towards hospitalised dying, more pronounced among the oldest old. To meet people's preferences for dying at home, the development of integrated specialist home palliative care teams is needed.

## Keywords

Palliative care, terminal care, death certificates, health planning, home care services, aged

### What is already known about the topic?

- The majority of people would prefer to die at home.
- Monitoring where people die is key to ensure that palliative care is provided in a responsive and integrated way.

### What this paper adds?

- Hospital death proportions have increased steadily from 44.7% to 61.7% in one of the most ageing countries in the world (Portugal, 1988–2010).

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- Hospital deaths are projected to increase further by at least a quarter until 2030, to 74.6% of all deaths.
- The past and future increase in hospital deaths in such an ageing country is mainly due to the rise of hospital deaths in the older people (85+ years).

#### Implications for practice, theory or policy

- To meet people's preferences for dying at home, the development of integrated specialist home palliative care teams is needed.

## Introduction

Worldwide, people are increasingly living and dying with ageing due to better life expectancy.<sup>1</sup> Many countries face increasing mortality caused by chronic illness and large cohorts of baby-boomers reaching later life, coupled with rising numbers of deaths in hospital.<sup>2</sup>

However, when eliciting preferences for where to die in the context of advanced illness, 31%–87% of patients, 25%–64% of caregivers and 49%–70% of the general population state home is their preferred place,<sup>3</sup> hospital being one of the least preferred places.<sup>4</sup>

With a population of 10 million and around 100,000 deaths per year, Portugal has the seventh most ageing population in the world, alongside countries such as Denmark, Germany and France, with 24% of people aged 60+ years.<sup>1</sup> As this proportion is expected to rise to 40% by 2050, Portugal will become the second most ageing country in the world, only behind Japan.<sup>1</sup> It is known that ageing is associated with higher levels of dependency, comorbidities and complex needs.<sup>2</sup>

In light of the current and future socio-demographic scenario in Portugal, which resonates with many other developed and ageing nations, the provision of appropriate physical, psychological, social and spiritual support to older people facing incurable illnesses is a public health priority.<sup>5</sup> Nonetheless, there are major barriers to the integration of palliative care into the wider health system as a treatment component within the continuum of care for patients: scarcity of palliative care services, lack of recognition of palliative care needs by professionals, late referrals, medical and nursing education without basic training on palliative care.<sup>7</sup> A recent World Health Organization (WHO) resolution<sup>8</sup> urges countries to develop integrated models of palliative care, mainly focused in primary care, community and home care services.

Monitoring where people die is, therefore, key to ensure that care in later life towards death is provided in a responsive and integrated way. This study aimed to examine trends of place of death by age, gender and cause of death and to project future hospital deaths until 2030 in an ageing country without integrated palliative care (Portugal 1988–2030).<sup>7</sup>

## Methods

### Study design

Epidemiological population-based analysis of Portuguese mortality data from 1988 to 2010 by gender, age and cause

of death, and projections of hospital deaths until 2030. This study followed the STrengthening the Reporting of OBservational Studies in Epidemiology (STROBE) guidelines.

### Data sources

Data for all deaths that occurred in Portuguese territory (mainland, Azores and Madeira) from 1988 to 2010 were provided by the Portuguese Statistics Institute (INE) free of charge, under a protocol established between the INE, the researchers' host organisation and the Portuguese Ministry of Science, Technology and Higher Education. The dataset included data derived from death certificates, which are originally completed by the physician who was primarily responsible for the care of the person or the one who first attends the place of death.<sup>9</sup>

The requested dataset contained individual anonymised data for all deaths by place of death, gender, age, date of death and cause of death. Date of death was coded into three variables: day of the week, month and year of death.

Projections of gender- and age-specific mortality rates and population estimates were provided by the Eurostat with no costs associated, for the years 2011–2060. The methodological details of these forecasts are described in detail elsewhere.<sup>10</sup> They rely on several assumptions of fertility, mortality and migration, in which the 'what-if' scenarios are based in.

### Classification of place of death and primary outcome

In the Portuguese death certificate, place of death is classified into three categories since 1996: 'domicile', 'hospital/clinic' and 'other place'. The first category includes deaths occurring at home, care homes, nursing homes or any non-public/non-clinical place. Deaths at 'hospital/clinic' are those occurring in clinical facilities, such as public or private hospitals (this category is from now on named 'hospital'). Finally, a person is categorised as having died at 'other place' when this occurred in a public space (e.g. street, transports). Before 1996, there was one additional category: 'public way'. It was deemed sensible to aggregate this with the category 'other place'.

Our primary outcome was defined as death in hospital (i.e. occurring at 'hospital/clinic') versus others, as deaths

occurring at home and care homes/nursing homes are not separately coded in Portuguese death certificates, which prevented us from examining past trends and projecting for these different places.

## Analysis

**Past trends.** We analysed place of death for all adults ( $\geq 18$  years old) who have died in Portuguese territory during a 23-year period (1988–2010). We tabulated frequencies for the different places in each year by gender, age and cause of death. Six age groups were defined taking into account Portuguese preferences data<sup>6</sup> and to enable international comparisons.<sup>11–14</sup> We calculated gender- and age-standardised proportions of hospital deaths (direct method) to control for the influence of differences in the gender and age distribution of deaths in changes of place of death over time. The gender and age distribution of 1988 was taken as standard. Place of death was also analysed by cause of death from 2002 onwards (year when the International Classification of Diseases, 10th revision (ICD-10) was implemented in Portugal), divided into three major groups: cancer, non-cancer and external/unknown causes. All but the latter analysis were performed in Microsoft Excel<sup>®</sup> (cause of death was analysed in SPSS<sup>®</sup> version 18).

**Projections.** From the Eurostat projections (gender- and age-specific mortality rates and resident numbers), we calculated projected gender- and age-specific numbers of deaths. Projections of hospital deaths assumed that the last 5-year trends (2006–2010) will be maintained and were performed in three steps: (1) calculation of gender- and age-specific mean of the slopes of deaths by place of death in the last 5 years (2006–2010), (2) the slopes' means were applied consecutively from 2010 onwards to obtain gender- and age-specific place of death numbers or proportions and (3) gender- and age-specific place of death numbers or proportions were applied to the projections of total deaths to obtain the respective proportions or numbers of hospital deaths.

We modelled three scenarios based on different assumptions: in model 1, we assumed that trends in *absolute changes in numbers* of hospital deaths will be maintained; in model 2, we assumed that future hospital deaths will be determined by *proportional changes in numbers* of hospital deaths; and in model 3, *proportions of non-hospital deaths* of recent years were assumed to be the main driver of future hospital trends. These models are explained in more detail in Appendix 1 (further details design of the models are available from the authors on request).

## Approvals

To access the mortality data, a protocol with the INE, the researchers' host organisation and the Portuguese Ministry of Science, Technology and Higher Education was established. This protocol included a binding code of conduct,

and all researchers signed a declaration of confidentiality. The ethics committee of the researchers' host organisation advised that ethical approval was not needed, as the data were anonymised and referred to deceased people.

## Results

### Past trends

There were 2,364,932 adults ( $\geq 18$  years old) who died in Portugal in the 23 study years, 52.2% men. Annual numbers of deaths increased 11.1%, from 95,154 in 1988 to 105,691 in 2010 (Table 1), and have overtaken the number of births in 3 recent years (2007, 2009 and 2010; Figure 1). This increase in the number of deaths is mainly due to the sharp increase in the number and proportion of deaths from people aged 85+ years (from 17,241 or 18.1% to 35,175 or 33.3% of all deaths; Table 1; Figure 1). Deaths from people in other age groups have generally decreased or remained similar over time. Therefore, death in Portugal is occurring at later ages, following from the continuous population ageing observed over the last years (Figure 1). The increases in the yearly median death age (75 to 80 years old) and interquartile ranges (65–82 to 71–87 years old) further confirm this trend (Table 1). Men accounted for 52.2% of all deaths in 1988 and 51.2% in 2010 (Figure 1; Appendix 2). Despite trends for both men and women to die later in life, men are dying 6 years earlier than women (at median ages of 77 and 83 years, respectively, in 2010).

The proportions and absolute numbers of deaths due to cancer as the underlying cause have been slowly increasing since 2002, from 21.0% (22,181 deaths) to 23.6% (24,293 deaths) in 2010, while deaths due to non-malignant diseases decreased from 67.6% (71,374 deaths) in 2002 to 64.7% (68,422 deaths) in 2010 (Table 2). Unknown and external causes were responsible for the remaining deaths. Women die more frequently from non-malignant diseases than men (70.9% vs 58.9% in 2010, respectively). Older people also die more often from non-malignant diseases; these accounted for 80.2% of the deaths from people aged 85+ years in 2010. Cancers are responsible for almost half of the deaths (44.5% in 2010) from those aged 55–64 years.

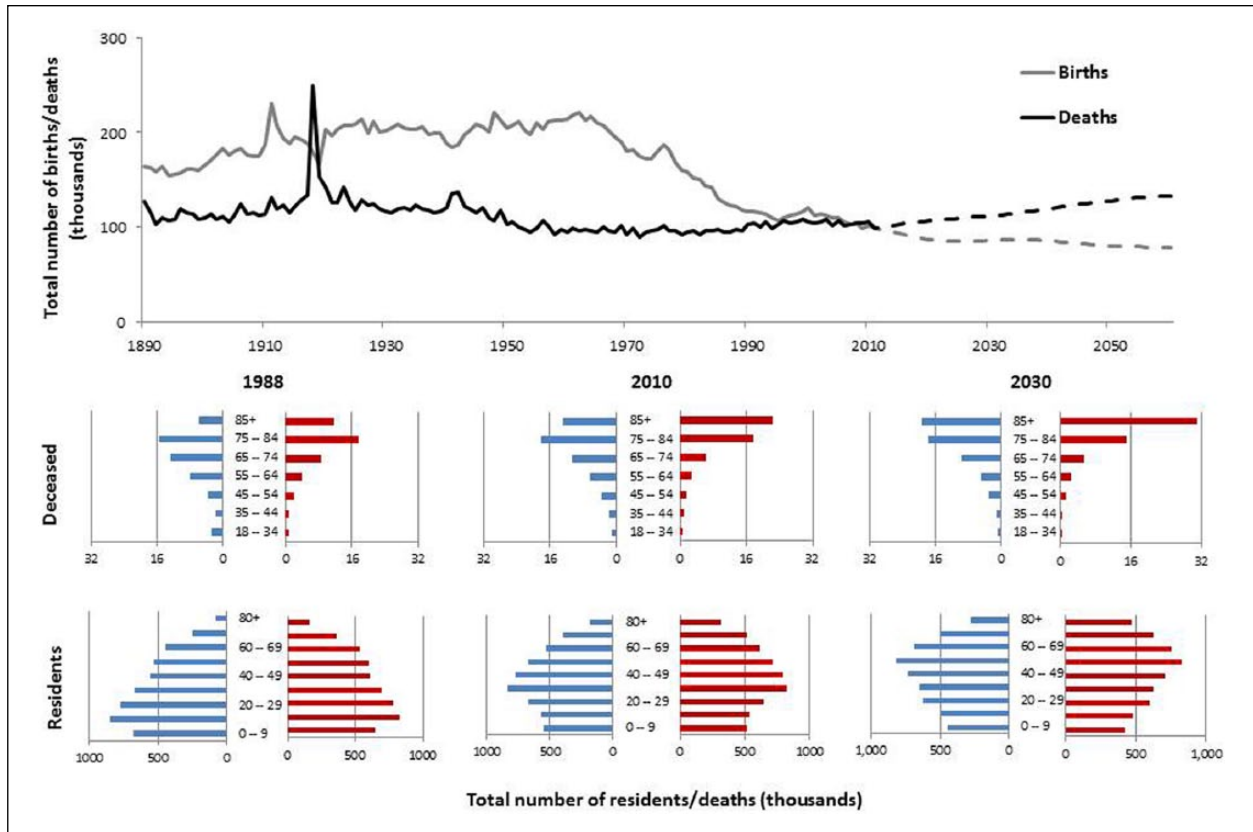
During the study period, 1,289,266 deaths were recorded as occurring in hospital (54.5% of all deaths). The proportion of hospital deaths increased steadily over time by a mean of 0.8% and 1030 deaths per year, from 44.7% (42,571 deaths) in 1988 to 61.7% (65,221 deaths) in 2010. Differences in the gender and age distribution of the deceased over the years analysed did not alter this trend (Figure 2). The increase in hospital death proportions occurred in all age groups except the youngest (18–34 years), but was largest in the older age groups (75–84 and 85+ years) and more prominent in women than men (Table 1). People dying in hospital were more often men and younger than those dying elsewhere, but these differences have been decreasing over time (Table 1). People

**Table 1.** Past trends of place of death by gender, age and cause of death (Portugal – 1988, 2000, 2010).

	All places			Hospital			Domicile			Other place		
	1988	2000	2010	1988	2000	2010	1988	2000	2010	1988	2000	2010
All deaths												
N	95,154	104,498	105,691	42,571	57,066	65,221	47,810	37,042	31,277	4773	10,390	9193
%	100	100	100	44.7	54.6	61.7	50.2	35.4	29.6	5.0	9.9	8.70
Stand. %	–	–	–	44.7	56.2	63.4	50.2	33.8	27.6	5.0	10.1	9.0
Age (years)												
Med, IQR	75, 65–82	77, 68–85	80, 71–87	72, 61–80	75, 65–83	79, 69–86	78, 70–85	81, 73–87	83, 74–88	61, 39–77	75, 57–84	80, 66–87
N	3325	3067	1370	1751	1629	679	567	428	252	1007	1010	439
%	3.5	2.9	1.3	52.7	53.1	49.6	17.1	14.0	18.4	30.3	32.9	32.0
N	2677	3147	2474	1521	1940	1545	741	567	531	415	640	398
%	2.8	3.0	2.3	56.8	61.6	62.4	27.7	18.0	21.5	15.5	20.3	16.1
N	5493	5299	5210	3265	3500	3536	1714	1076	1073	514	723	601
%	5.8	5.1	4.9	59.4	66.1	67.9	31.2	20.3	20.6	9.4	13.6	11.5
N	11,879	9449	8881	6742	6293	6265	4465	2211	1927	672	945	689
%	12.5	9.0	8.4	56.8	66.6	70.5	37.6	23.4	21.7	5.7	10.0	7.8
N	21,215	21,791	16,861	10,906	13,705	11,637	9575	6396	4092	734	1690	1132
%	22.3	20.9	16.0	51.4	62.9	69.0	45.1	29.4	24.3	3.5	7.8	6.7
N	33,324	34,438	35,686	13,587	18,639	22,548	18,768	12,976	10,505	969	2823	2633
%	35.0	33.0	33.8	40.8	54.1	63.2	56.3	37.7	29.4	2.9	8.2	7.4
N	17,241	27,307	35,175	4799	11,360	18,998	11,980	13,388	12,891	462	2559	3286
%	18.1	26.1	33.3	27.8	41.6	54.0	69.5	49.0	36.6	2.7	9.4	9.3
Gender												
Men												
N	49,654	54,559	54,112	24,121	31,447	34,839	22,354	17,335	14,463	3179	5777	4810
%	52.2	52.2	51.2	48.6	57.6	64.4	45.0	31.8	26.7	6.4	10.6	8.9
Stand. %	–	–	–	48.6	58.7	64.8	45.0	30.4	25.2	6.4	10.9	10.0
Med, IQR	72, 61–80	74, 64–82	77, 66–84	69, 59–78	73, 63–80	76, 66–84	76, 67–82	78, 69–84	79, 69–86	54, 33–69	67, 45–79	73, 55–83
N	45,500	49,939	51,579	18,450	25,619	30,382	25,456	19,707	16,814	1594	4613	4383
% real	47.8	47.8	48.8	40.5	51.3	58.9	55.9	39.5	32.6	3.5	9.2	8.5
Stand. %	–	–	–	40.5	53.4	61.9	55.9	37.5	30.2	3.5	9.1	7.9
Med, IQR	79, 70–85	81, 72–87	83, 76–88	75, 65–82	78, 69–85	82, 73–87	81, 74–86	84, 77–89	85, 79–90	76, 59–83	82, 73–88	85, 78–90

%; non-standardised proportion; stand. %: age- and gender-standardised proportion; Med: median; IQR: interquartile range.

All medians and IQR relative to age; median reported instead of mean due to non-normal age distribution. 'Domicile' includes deaths at home and care/nursing homes; 'Hospital' includes deaths in clinical facilities; 'Other place' includes deaths occurring in public spaces.



**Figure 1.** Past trends and future projections of total numbers of births and deaths (Portugal, 1890–2060), deceased and resident population pyramids (Portugal, 1988, 2010, 2030). Data source for past deaths, births and resident numbers (1890–2010) – INE; data source for future deaths, births and resident numbers (2011–2060) – Eurostat; deceased age pyramids only include deaths at ages of 18+ years. Left bars (blue) in the age pyramids refer to men and right bars (red) refer to women.

**Table 2.** Past trends of place of death by cause of death (Portugal – 2002, 2010).

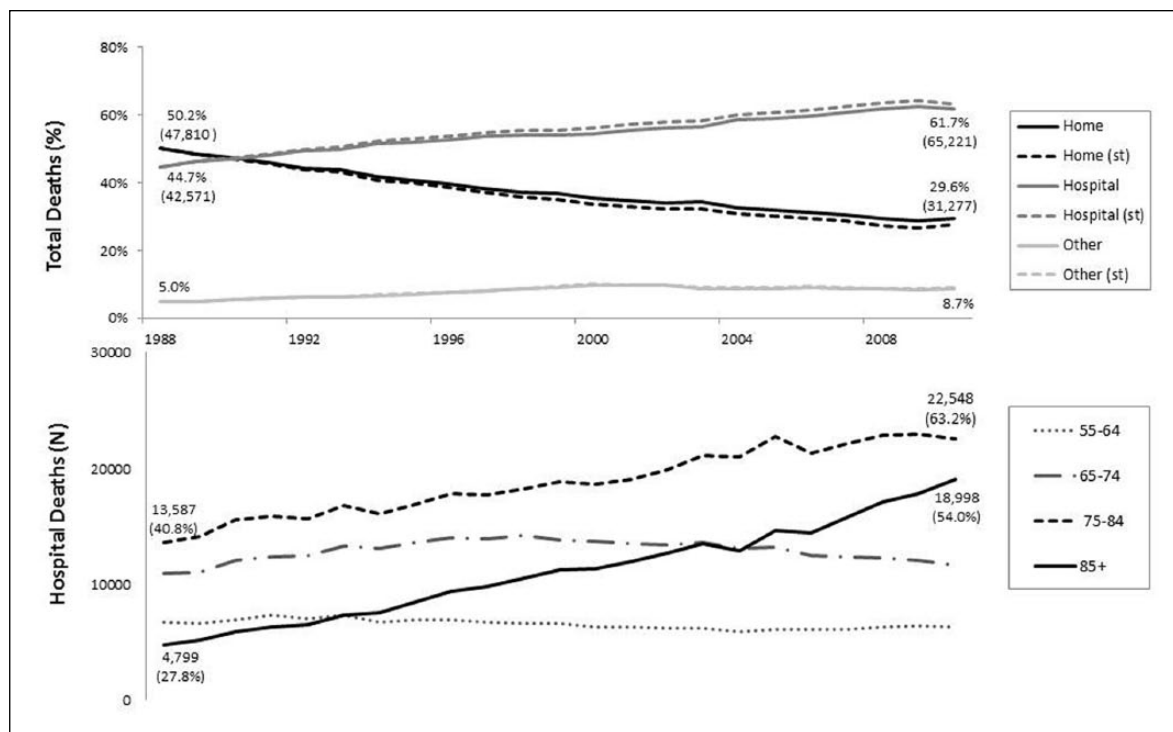
Cause of death		All places		Hospital		Domicile		Other place	
		2002	2010	2002	2010	2002	2010	2002	2010
Cancer	N	22,181	24,923	15,252	19,058	6214	5073	715	792
	%	21.0	23.6	68.8	76.5	28.0	20.4	3.2	3.2
Non-malignant	N	71,374	68,422	39,480	42,085	26,598	21,257	5296	5080
	%	67.6	64.7	55.3	61.5	37.3	31.1	7.4	7.4
External/unknown	N	11,960	12,346	4572	4078	3251	4947	4137	3321
	%	11.3	11.7	38.2	33.0	27.2	40.1	34.6	26.9

‘Domicile’ includes deaths at home and care/nursing homes; ‘Hospital’ includes deaths in clinical facilities; ‘Other place’ includes deaths occurring in public spaces. The cause of death was coded according to the International Classification of Diseases, 10th revision (ICD-10) and grouped into three major groups: cancer (including haematological malignancies), non-malignant diseases and external or unknown causes of death.

dying with cancer died more often in hospital than those dying from non-malignant diseases (76.5% compared to 61.5% in 2010).

From 1988 to 2010, 889,021 deaths occurred in the domicile (37.6% of all deaths), including deaths at home and care homes. Despite the increase in total numbers of deaths in the years analysed, domicile deaths have decreased over time, from 47,810 (50.2%) in 1988 to

31,277 (29.6%) in 2010 (Figure 2). This fall was observed in all age groups except the youngest (18–34 years) and was higher in the age groups of 65+ years (mirroring the age differences observed in hospital deaths). The trend is not explained by changes in the gender and age distribution over the years as it maintained when calculated using age- and gender-standardised percentages of hospital deaths (Figure 2).



**Figure 2.** Past trends of deaths by place of death and proportion of hospital deaths by age group (Portugal, 1988–2010). st: age- and gender-standardised proportion; the age groups presented represent more than 90% of all deaths in the study in recent years.

Deaths in the domicile were more frequent in older ages and among women (Table 1). People dying from cancer die less often in the domicile than those dying from non-malignant diseases (20.4% compared to 31.1% in 2010).

A minority of deaths were registered as taking place in ‘other places’ (186,545 deaths from 1988–2010, accounting for 7.9% of all deaths). Historically, men and younger people died in other places more often than women and older people, but these differences have been decreasing over time. Notably, the proportion of the very old (85+ years) people dying in other places has increased 7 percentage points, from 2.7% to 9.4% in 2010 (Table 1). People aged 18–34 years and those dying from external or unknown causes die more frequently in other places than other age groups (Table 1).

### Projections

Annual numbers of deaths are projected to rise further by 5.6% until 2030 to 111,584 deaths. This is mainly due to the projected increase in deaths from people aged 85+ years, which are expected to increase by 42.7%, to 45.0% of all deaths in Portugal in 2030 (Table 3; Figure 1). The projections also show a progressively ageing population. Substantial changes in the age pyramids of residents and deceased populations will occur until 2030, when 30.9% of the residents are expected to be aged 60+ years and 7.0% aged 80+ years, compared to 23.9% and 4.6%, respectively, in 2010 (Figure 1).

Within this scenario of increasing numbers of deaths occurring at later ages, annual numbers of hospital deaths are projected to increase to more than 80,000 regardless of the scenario considered, ranging from 83,293 deaths (74.6% of all deaths) when assuming trends in non-hospital deaths will continue (model 3) to 99,176 deaths (88.9% of all deaths) when assuming the proportional change in hospital deaths will continue (model 2; Table 3; Figure 3). These numbers correspond to an increase in the annual number of hospital deaths by a minimum of 18,072 deaths (27.7% rise from 2010) to a maximum of 33,955 deaths (52.1% rise) by 2030, when compared to 2010. This is mainly due to the expected sharp increase in hospital deaths from people aged 85+ years, from 18,988 (54.0%) to at least 36,957 (73.6%) deaths in the third model. Model 2 (assuming recent proportional changes in hospital deaths continue) projects 100% of deaths from people aged 85+ years to take place in hospital by 2024 onwards.

### Discussion

Our study shows that regardless of the scenario considered, and if current trends continue, hospital death proportions will increase by more than a quarter until 2030.

This is the first time that mortality is projected by place of death in a country without integrated palliative care (Portugal). Globally, about 39% of countries are in this situation.<sup>7</sup> Our projections show a topical upward trend of hospital deaths, in the context of marked ageing and

**Table 3.** Projected total deaths and hospital deaths by age and gender according to three models (Portugal – 2010, 2020, 2030).

	All deaths (all places)			Hospital deaths							
	2010	2020	2030	Model 1			Model 2		Model 3		
				2010	2020	2030	2020	2030	2020	2030	
<b>Total</b>											
N	105,691	106,221	111,584	65,221	76,597	87,905	85,159	99,176	71,959	83,293	
%	100	100	100	61.7	72.1	78.8	80.2	88.9	67.7	74.6	
<b>Age (years)</b>											
18–34	1370	1003	876	679	245	220	378	271	418	300	
%	1.3	0.9	0.8	49.6	24.4	25.1	37.7	31.0	41.7	34.3	
35–44	2474	2143	1535	1545	800	362	1034	724	1271	861	
%	2.3	2.0	1.4	62.4	37.3	23.6	48.3	47.1	59.3	56.0	
45–54	5210	4708	4174	3536	3536	3252	3613	3309	3225	2885	
%	4.9	4.4	3.7	67.9	75.1	77.9	76.7	79.2	68.5	69.1	
55–64	8881	8064	7382	6265	6593	6408	6715	6541	5956	5694	
%	8.4	7.6	6.6	70.5	81.8	86.8	83.3	88.6	73.9	77.1	
65–74	16,861	15,138	14,710	11,637	9502	7367	9760	8189	11,160	11,538	
%	16.0	14.3	13.2	69.0	62.8	50.1	64.5	55.7	73.7	78.4	
75–84	35,686	32,376	32,716	22,548	25,586	28,623	25,985	29,952	22,619	25,058	
%	33.8	30.5	29.3	63.2	79.0	87.5	80.3	91.6	69.9	76.6	
85+	35,175	42,790	50,190	18,998	30,336	41,673	37,674	50,190	27,311	36,957	
%	33.3	40.3	45.0	54.0	70.9	83.0	88.0	100.00	63.8	73.6	
<b>Gender</b>											
Men	N	54,112	53,332	55,870	34,839	39,043	43,458	42,852	47,167	37,301	42,608
	%	51.2	50.2	50.1	64.4	73.2	77.8	80.3	84.4	69.9	76.3
Women	N	51,579	52,889	55,718	30,382	37,554	44,447	42,307	52,009	34,658	40,685
	%	48.8	49.8	49.9	58.9	71.0	79.8	80.0	93.3	65.5	73.0

#: non-standardised proportion.

Model 1 assumed that last 5 year trends of numbers of hospital deaths will be maintained in the future; model 2 assumed that last 5 year trends of variation of hospital deaths will be maintained; model 3 assumed that last 5 year trends of proportions of non-hospital deaths will be maintained (for more details on how these models were designed, please refer to Appendix 1).

increasing numbers of deaths. This trend goes against what the majority of people prefer, which is to die at home,<sup>3,4,6</sup> and raises questions about the future sustainability of hospital inpatient care. The study and its implications substantially strengthen the resolution approved by the WHO Board of Directors in January 2014, calling for countries to integrate palliative care in their healthcare systems.<sup>8</sup>

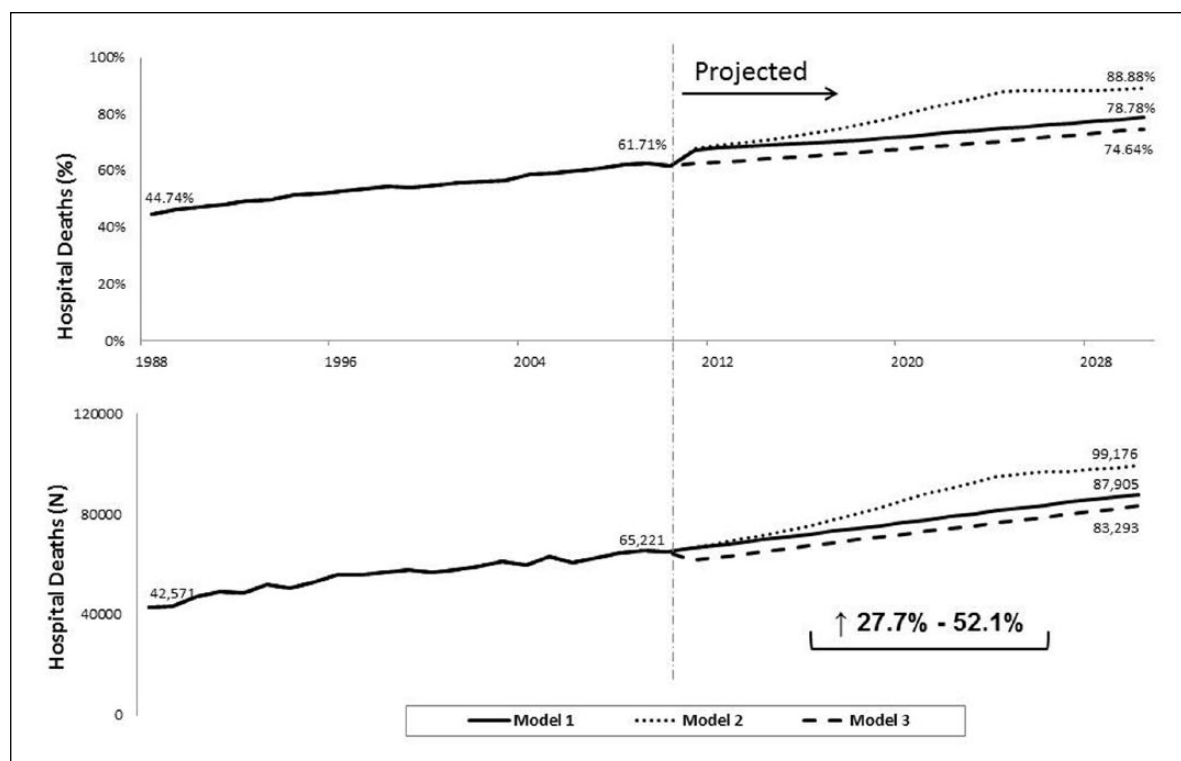
### Limitations

The limitations of analysing routinely collected mortality data include the possibility of filling and coding errors, and coding changes during the study period. To our knowledge, the accuracy of place of death of this dataset has not been determined. This is a limitation that applies to place of death data for many countries;<sup>15,16</sup> in Portugal, the fact that the data are filled in by the doctor who certifies the death may provide added reassurance that the recorded location is correct. In 1996, the coding of place of death in Portuguese death certificates was altered from four to three categories, with the deletion of the category ‘public way’,

but the impact of this change on the findings is minimal because the more recent definition of ‘other places’ includes public ways. No further changes have been made in the time period analysed. However, considering recent data showing that the population clearly distinguishes home, care homes and palliative care units in terms of preferences for place of death,<sup>6</sup> it is crucial to change the categories for place of death in Portuguese death certificates, in order to distinguish these different places.

Comparing the projected and actual numbers of deaths in Portugal in 2011, we found that the Eurostat projections underestimate the actual numbers of deaths by 4776 deaths (4.6%). This is important to consider when interpreting the results of projected proportions of hospital deaths in models 1 and 2 and projected hospital death numbers in model 3, as they may have been underestimated to the same extent.

Projections rely on assumptions that may or may not confirm in the future, being also dependent on policy decisions that may happen in the meantime. For this study, we assumed that the last 5-year trends (2006–2010) will be maintained. We then modelled three scenarios, based on



**Figure 3.** Past trends and future projections of hospital deaths according to three models (Portugal, 1988–2030).

The mean of the last 5-year slopes (2006–2010) was used in all models. The slopes' variable changed depending on the model: model 1 – slopes of absolute numbers of hospital deaths; model 2 – slopes of proportion of change of hospital deaths; and model 3 – slopes of proportions of non-hospital deaths.

different assumptions. Despite differences, all three models show a consistent trend of increasing hospital deaths in the future, by at least one quarter until 2030. Importantly, these projections agree with more recent numbers, although it is yet too early to see a consistent trend. Percentages of hospital deaths were 63.4% (64,818) in 2011, 63.6% (68,074) in 2012 and 64.3% (68,223) in 2013; both the percentages and numbers fall between our projected values from models 1 to 3 (INE, personal communication 1/07/2015).

### Socio-demographic sustainability

Our findings confirm that people are increasingly dying at older ages in Portugal, with a notable increase in the median age at death of 5 years for men and 4 years for women from 1988<sup>1,2</sup> to 2010. This is at the forefront of global ageing trends,<sup>1,2</sup> showing that Portugal is particularly affected by the complex challenges posed by ageing while having scarce resources to meet people's palliative care needs.<sup>7</sup>

In addition, a future reduction in informal and formal care availability is likely, due to the projected fall of birth numbers, which were already outnumbered by deaths in recent years, and decreasing older-age support ratios. Based on the findings, we call for the development of a

national public health strategy with two main goals: (1) to increase birth numbers, by providing economic and social conditions for childbearing age people to create families, and (2) to ensure community support for older people, by developing sustainable community services including home care, care homes and day centres supported by public and private sectors and integrated in the health and social care systems.

### Projected increase in hospital deaths

Based on the trends observed in the last 5 years (2006–2010), we project hospital deaths to rise by at least 27.7% until 2030, corresponding to an increase of more than 15,000 annual deaths within a projected total number of deaths of approximately 111,000 per year by 2030. This increase will occur mainly due to almost doubling numbers of hospital deaths of those aged 85+ years, irrespective of the model considered. In less than 10 years' time, by 2024 onwards, and if current trends of proportional changes of hospital deaths continue (model 2), all of those dying at ages of 85 years or beyond will die in hospital. It is important to note that age is one key factor shaping preferences for where to die, with older people having a higher preference for dying at home (66.2% of age 75+ years compared to 51.2% among the 1286 participants in the



PRISMA population survey in Portugal).<sup>6</sup> The prevailing trend towards hospitalised dying in Portugal is therefore not only difficult to sustain in terms of healthcare resources, but also it is heading in a direction which is against people's preferences, particularly for those dying at older ages.

Regarding gender differences, we found that men died more frequently in hospital than women, although the difference in proportions has decreased over time. This trend is mirrored in the projections, with models 1 and 2 projecting that if current trends continue, women will die more frequently in hospital than men by 2030. More research is needed to understand these gender trends.

Compared to other countries, the proportion of hospital deaths in Portugal is relatively high –62% compared with 54% in a recent international review of statistics from 45 countries.<sup>15</sup> This is unlikely to be explained by the availability of hospital beds, as Portugal had fewer beds (3.4) than EU-27 (5.3) per 1000 population in 2010.<sup>17</sup> In the international comparison, Portugal was the eighth country with the highest proportion of hospital deaths, preceded only by Japan, Brazil, Malta, Korea, Botswana, Wales and Sweden.<sup>15</sup> We projected this proportion to increase to at least three quarters of all deaths by 2030. In the worst case scenario projected, they can increase up to 89% of all deaths.

This is not such a common finding in other studies. In Germany, the proportion of hospital deaths is expected to remain stable in future years,<sup>12</sup> and in the United Kingdom, Canada and the United States, where home care is more developed, a reversal of trends has already happened.<sup>14,18,19</sup> Also, in Belgium, where a policy to support care homes has been developed, a shift in the numbers of deaths from hospital to care homes was observed in recent years.<sup>13</sup> Interestingly, in these countries, it was found that patients dying from cancer die more often than others at home. In Portugal, we found the opposite. We know that being supported by home palliative care is a determinant factor to die at home.<sup>20</sup> What we see in Portugal is a shortage of these teams and a general lack of integration of palliative care in the mainstream healthcare.<sup>6,7</sup> Considering that patients with cancer experience a more predictable trajectory, these patients might be more likely to remain in hospital when deemed to be in the end-of-life stage, so as to access care to relieve their physical suffering in a context of scarce home palliative care. This might be a potential explanation. It would be interesting to compare our results with countries with similar palliative care development levels. For instance, in Botswana, 10% of all cancer deaths occur at home, while people dying from cardiovascular diseases and other diagnoses died more often in a home setting (14% and 13%, respectively).<sup>21</sup> Nonetheless, this comparison is challenging, as in Botswana the proportion of deaths due to unknown causes is very high (33%), and

of these, 91% die at home. In Japan, patients with non-malignant diseases also die more often at home than patients with cancer.<sup>22</sup> Although palliative care is generally more developed in this country,<sup>7</sup> service provision is mainly focused in palliative care units and hospital-support teams. Home palliative care is still under development in Japan. A study of six European countries in 2002/2003 found higher home death proportions in cancer compared to non-cancer deaths in all countries except Norway, where cancer patients were more likely to die in hospital (similar to Portugal). The authors suggested that this could be because palliative care developed mainly in hospitals and access to institutional care remains high in Norway, with primary care playing a relatively weak gate-keeping role.<sup>23</sup> Variations are likely to be due to a combination of organisational, societal and cultural factors as well as physicians' attitudes and training.

### *Implications for practice, policy and future research*

Examining experiences in other countries including the United States and the United Kingdom,<sup>14,24</sup> it seems that with targeted national strategies, focused on developing palliative care support in the community, it is possible to influence hospital death trends. This is further supported by evidence from a Cochrane review, which found that specialist home palliative care services double the odds of death at home while significantly decreasing symptom burden when compared to usual care.<sup>25</sup>

If, by the contrary, nothing is done, our study suggests that countries with ageing populations and scarce palliative care services may face a marked increase in hospital deaths which is not economically sustainable nor desired by the population.

Therefore, in order to meet people's preferences for dying at home, we call for the development of home palliative care teams integrated in the existent healthcare systems. This is especially needed in ageing countries, where the numbers of deaths and dependency ratios are increasing, so as to avoid unwanted hospitalisations and unsustainable hospital care while increasing the quality of care for the older population.

Further research is needed to determine the impact of such high proportions of older people dying in hospitals in regions where palliative care is not integrated in the healthcare system, both in terms of resources and in relation to the quality of care that people receive at the end of life. We also call for improvements in the way place of death is coded in death certificates, with the inclusion of separate categories which are known to be key in people's preferences, mainly 'palliative care unit', 'home' and 'care/nursing home', so as to meaningfully monitor such an important outcome.

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## Author contributions

B.G. is Principal Investigator, conceived the study and together with I.J.H. and P.L.F. obtained funding. All authors contributed to its design. B.G. and V.P.S. negotiated the acquisition of the mortality data from the Portuguese Statistics Institute; V.P.S. negotiated acquisition of the population projections data from Eurostat. V.P.S. and B.G. decided the projection models, and V.P.S. analysed the data and interpreted the results supervised by B.G. with contributions from I.J.H. and P.L.F. V.P.S. drafted the manuscript; all authors read and approved the final manuscript.

## Declaration of conflicting interests

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#### Appendix I. Three different models for the projections of hospital deaths in Portugal (2011–2030)

Model	Assumption	Slopes calculation (e.g.: Slope <sub>2009–10</sub> )
Model 1	Current trends in the number of hospital deaths will be maintained in the future.	$\text{Slope}_{2009-10} = N_{2010 \text{ hospital deaths}} - N_{2009 \text{ hospital deaths}}$
Model 2	Proportional changes of hospital deaths will be maintained in the future.	$\text{Slope}_{2009-10} = \frac{(N_{2010 \text{ hospital deaths}} - N_{2009 \text{ hospital deaths}})}{N_{2009 \text{ hospital deaths}}}$
Model 3	Differences in proportions of non-hospital deaths will be maintained in the future.	<p>1. <math>N_{\text{domicile}} + N_{\text{other place}} = N_{\text{non-hospital deaths}}</math></p> <p>2. <math>\text{Slope}_{2009-10} = \% \text{ Non-hospital deaths } 2010 - \% \text{ Non-hospital deaths } 2009</math></p>