Original Investigation

Comparison of Site of Death, Health Care Utilization, and Hospital Expenditures for Patients Dying With Cancer in 7 Developed Countries

Justin E. Bekelman, MD; Scott D. Halpern, MD, PhD; Carl Rudolf Blankart, PhD; Julie P. Bynum, MD, MPH; Joachim Cohen, MSc, PhD; Robert Fowler, MDCM, MS(Epi); Stein Kaasa, MD, PhD; Lukas Kwietniewski, MSc; Hans Olav Melberg, PhD; Bregje Onwuteaka-Philipsen, PhD; Mariska Oosterveld-Vlug, PhD; Andrew Pring, MSc; Jonas Schreyögg, PhD; Connie M. Ulrich, PhD, RN; Julia Verne, MBBS, PhD; Hannah Wunsch, MD, MSc; Ezekiel J. Emanuel, MD, PhD; for the International Consortium for End-of-Life Research (ICELR)

IMPORTANCE Differences in utilization and costs of end-of-life care among developed countries are of considerable policy interest.

OBJECTIVE To compare site of death, health care utilization, and hospital expenditures in 7 countries: Belgium, Canada, England, Germany, the Netherlands, Norway, and the United States.

DESIGN, SETTING, AND PARTICIPANTS Retrospective cohort study using administrative and registry data from 2010. Participants were decedents older than 65 years who died with cancer. Secondary analyses included decedents of any age, decedents older than 65 years with lung cancer, and decedents older than 65 years in the United States and Germany from 2012.

MAIN OUTCOMES AND MEASURES Deaths in acute care hospitals, 3 inpatient measures (hospitalizations in acute care hospitals, admissions to intensive care units, and emergency department visits), 1 outpatient measure (chemotherapy episodes), and hospital expenditures paid by insurers (commercial or governmental) during the 180-day and 30-day periods before death. Expenditures were derived from country-specific methods for costing inpatient services.

RESULTS The United States (cohort of decedents aged >65 years, N = 211 816) and the Netherlands (N = 7216) had the lowest proportion of decedents die in acute care hospitals (22.2.% and 29.4%, respectively). A higher proportion of decedents died in acute care hospitals in Belgium (N = 21 054; 51.2%), Canada (N = 20 818; 52.1%), England (N = 97 099; 41.7%), Germany (N = 24 434; 38.3%), and Norway (N = 6636; 44.7%). In the last 180 days of life, 40.3% of US decedents had an intensive care unit admission compared with less than 18% in other reporting nations. In the last 180 days of life, mean per capita hospital expenditures were higher in Canada (US $21 840), Norway (US $19 783), and the United States (US $18 500), intermediate in Germany (US $16 221) and Belgium (US $15 699), and lower in the Netherlands (US $10 936) and England (US $9342). Secondary analyses showed similar results.

CONCLUSIONS AND RELEVANCE Among patients older than 65 years who died with cancer in 7 developed countries in 2010, end-of-life care was more hospital-centric in Belgium, Canada, England, Germany, and Norway than in the Netherlands or the United States. Hospital expenditures near the end of life were higher in the United States, Norway, and Canada, intermediate in Germany and Belgium, and lower in the Netherlands and England. However, intensive care unit admissions were more than twice as common in the United States as in other countries.

JAMA. 2016;315(3):272-283. doi:10.1001/jama.2015.18603

Author Video Interview and JAMA Report Video at jama.com

Supplemental content at jama.com

CME Quiz at jamanetworkcme.com and CME Questions page 299

Author Affiliations: Author affiliations are listed at the end of this article.

Corresponding Author: Ezekiel J. Emanuel, MD, PhD, Department of Medical Ethics and Health Policy, University of Pennsylvania Perelman School of Medicine, 122 College Hall, Philadelphia, PA 19104 (mehpchair@upenn.edu).

Differences in utilization and costs of end-of-life care among developed countries are of considerable policy interest despite scarce data to inform international comparisons. In the United States, end-of-life care is considered resource intensive, expensive, and insufficiently attentive to patients' needs and wishes.[1] Two decades ago, the majority of deaths due to terminal illness were reported to occur in the hospital.[2] More than a quarter of the Medicare budget, which pays for the health care of Americans aged 65 years or older, is devoted to the care of beneficiaries who die in that year.[3,4] Other developed nations spend less than the United States on health care, a finding some attribute to lower-intensity care at the end of life.[5,6] Simultaneously, irrespective of nation of origin, there appears to be a disconnect between patients' stated preferences for dying at home and actually dying in the hospital.[7-9]

Challenges with end-of-life care are not new, and many efforts have been made to improve care.[1,6,10] Yet few research efforts have directly compared end-of-life care among developed countries. Limited prior studies have yielded conflicting findings: some suggest that patterns of care among developed countries may not differ[11,12]; others found considerable variation in end-of-life care among countries.[13]

To address an essential knowledge gap in cross-national end-of-life research, we formed the International Consortium for End-of-Life Research (ICELR). We aimed to conduct a systematic examination of patterns of care, health care utilization, and expenditures among patients dying in 7 developed countries. We focused on cancer because it is the second leading cause of death, accounting for more than 20% of deaths in most developed countries,[14] is identifiable in registry or administrative claims data, and is among the most resource-intensive illnesses.[15]

Methods

Study Design and Data Sources

We conducted a retrospective observational study of persons dying with cancer in 2010 using administrative claims or registry data sets from 7 developed nations, Belgium, Canada, England, Germany, the Netherlands, Norway, and the United States (**Table 1**). These nations were selected because they had diverse modes of health care financing and delivery and available high-quality sources of administrative claims and registry data. Investigators in 2 other developed nations were approached but were unable to provide data.

The research was approved by institutional review boards with waivers of consent at the University of Pennsylvania and Dartmouth College (United States), at Sunnybrook Health Sciences Center (Canada), and through the Regional Committees for Medical and Health Research Ethics (Norway). In other countries, the research did not require institutional review board approval because anonymized data was used in Germany (based on section 75 of the German Social Code Book V) and England (based on a license to reuse anonymized data with permission of the Health and Social Care Information Center; reference NIC-152151-PD4PG); because the study did not involve an intervention and posthumous anonymized data was used in the Netherlands (based on guidance from the Central Committee on Research Involving Human Subjects and the Dutch Personal Data Protection Act); and because the InterMutualist Agency (through the Programme Law of December 24, 2002) and the Belgian Cancer Registry (through the Law of December 13, 2006, article 39) have statutory authority to undertake the analyses conducted for the study in Belgium without institutional review board approval.

Identification of Decedents With Cancer

The identification of study cohorts followed prior methods used in each participating country.[16-22] We identified decedents between January 1, 2010, and December 31, 2010, who had a diagnosis of cancer documented within 180 days before death. In Canada, England, Germany, the Netherlands, and the United States, cancers were identified in administrative data through *International Classification of Diseases, Ninth Revision* (*ICD-9*) or *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision* (*ICD-10*) diagnosis codes, excluding neoplasms of the skin.[23] In the Netherlands, *ICD-9/10* codes were translated into diagnosis-treatment combinations captured within the Achmea Health Database. In Norway, *ICD-9/10* codes were translated into diagnosis related groups captured within the Norwegian Patient Register. In Belgium, an analogous set of cancers were identified from the Belgium Cancer Registry, allowing for identification of corresponding persons in the national health claims database of the InterMutualist Agency. The US data set was restricted to decedents older than 65 years in fee-for-service Medicare; other data sets covered all ages.

Baseline Characteristics

Baseline characteristics of patients included sex, age, and cancer diagnosis. Patients with multiple cancers were classified into mutually exclusive primary cancer diagnoses according to a hierarchy: lung, hematologic, colon, breast, prostate, and other.

Site of Death, Health Care Utilization, and Hospital Expenditures

We examined site of death by determining whether decedents died in an acute care hospital. We examined health care utilization by assessing 3 inpatient measures (hospitalizations in acute care hospitals, admissions to intensive care units [ICUs], and emergency department visits) and 1 outpatient measure (chemotherapy episodes).[24-26]

We defined acute care hospitals as hospitals that provide inpatient care for acute medical conditions or surgery, excluding skilled nursing facilities, long-term care facilities, or rehabilitation hospitals. In secondary analyses of site of death in the United States, where health policies have promoted patient transfers from acute care hospitals to skilled nursing facilities, we also examined deaths in skilled nursing facilities (similar data were not available or comparable in other nations).

We defined ICUs within acute care hospitals as specialized units for the purposes of critical care with a high staff-to-patient ratio, acknowledging heterogeneity among countries in the definition of critical care beds.[27] We identified other in-

Table 1. Health Insurance Systems, Hospital Payment Structures, and Data Sources in 7 Developed Nations

	Health Insurance System	Hospital Payment Structure	Data Source	Source Description	Population Covered by Data Source
Belgium	Statutory multipayer insurance	Global lump sum with DRG-based hospital budget and per diem payments	InterMutualist Agency, comprising data from all 7 sickness funds mandated by statutory health insurance; cases with cancer as identified through the Belgian Cancer Registry were selected	Linked registry-administrative claims data set for all health-insured persons in Belgium (health insurance is mandatory in Belgium)	10.5 million persons (95% of Belgium's population in 2010)
Canada	Single public payer by province	Global, lump-sum payments	Ontario Health Insurance Plan in Canada's most populous province; linkage via encrypted health insurance numbers to the Canadian Institute for Health Information Discharge Abstracts Database, the Same Day Surgery, the National Ambulatory Care Reporting System database, and the Registered Persons Database	Linked registry-administrative claims data set for all health-insured persons in Ontario; there are small differences in cohort population sizes for expenditure and nonexpenditure data because expenditure cohort size relied on real-time calculations reflecting small dynamic updates in the registered persons database	All people in Ontario, a population of 12.9 million persons in 2011 (38% of the Canadian population in 2011)
England	Single public payer	Global, lump-sum payments combined with per-patient payments by DRG	Hospital Episode Statistics linked to death certificates	Linked registry data set comprising all hospital admissions for persons in England matching a death registered in England or Wales	All people in England, a population of 52.6 million persons in 2010
Germany	Statutory multipayer insurance	Per-patient payments by DRG	BARMER GEK, the largest sickness fund mandated by statutory health insurance	Administrative claims data set	8.5 million persons in Germany (10.4% of Germany's population in 2010)
The Netherlands	Multipayer private insurance	Per-patient diagnosis-treatment combinations, which are DRG-like	Achmea, the major health care insurer, linked to the Hospital Discharge Register and Cause of Death Register, provided by Statistics Netherlands	Linked registry-administrative claims data set	3.6 million persons in the Netherlands (22% of the Netherlands' population in 2010)
Norway	Single public payer	Global, lump-sum payments combined with per-patient payments by DRG	Norwegian Patient Register, comprising data on all hospital admissions in Norway	Administrative claims data set	All people in Norway, a population of 4.9 million persons in 2010
United States	Public and private multipayer insurance	Per-patient payments by DRG (Medicare)	Centers for Medicare & Medicaid Services Medicare files	Administrative claims data set	100% of all fee-for-service Medicare beneficiaries aged >65 y in the United States

Abbreviation: DRG, diagnosis related group.

patient and outpatient measures based on prior methods tailored to each country-specific data set. Data on ICU admissions were not available from Norway and England, and data on emergency department visits were not available from the Netherlands or Norway.

We examined health care expenditures paid by insurers (commercial or governmental) in each country. To report the most similar health care expenditures among countries, we calculated health care expenditures associated with acute care hospital admissions ("hospital expenditures"), excluding outpatient, hospice, and other indirect medical expenditures. Country-specific approaches to calculate hospital expenditures are described in eTable 1 in the Supplement. In each country, hospital expenditures accounted for the largest proportion of total health care expenditures and end-of-life care costs. In the 6 non-US nations, physician costs were part of hospital admissions and thus included in hospital expenditures.

In the United States, physician costs associated with hospital admissions were reimbursed separately from hospital admissions through the Medicare Part B program.[28] For US expenditures, we estimate that Medicare Part B expenditures during the period of hospital admission add 11.5%, on average, to US hospital expenditures (eFigure in the Supplement). To compare expenditures, we converted currencies to 2010 US dollars using Organisation for Economic Co-operation and Development health-specific purchasing power parity conversions (from 2011, the closest year available) to account for the different health purchasing power of national currencies.[29]

Observation Periods

We determined health care utilization and hospital expenditures during the 180-day and 30-day periods before death. We included hospitalizations and expenditures if the initial date or date of admission occurred within the observation periods and excluded those that began before but extended into the observation periods.

Analyses

We calculated descriptive statistics for each country's sample and report unadjusted results, drawing from the balance sheet model for integrating and interpreting evidence.[30] Regulatory and data restrictions did not allow combining patient-level observations across national data sets, thereby precluding adjusted comparisons of outcomes among nations.

Our primary analyses examined data for decedents older than 65 years with any cancer diagnoses. To evaluate whether our findings held for decedents of all ages, we analyzed the 6 non-US nations. To evaluate whether our findings held among the most

Table 2. Characteristics of Cohorts of Decedents Older Than 65 Years With Any Cancer

Characteristics	Belgium	Canada	England	Germany	The Netherlands	Norway	United States
Country statistics for persons aged >65 y, No.							
National population, 2010[a]	1 860 159	4 819 600	8 020 000	19 933 067	2 538 328	670 733	40 267 984
Deaths due to all cancers, 2010[b]	21 054	53 467[c]	97 099	167 406[d]	30 621[e]	8387[f]	396 173[g]
Decedents in cohort, 2010, No.[b]	21 054	20 818[h]	97 099	24 434	7216	6636	211 816
Female, No. (%)	9665 (45.9)	9722 (46.7)	45 609 (47.0)	12 427 (50.9)	2981 (41.3)	2960 (44.6)	94 697 (44.7)
Age, y							
Mean (SD)	78.9 (7.5)	78.8 (7.9)	79.2 (7.6)	79.5 (7.9)	78.7 (7.7)	78.5 (7.6)	79.4 (7.8)
No. (%)							
66-74	6383 (30.3)	6745 (32.4)	45 609 (30.5)	7726 (31.6)	2330 (32.3)	2203 (33.2)	65 190 (30.8)
75-84	9411 (44.7)	8723 (41.9)	41 749 (43.0)	9450 (38.7)	3063 (42.4)	2800 (42.2)	87 055 (41.1)
≥85	5259 (25.0)	5350 (25.7)	25 700 (26.5)	7258 (29.7)	1823 (25.3)	1632 (24.6)	59 520 (28.1)
Cancer diagnoses, No. (%)							
Lung	4063 (19.3)	4622 (22.2)	21 092 (21.7)	3577 (14.6)	1354 (18.8)	1241 (18.7)	44 942 (21.2)
Breast	1369 (6.5)	812 (3.9)	6256 (6.4)	2692 (11.0)	480 (6.7)	358 (5.4)	21 970 (10.4)
Colon	2969 (14.1)	2082 (10.0)	10 298 (10.6)	3630 (14.9)	954 (13.2)	803 (12.1)	20 544 (9.7)
Prostate	1663 (7.9)	1395 (6.7)	8368 (8.6)	2865 (11.7)	697 (9.7)	783 (11.8)	39 312 (18.6)
Hematologic	1347 (6.4)	2394 (11.5)	7796 (8.0)	2732 (11.2)	562 (7.8)	531 (8.0)	28 508 (13.5)
Other	9622 (45.7)	9513 (45.7)	43 299 (44.6)	8938 (36.6)	3169 (43.9)	2913 (43.9)	56 540 (26.7)

[a] Canada and Norway population as reported by the World Bank. England and the Netherlands population as reported by the Office for National Statistics (England) and Statistics Netherlands. Belgium population as reported by Eurostat. United States population as reported by the US Census Bureau. Germany population as reported by Eurostat.

[b] Deaths due to all cancers are derived from published country resources. Decedents in cohort are the number of decedents in the data sets used in the study. Presentation of the 2 statistics offers a sense of what proportion of each country's deaths due to all cancers are captured within the analytic data sets.

[c] Estimated mortality rates for benign and malignant cancers in 2010, Statistics Canada, Canadian Vital Statistics, Death Database.

[d] As reported by Statistisches Bundesamt, Mortality Statistics 2010 (Todesursachenstatistik).

[e] Cause of death as registered at Statistics Netherlands.

[f] As reported by the Norwegian Cause of Death Registry (includes age >65 years).

[g] As reported by the US Census Bureau.

[h] Ontario province, comprising approximately 38% of the Canadian population.

comparable cohorts, we also conducted restricted analyses of decedents older than 65 years with lung cancer. This more homogeneous sample was selected to mitigate effects of variable cancer diagnoses among developed countries. To evaluate whether patterns remained consistent over time, we analyzed United States and Germany, the 2 nations able to provide 2012 data.

We examined the intensity and duration of health care utilization by calculating the percent of decedents with an outcome of interest (hospitalizations in acute care hospitals, admissions to ICUs, emergency department visits, or chemotherapy episodes) and per capita days (for selected measures). For example, we calculated the percent of decedents who died in acute care hospitals as the number of decedents who died in acute care hospitals (numerator) divided by the total number of decedents (denominator). For the 180-day and 30-day periods, we calculated the percent of decedents with ICU admission as the total number of decedents with at least 1 ICU admission (numerator) divided by the total number of decedents (denominator) and the mean number of ICU days as the total number of ICU days in a given period (numerator) divided by the total number of decedents (denominator). Ninety-five percent confidence intervals are not provided for proportions because data sets from all nations were full-population data sets rather than random samples. For the primary analyses of decedents older than 65 years, median, interquartile range, minimum, and maximum values are presented in eTable 2 in the Supplement.

For hospital expenditures, we calculated 180-day and 30-day mean per capita hospital expenditures and 180-day and 30-day mean hospital expenditures per hospital day, with standard deviations. We reasoned that mean per capita hospital expenditures during the 2 observation periods would be largely driven by per capita hospital days while mean per capita hospital expenditures per day could reflect daily costs and daily hospital care intensity. Analyses were conducted for Belgium, Canada, Germany, and the United States using SAS (various versions, SAS Institute Inc), for the Netherlands using SPSS (version 20, IBM SPSS), and for England and Norway using STATA (various versions, Stata Corp).

Results

Cohort Characteristics

The mean age of decedents was between 78.5 and 79.5 years for all countries (**Table 2**). Sex ratios were similar in all coun-

tries, although Germany had a higher and the Netherlands a lower proportion of female decedents (Table 2). In all countries but Germany, the largest proportion of decedents were diagnosed as having lung cancer. The United States had a disproportionately high rate of decedents with prostate cancer.[31]

Site of Death

In Belgium (cohort of decedents >65 years, N = 21 054; death in acute care hospital, 51.2%), Canada (N = 20 818; 52.1%), England (N = 97 099; 41.7%), Germany (N = 24 434; 38.3%), and Norway (N = 6636; 44.7%), a high proportion of decedents died in acute care hospitals. In comparison, 29.4% of decedents in the Netherlands (N = 7216) and 22.2% of decedents in the United States (N = 211 816) died in acute care hospitals (**Table 3**). In the United States, 29.5% of decedents died in acute care hospitals or skilled nursing facilities.

Inpatient Health Care Utilization

In the last 180 days of life, between 82.6% and 88.7% of decedents were hospitalized in Belgium, Canada, England, and Norway, while less than 77% were hospitalized in Germany, the Netherlands, and the United States (Table 3). In the last 180 days, the United States had the fewest mean per capita hospital days (10.7 [SD, 14.0] days) while Belgium (mean, 27.7 [SD, 27.4] days) and Norway (mean, 24.8 [SD, 12.8] days) had the highest mean per capita hospital days. Germany (mean, 21.7 [SD, 25.0] days), Canada (mean, 19.0 [SD, 21.5] days), England (mean, 18.3 [SD, 20.7] days), and the Netherlands (mean, 17.8 [SD, 24.9] days) had intermediate per capita hospital days.

Despite having the second lowest hospitalization rate, 40.3% of US cancer decedents had an ICU admission in the last 180 days compared with less than 18% in other reporting countries (Table 3). Similarly, the mean per capita ICU days in the last 180 days of life in the United States was 3.6 days, while it was less than 1.5 days in other reporting countries.

In the last 30 days of life, England, Belgium, Canada, Norway, and the United States had intermediate rates of hospitalization (ranging from 49.0% to 62.6%), while Germany (44.8%) and the Netherlands (43.2%) had lower hospitalization rates (Table 3). Belgium had a higher mean per capita number of hospital days (10.6 [SD, 10.4] days), while those in Germany (mean, 5.0 [SD, 7.4] days), England (mean, 5.0 [SD, 7.4] days), and the United States (mean, 5.0 [SD, 8.4] days) were lower. However, in the last 30 days of life, 27.2% of US decedents had an ICU admission while 11.0% of decedents or less did in other reporting countries. Similarly, US decedents had a mean of 2.0 (SD, 5.5) ICU days compared with less than 1.0 for other reporting countries (Table 3). England and Norway did not report ICU utilization.

Chemotherapy Utilization

In the last 180 days of life, 38.7% in the United States, 33.0% of patients in Belgium, 29.1% in Canada, and 28.2% in Germany received chemotherapy at least once, while the rate was 23.7% in Norway and 18.1% in the Netherlands (Table 3). In the last 30 days of life, Belgium (12.7%), United States (10.6%), the Netherlands (10.6%), Germany (10.5%), and Canada (8.8%) had higher chemotherapy utilization while Norway (4.8%) had lower chemotherapy utilization (Table 3). England did not report chemotherapy utilization.

Hospital Expenditures

In the last 180 days of life, mean per capita hospital expenditures were higher in Canada (US $21 840), Norway (US $19 783), and the United States (US $18 500) (Table 3). Mean per capita hospital expenditures were intermediate in Germany (US $16 221) and Belgium (US $15 699) and lower in the Netherlands and England (US $10 936 and $9352, respectively). However, mean hospital expenditures per day were highest in the United States (US $1729), intermediate in Canada (US $1149), Norway (US $1064), and Germany (US $748) and lower in the Netherlands (US $614), Belgium (US $567), and England (US $510). The **Figure** shows site of death and hospital expenditures in the last 180 days of life for decedents older than 65 years.

In the last 30 days of life, mean per capita hospital expenditures were highest in Canada (US $10 273), the United States (US $8126), and Norway (US $6625), intermediate in Belgium (US $5840) and Germany (US $4382), and lower in the Netherlands (US $3680) and England (US $3160). Mean hospital expenditures per day were highest in Canada (US $1712) and the United States (US $1625), intermediate in Norway (US $946) and Germany (US $876), and lower in England (US $632), Belgium (US $551), and the Netherlands (US $497).

Physician expenditures were included in non-US hospital expenditures but were excluded from US hospital expenditures. If Medicare Part B expenditures, which include physician costs, were included in US hospital expenditures during the period of hospital admissions, we estimate that US hospital expenditures could be an average of 11.5% higher (eFigure in the Supplement).

Analysis of Decedents of Any Age

We conducted similar analyses of decedents of any age from the 6 non-US countries (Belgium, Canada, England, Germany, the Netherlands, and Norway) that could report findings unrestricted by age. The comparative patterns in acute care hospital deaths, hospitalization rates, ICU rates, expenditures, and other outcomes were consistent with analyses of decedents older than 65 years (**Table 4**). Specifically, in Belgium, Canada, England, Germany, and Norway, between 41.4% and 54.1% of decedents died in acute care hospitals. Conversely, in the Netherlands, 29.4% died in acute care hospitals. In the last 180 days of life, between 82.1% and 89.3% of decedents were hospitalized in Belgium, Canada, England, and Norway, while less than 78% were hospitalized in Germany and the Netherlands. In the last 180 days of life, mean per capita hospital expenditures were higher in Canada (US $23 333) and Norway (US $22 005). Mean per capita hospital expenditures were intermediate in Germany (US $18 414) and Belgium (US $17 022) and lower in the Netherlands (US $11 640) and England (US $10 033).

Analysis of Decedents Older Than 65 Years With Lung Cancer

To validate the general results in a more homogeneous cohort of patients, we conducted a subset analysis on lung can-

Table 3. Health Care Utilization and Hospital Expenditures for Decedents Older Than 65 Years With Any Cancer in 7 Developed Nations

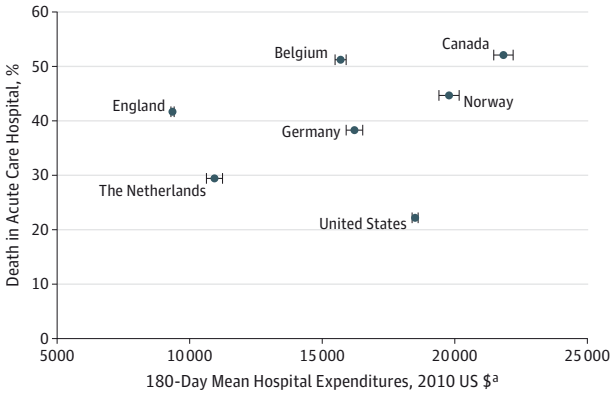
	Belgium	Canada	England	Germany	The Netherlands	Norway	United States
Decedents in cohort, 2010, No.	21 054	20 818	97 099	24 434	7216	6636	211 816
Deaths in acute care hospitals, No. (%)	10 780 (51.2)	10 846 (52.1)	40 514 (41.7)[a]	9369 (38.3)	2125 (29.4)	2966 (44.7)	47 087 (22.2)[b]
Last 180 Days of Life							
Inpatient health care utilization							
Hospitalization in acute care hospital, No. (%)	18 675 (88.7)	18 132 (87.1)	80 283 (82.7)	17 078 (69.9)	5524 (76.5)	5481 (82.6)	158 227 (74.7)
Per capita hospital admissions, mean (SD)	2.0 (1.5)	1.6 (1.2)	1.7 (1.5)	1.7 (1.8)	1.6 (1.9)	3.1 (1.8)	1.6 (1.5)
Per capita hospital days, mean (SD)	27.7 (27.4)	19.0 (21.5)	18.3 (20.7)	21.7 (25.0)	17.8 (24.9)	24.8 (12.8)	10.7 (14.0)
≥1 ICU admission, No. (%)	3684 (17.5)	3164 (15.2)		2014 (8.2)	737 (10.2)		85 362 (40.3)
Per capita ICU days, mean (SD)	1.3 (5.7)	1.2 (5.1)		0.6 (4.1)	0.7 (3.7)		3.6 (8.4)
ED visit, No. (%)	13 580 (64.5)	18 341 (88.1)	76 121 (78.4)	11 426 (46.8)			156 532 (73.9)
Per capita ED visits, mean (SD)	1.0 (1.0)	2.3 (2.1)	1.4 (1.2)	0.7 (1.0)			1.7 (1.7)
Outpatient health care utilization							
≥1 Chemotherapy episode, No. (%)	6948 (33.0)	6058 (29.1)		6899 (28.2)	1303 (18.1)	1572 (23.7)	81 973 (38.7)
Health expenditures (using 2011 health-specific purchasing power parity conversion)							
Per capita hospital expenditures, 2010, mean (SD), US $	15 699 (15 255)	21 840 (26 480)	9342 (9216)	16 221 (24 740)	10 936 (13 137)	19 783 (15 849)	18 500 (26 983)
Hospital expenditures per hospital day, 2010, mean, US $	567	1149	510	748	614	1064	1729
Last 30 Days of Life							
Inpatient health care utilization							
Hospitalization in acute care hospital, No. (%)	10 864 (51.6)	12 532 (60.2)	47 619 (49.0)	10 945 (44.8)	3115 (43.2)	4153 (62.6)	110 296 (52.1)
Per capita hospital admissions, mean (SD)	0.7 (0.6)	0.7 (0.7)	0.6 (0.7)	0.5 (0.6)	0.6 (0.9)	1.0 (1.0)	0.7 (0.8)
Per capita hospital days, mean (SD)	10.6 (10.4)	6.0 (7.7)	5.0 (7.4)	5.0 (7.4)	7.4 (11.9)	7.0 (9.0)	5.0 (8.4)
≥1 ICU admission, No. (%)	2316 (11.0)	2040 (9.8)		864 (3.5)	508 (7.0)		66 643 (27.2)
Per capita ICU days, mean (SD)	0.8 (3.3)	0.6 (2.4)		0.2 (1.3)	0.4 (2.4)		2.0 (5.5)
ED visit, No. (%)	7537 (35.8)	11 991 (57.6)	44 557 (45.9)	6278 (25.7)			98 071 (46.3)
Per capita ED visits, mean (SD)	0.4 (0.6)	0.8 (0.9)	0.5 (0.6)	0.3 (0.5)			0.6 (0.7)
Outpatient health care utilization							
≥1 Chemotherapy episode, No. (%)	2674 (12.7)	1832 (8.8)		2555 (10.5)	768 (10.6)	319 (4.8)	22 516 (10.6)
Health expenditures (using 2011 health-specific purchasing power parity conversion)							
Per capita hospital expenditures 2010, mean (SD), US $	5840 (6204)	10 273 (12 734)	3160 (4237)	4382 (9034)	3680 (7089)	6625 (6154)	8126 (14 243)
Hospital expenditures per hospital day, 2010, mean, US $	551	1712	632	876	497	946	1625

Abbreviations: ED, emergency department; ICU, intensive care unit.

[a] Includes deaths in acute care, primary, and private hospitals. The National End of Life Care Intelligence Network estimates that 95% of hospital deaths in England occur in acute care hospitals.

[b] In the United States, 29.5% of patients died in acute care hospitals or skilled nursing facilities.

Figure. Hospital Expenditures in the Last 180 Days of Life for Patients Older Than 65 Years Dying With Cancer in Acute Care Hospitals in 7 Developed Nations



Physician costs associated with hospital admissions are included in mean hospital expenditures reported for the 6 non-US nations. United States expenditures shown are an underestimate because physician costs are not included; in the United States, it is estimated that Medicare Part B, which includes physician costs, adds an average of 11.5% in expenditures to mean hospital expenditures. Error bars indicate 95% confidence intervals.

[a] Using 2011 health-specific purchasing power parity conversion.

cer decedents older than 65 years from the 6 countries that could identify them, Canada, England, Germany, the Netherlands, Norway, and the United States. The comparative patterns in acute care hospital deaths, hospitalization rates, ICU rates, expenditures, and other outcomes were consistent with other analyses (**Table 5**).

Analysis of Decedents Older Than 65 Years in 2012

To examine temporal patterns, we analyzed decedents older than 65 years from the 2 countries that could provide more recent data, Germany and the United States. In these 2 nations, the comparative patterns were also consistent with other analyses (**Table 6**).

Discussion

This is the first international comparative study to our knowledge of site of death, health care utilization, and hospital expenditures at the end of life. All 7 nations had high rates of hospital admissions and hospital days near the end of life. The United States had the lowest proportion of decedents with cancer dying in acute care hospitals. Norway and England had higher rates of in-hospital deaths, hospital admissions, and hospital days, and Norway had among the highest hospital expenditures but England had among the lowest. We found similar patterns in the larger cohort of decedents of any age and the more homogeneous cohort of decedents older than 65 years with lung cancer, suggesting that the differences observed are likely driven more by end-of-life care practices and organization rather than differences in cohort identification. Four points are worth emphasizing.

First, 3 broad patterns of end-of-life care emerged in the 7 countries we examined (Figure). Decedents in Belgium, Canada, Germany, and Norway received more hospital-centric care with correspondingly high expenditures for hospitalizations, where hospital-centric implies higher rates of death in acute care hospitals and other measures of inpatient utilization. End-of-life care in England was hospital-centric but at a lower cost. Decedents in the United States and the Netherlands received care in acute care hospitals less often and for fewer days, although hospital expenditures near the end of life in the United States were higher (commensurate with expenditures in Canada and Norway), while hospital expenditures in the Netherlands were lower. However, even among nations with lower rates of deaths in acute care hospitals, 4 in 10 decedents with cancer were admitted to acute care hospitals for an average of 5 days in the last 30 days of life.

Second, the United States had the lowest proportion of patients dying in the hospital. Only 22.5% of US decedents older than 65 years with cancer died in acute care hospitals (29.5% died in acute care hospitals or skilled nursing facilities). Death in US acute care hospitals has declined considerably,[32,33] and in 2010, death in the hospital was half of most other countries studied. The Netherlands also had lower acute care hospital deaths, consistent with explicit policies in the Netherlands that promote the provision of generalist-led palliative and home care.[34] Dying in the hospital is often viewed negatively; surveys consistently suggest that people would like to be at home among family and loved ones when they die.[7,35,36]

This difference may reflect differences in infrastructure and the cost of hospital-based care. Deaths not occurring in acute care hospitals may occur at other health care facilities rather than at home, such as skilled nursing facilities.[32] The United States also has more than 5300 hospices, and two-thirds of them provide home-based care.[37] In addition, the United States had a higher per-day hospital cost compared with other developed countries. The economic pressure to find alternatives to hospitalization near the end of life may be less in other countries, and national health care systems may have underdeveloped end-of-life alternatives to hospitalization like hospice, home, and palliative care. Nonetheless, the Netherlands was distinguished by lower hospital utilization rates and lower hospital expenditures, suggesting that economic pressures may be only 1 contributing factor to promoting nonhospital end-of-life care alternatives.

The lower rates of acute care hospital admissions, length of stay, and in-hospital deaths in the United States and the Netherlands suggest that end-of-life care can evolve to reflect patient preferences and goals about site of death irrespective of health system (Table 1).[1,10,32,35] In the early 1980s, more than 70% of US cancer patients died in hospital.[33] Over the last 30 years, recognition of preferences for home-based end-of-life care and patients' rights to refuse medical interventions and economic pressures to lower end-of-life costs and expand hospice use have all played an important role in advancing end-of-life care.[1,35,38] Yet excessive utilization of high-intensity care near the end of life, particularly in the United States relative to other developed countries, underscores the need for continued progress to improve end-of-life care practices.

Table 4. Health Care Utilization and Hospital Expenditures for Decedents of Any Age With Any Cancer in 6 Developed Nations

	Belgium	Canada	England	Germany	The Netherlands	Norway
Country statistics, No.						
National population, 2010[a]	10 895 586	34 005 274	52 600 000	81 802 257	16 615 394	4 889 252
Deaths due to all cancers, 2010	27 325	76 200[b]	129 117	218 889[c]	43 516[d]	11 036[e]
Decedents in cohort, 2010, No.	27 325	28 102[f]	129 117	30 277	9520	11 036
Female, No. (%)	11 012 (40.3)	13 124 (46.7)	61 150 (47.4)	15 572 (51.4)	4077 (42.8)	5065 (45.9)
Age, mean (SD)	73.3 (12.7)	72.6 (13.2)	73.4 (12.9)	75 (12.1)	73.0 (12.9)	72.3 (13.0)
Deaths in acute care hospitals, No. (%)	14 100 (51.6)	15 203 (54.1)	53 423 (41.4)[g]	12 567 (41.5)	2797 (29.4)	5054 (45.8)
Last 180 Days of Life						
Inpatient health care utilization						
Hospitalization in acute care hospital, No. (%)	24 401 (89.3)	24 589 (87.5)	108 421 (84.0)	22 336 (73.8)	7371 (77.4)	9061 (82.1)
Per capita hospital admissions, mean (SD)	2.0 (1.6)	1.6 (1.3)	1.9 (1.6)	1.9 (1.9)	1.7 (2.0)	3.4 (2.4)
Per capita hospital days, mean (SD)	28.2 (27.7)	19.4 (22.0)	18.5 (20.9)	23.7 (26.0)	18.2 (25.7)	27.4 (23.8)
≥1 ICU admission, No. (%)	4891 (17.9)	4609 (16.4)		2720 (9.0)	978 (10.3)	
Per capita ICU days, mean (SD)	1.4 (6.0)	1.3 (5.3)		0.6 (4.3)	0.7 (3.8)	
ED visit, No. (%)	17 625 (64.5)	24 814 (88.3)	102 597 (79.5)	15 005 (49.6)		
Per capita ED visits, mean (SD)	1.0 (1.1)	2.4 (2.2)	1.5 (1.3)	0.8 (1.0)		
Outpatient health care utilization						
≥1 Chemotherapy episode, No. (%)	11 203 (41.0)	8178 (29.1)		10 606 (35.0)	2370 (24.9)	2682 (24.3)
Health expenditures (using 2011 health-specific purchasing power parity conversion)						
Per capita hospital expenditures, 2010, mean (SD), US $	17 022 (17 642)	23 333 (28 922)	10 033 (9858)	18 414 (28 673)	11 640 (14 398)	22 005 (20 920)
Hospital expenditures per hospital day, 2010, mean, US $	604	1203	542	777	640	803
Last 30 Days of Life						
Inpatient health care utilization						
Hospitalization in acute care hospital, No. (%)	14 455 (52.9)	16 917 (60.2)	65 616 (50.8)	14 468 (47.8)	3155 (43.7)	7052 (63.9)
Per capita hospital admissions, mean (SD)	0.6 (0.7)	0.7 (0.7)	0.6 (0.7)	0.6 (0.7)	0.6 (0.9)	1.1 (1.0)
Per capita hospital days, mean (SD)	10.7 (10.3)	6.0 (7.7)	5.1 (7.4)	5.4 (7.6)	7.3 (11.9)	7.5 (9.6)
≥1 ICU admission, No. (%)	3060 (11.2)	2754 (9.8)		1138 (3.8)	665 (7.0)	
Per capita ICU days, mean (SD)	0.8 (3.4)	0.6 (2.4)		0.2 (1.3)	0.4 (2.4)	
ED visit, No. (%)	9755 (35.7)	16 187 (57.6)	60 936 (47.2)	8318 (27.5)		
Per capita ED visits, mean (SD)	0.4 (0.6)	0.8 (0.9)	0.6 (0.7)	0.3 (0.5)		
Outpatient health care utilization						
≥1 Chemotherapy episode, No. (%)	4372 (16.0)	2473 (8.8)		4018 (13.3)	1404 (14.7)	662 (6.0)
Health expenditures (using 2011 health-specific purchasing power parity conversion)						
Per capita hospital expenditures 2010, mean (SD), US $	6206 (6929)	10 843 (13 710)	3326 (4394)	4766 (9653)	3646 (7227)	6934 (6842)
Hospital expenditures per hospital day, 2010, mean, US $	580	1807	652	883	499	925

Abbreviations: ED, emergency department; ICU, intensive care unit.

[a] Belgium, Canada, Germany, the Netherlands, and Norway total populations as reported by the World Bank. England total population as reported by the Office for National Statistics.

[b] Estimated mortality rates for all cancers in 2010, Canadian Cancer Society.

[c] Statistisches Bundesamt. Mortality Statistics 2010 (Todesursachenstatistik).

[d] Cause of death as registered at Statistics Netherlands.

[e] Deaths due to cancer as reported by the cancer registry of Norway.

[f] Ontario province sample, comprising approximately 39% of the Canadian population.

[g] Includes deaths in acute care, primary, and private hospitals. The National End of Life Care Intelligence Network estimates that 95% of hospital deaths in England occur in acute care hospitals.

Table 5. Health Care Utilization and Hospital Expenditures for Decedents Older Than 65 Years With Lung Cancer in 6 Developed Nations[a]

	Canada	England	Germany	The Netherlands	Norway	United States
Decedents in cohort, 2010, No.	4467	21 092	3577	1354	1400	44 942
Female, No. (%)	2015 (45.1)	9262 (43.9)	1361 (38.0)	394 (29.1)	594 (42.4)	21 707 (48.3)
Age, mean (SD)	77.4 (7.2)	77.7 (7.1)	76.3 (6.9)	75.9 (6.7)	76.3 (7.2)	76.7 (6.9)
Deaths in acute care hospitals, No. (%)	2417 (54.1)	8988 (42.6)[b]	1611 (45.0)	400 (29.5)	651 (46.5)	9078 (20.2)
Last 180 Days of Life						
Inpatient health care utilization						
Hospitalization in acute care hospital, No. (%)	3922 (87.8)	17 491 (82.9)	3120 (87.2)	110 (81.2)	1179 (84.2)	32 628 (72.6)
Per capita hospital admissions, mean (SD)	1.5 (1.1)	1.6 (1.3)	2.3 (1.9)	1.8 (2.0)	3.2 (2.1)	1.5 (1.5)
Per capita hospital days, mean (SD)	17.2 (19.8)	16.3 (17.9)	27.0 (24.0)	18.0 (23.9)	26.2 (19.5)	9.6 (12.3)
≥1 ICU admission, No. (%)	612 (13.7)		288 (8.1)	96 (7.1)		17 213 (38.3)
Per capita ICU days, mean (SD)	1.1 (5.2)		0.4 (3.0)	0.4 (2.3)		3.2 (7.8)
ED visit, No. (%)	4065 (91.0)	16 926 (80.2)	2051 (57.3)			32 763 (72.9)
Per capita ED visits, mean (SD)	2.3 (1.9)	1.4 (1.2)	0.9 (1.0)			1.6 (1.7)
Outpatient health care utilization						
≥1 Chemotherapy episode, No. (%)	880 (19.7)		1491 (41.7)	376 (27.8)	427 (30.5)	19 685 (43.8)
Health expenditures (using 2011 health-specific purchasing power parity conversion)						
Per capita hospital expenditures, 2010, mean (SD), US $	19 076 (23 597)	8502 (7955)	18 423 (21 000)	10 685 (11 089)	19 369 (14 461)	15 815 (22 616)
Hospital expenditures per hospital day, 2010, mean, US $	1109	522	682	594	739	1647
Last 30 Days of Life						
Inpatient health care utilization						
Hospitalization in acute care hospital, No. (%)	2743 (61.4)	10 841 (51.4)	2086 (58.3)	613 (45.3)	920 (65.7)	22 111 (49.2)
Per capita hospital admissions, mean (SD)	0.7 (0.7)	0.6 (0.7)	0.7 (0.7)	0.6 (0.9)	1.1 (1.0)	0.6 (0.8)
Per capita hospital days, mean (SD)	5.9 (7.4)	5.1 (7.4)	6.7 (8.0)	7.6 (11.5)	7.6 (8.2)	4.3 (7.3)
≥1 ICU admission, No. (%)	380 (8.5)		135 (3.8)	57 (4.2)		11 191 (24.9)
Per capita ICU days, mean (SD)	0.5 (2.1)		0.1 (1.2)	0.3 (1.9)		1.7 (4.9)
ED visit, No. (%)	2761 (61.8)	10 403 (49.3)	1181 (33.0)			20 179 (44.9)
Per capita ED visits, mean (SD)	0.9 (0.9)	0.6 (0.7)	0.4 (0.5)			0.6 (0.7)
Outpatient health care utilization						
≥1 Chemotherapy episode, No. (%)	264 (5.9)		601 (16.8)	222 (16.4)	80 (5.7)	5438 (12.1)
Health expenditures (using 2011 health-specific purchasing power parity conversion)						
Per capita hospital expenditures, 2010, mean (SD), US $	7434 (10 967)	3239 (4118)	5274 (9147)	3121 (6200)	6320 (5157)	6915 (12 147)
Hospital expenditures per hospital day, 2010, mean, US $	1559	635	787	411	831	1608

Abbreviations: ED, emergency department; ICU, intensive care unit.

[a] Belgium was not included in the analysis of lung cancer decedents because regulatory restrictions allowed only analyses of decedents with any cancer rather than with specific cancers.

[b] Includes deaths in acute care, primary, and private hospitals. The National End of Life Care Intelligence Network estimates that 95% of hospital deaths in England occur in acute care hospitals.

Third, the United States was prominent in its use of expensive, resource-intense services at the end of life. While the United States had a comparatively low rate of hospital deaths and hospitalizations and shorter hospital stays, 40% of all decedents were admitted to the ICU in the last 180 days and 27% in the last 30 days of life, more than twice the rate of other countries. Days spent in the ICU in the United States were also more than twice the corresponding numbers in other countries. These high rates of ICU use extended to the more homogeneous cohort of lung cancer patients older than 65 years. Similarly, the United States had higher rates of chemotherapy use at the end of life, second only to Belgium.

Fourth, this study collected a wide variety of data on decedents across 7 developed countries. Cross-national comparisons are rare because of the difficulties in identifying consistent cohorts and collecting comparable data on utilization and costs. We were able to mitigate these challenges by focusing on cancer decedents, validating findings from the general cohorts on a more homogeneous cohort of patients older than 65 years with lung cancer, and examining a limited but important set of measures of health care utilization that are available in claims data, such as hospitalizations and ICU admissions.

This study has limitations. First, we identified decedents dying with cancer rather than dying of cancer. This differential may reduce cancer severity in the United States because of a higher incidence of prostate cancer cases[31] and may bias US health care utilization and costs downward. However, the analysis of patients older than 65 years with lung cancer identified patterns consistent with those for the entire cancer cohort. This subset analysis restricted to a homogeneous patient population supports the internal validity of our findings.

Second, each country used disparate data sources that may not be entirely comparable; moreover, the data sources for some countries are samples that may not be representative of their populations. Thus, our findings are hypothesis generating and not definitive. Third, health and end-of-life care payment policies and financing differ among the nations and cohorts examined, and the US cohort was restricted to decedents in fee-for-service Medicare. Moreover, while we restricted our definition of expenditures to those associated with acute care hospital admissions, inevitably there were differences in how hospital expenditures were accounted for and in the expenditures associated with similar inpatient services.[39] For example, US hospital expenditures were an underestimate in comparison with the 6 non-US nations because US hospital expenditures exclude physician costs; we estimate that Medicare Part B, which includes physician costs, adds 11.5% in expenditures, on average, to overall health expenditures related to hospital admissions. Fourth, this study does not provide comparative insights into nonhospital health care or expenditures. Fifth, we were unable to identify comparable data across countries regarding use of hospice or palliative care services or admission to other care facilities like skilled nursing facilities or nursing homes. Sixth, the data sources used did not allow us to evaluate differences in quality of care or patient-reported outcomes. Our findings and the limitations highlight the need for greater cross-national comparisons of end-of-life care using prospectively designed quality and cost metrics.

Conclusions

Among patients older than 65 years who died with cancer in 7 developed countries in 2010, end-of-life care was more hospital-centric in Belgium, Canada, England, Germany, and Norway than in the Netherlands or the United States. Hospital expenditures near the end of life were higher in the United States, Norway, and Canada, intermediate in Germany and Belgium, and lower in the Netherlands and England. However, ICU admissions were more than twice as common in the United States as in other countries.

Table 6. Health Care Utilization and Hospital Expenditures for Decedents Older Than 65 Years With Any Cancer in 2 Developed Nations

	Germany	United States
Country statistics, No.		
National population, 2012	16 547 548	43 145 000
Deaths due to all cancers, 2012	169 047	403 497
Decedents in cohort, 2012, No.	25 756	213 793
Female, No. (%)	13 063 (50.7)	169 793 (44.8)
Age, mean (SD)	80.0 (7.8)	79.4 (7.9)
Deaths in acute care hospitals, No. (%)	9323 (36.2)	44 734 (20.9)[a]
Last 180 Days of Life		
Inpatient health care utilization		
Hospitalization in acute care hospital, No. (%)	17 683 (68.7)	158 686 (74.2)
Per capita hospital admissions, mean (SD)	1.7 (1.8)	1.6 (1.5)
Per capita hospital days, mean (SD)	21.1 (24.8)	10.2 (13.5)
≥1 ICU admission, No. (%)		88 777 (41.5)
Per capita ICU days, mean (SD)		3.6 (8.3)
ED visit, No. (%)	12 263 (47.6)	163 435 (76.4)
Per capita ED visits, mean (SD)	0.8 (1.0)	1.8 (1.7)
Outpatient health care utilization		
≥1 Chemotherapy episode, No. (%)	6849 (26.6)	82 360 (38.5)
Health expenditures (using 2011 health-specific purchasing power parity conversion)		
Per capita hospital expenditures, 2012, mean (SD), US $	16 717 (25 999)	18 744 (27 624)
Hospital expenditures per hospital day, 2012, mean, US $	792	1832
Last 30 Days of Life		
Inpatient health care utilization		
Hospitalization in acute care hospital, No. (%)	10 988 (42.7)	109 473 (51.2)
Per capita hospital admissions, mean (SD)	0.5 (0.6)	0.7 (0.7)
Per capita hospital days, mean (SD)	4.8 (7.3)	4.7 (7.9)
≥1 ICU admission, No. (%)		59 319 (27.7)
Per capita ICU days, mean (SD)		1.9 (5.3)
ED visit, No. (%)	6773 (26.3)	102 844 (48.1)
Per capita ED visits, mean (SD)	0.3 (0.5)	0.6 (0.8)
Outpatient health care utilization		
≥1 Chemotherapy episode, No. (%)	2368 (9.2)	22 960 (10.7)
Health expenditures (using 2011 health-specific purchasing power parity conversion)		
Per capita hospital expenditures, 2012, mean (SD), US $	4537 (9626)	8156 (14 256)
Hospital expenditures per hospital day, 2012, mean, US $	945	1735

Abbreviations: ED, emergency department; ICU, intensive care unit.

[a] In the United States, 26.8% of patients died in acute care hospitals or skilled nursing facilities.

ARTICLE INFORMATION

Author Affiliations: Department of Radiation Oncology, Perelman School of Medicine at the University of Pennsylvania, Philadelphia (Bekelman); Department of Medical Ethics and Health Policy, Perelman School of Medicine at the University of Pennsylvania, Philadelphia (Bekelman, Halpern, Ulrich, Emanuel); Department of Medicine, Perelman School of Medicine at the University of Pennsylvania, Philadelphia (Halpern); Department of Biostatistics and Epidemiology, Perelman School of Medicine at the University of Pennsylvania, Philadelphia (Halpern); Hamburg Center for Health Economics, University of Hamburg, Hamburg, Germany (Blankart, Kwietniewski, Schreyögg); Center for Gerontology and Health Care Research, School of Public Health, Brown University, Providence, Rhode Island (Blankart); Center for Health Policy Research, Geisel School of Medicine at Dartmouth College, Hanover, New Hampshire (Bynum); End-of-Life Care Research Group, Vrije Universiteit Brussel and Ghent University, Brussels, Belgium (Cohen); Department of Medicine, Sunnybrook Health Sciences Centre, University of Toronto, Toronto, Ontario, Canada (Fowler); Department of Critical Care Medicine, Sunnybrook Health Sciences Centre, University of Toronto, Toronto, Ontario, Canada (Fowler, Wunsch); Department of Cancer Research and Molecular Medicine, Norwegian University of Science and Technology, Trondheim, Norway (Kaasa); Department of Oncology, Oslo University Hospital and University of Oslo, Oslo, Norway (Kaasa); Department of Health Management and Health Economics, University of Oslo, Oslo, Norway (Melberg); Oslo Centre for Biostatistics and Epidemiology, University of Oslo, Oslo, Norway (Melberg); Department of Public and Occupational Health, EMGO Institute for Health and Care Research and Cancer Center Amsterdam, VU University Medical Center, Amsterdam, the Netherlands (Onwuteaka-Philipsen, Oosterveld-Vlug); National End of Life Care Intelligence Network, Public Health England, London (Pring, Verne).

Author Contributions: Drs Bekelman and Emanuel had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.
Study concept and design: Bekelman, Halpern, Blankart, Bynum, Fowler, Kaasa, Melberg, Onwuteaka-Philipsen, Schreyögg, Ulrich, Wunsch, Emanuel.
Acquisition, analysis, or interpretation of data: Bekelman, Blankart, Bynum, Cohen, Fowler, Kwietniewski, Melberg, Onwuteaka-Philipsen, Oosterveld-Vlug, Pring, Schreyögg, Ulrich, Verne, Wunsch, Emanuel.
Drafting of the manuscript: Bekelman, Blankart, Cohen, Fowler, Kwietniewski, Ulrich, Emanuel.
Critical revision of the manuscript for important intellectual content: Bekelman, Halpern, Blankart, Bynum, Cohen, Fowler, Kaasa, Melberg, Onwuteaka-Philipsen, Pring, Schreyögg, Ulrich, Verne, Wunsch, Emanuel.
Statistical analysis: Bekelman, Blankart, Bynum, Cohen, Fowler, Kwietniewski, Melberg, Oosterveld-Vlug, Pring, Verne.
Obtained funding: Cohen, Fowler, Melberg, Onwuteaka-Philipsen, Schreyögg.
Administrative, technical, or material support: Bynum, Fowler, Schreyögg.
Study supervision: Halpern, Cohen, Onwuteaka-Philipsen, Schreyögg, Emanuel.

Conflict of Interest Disclosures: All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Dr Kaasa reports receipt of fees from the Anamorelin Advisory Board (paid to his institution) and majority stock in Eir Solutions. Dr Emanuel reports receipt of speaking fees from numerous companies and organizations and stock ownership in Nuna. No other disclosures were reported.

Funding/Support: This study was partially supported by the Commonwealth Fund and the National Institute on Aging (grant P01-G19783) and National Cancer Institute (grant K07CA163616).

Role of the Funder/Sponsor: The funding agencies did not participate in the design or conduct of the study; in the collection, analysis, or interpretation of the data; in the preparation, review, or approval of the manuscript; or in the decision to submit the manuscript for publication.

Disclaimer: The interpretation and reporting of these data are the sole responsibility of the authors.

Additional Contributions: We acknowledge the following persons and organizations for assistance with project management and analyses: Belgium: Birgit Gielen (InterMutualist Agency) and Harlinde De Schutter (Belgian Cancer Registry); Canada: Therese Stukel, Craig Earle, and Longdi Fu (Institute for Clinical Evaluative Sciences) (Mr Fu performed statistical analyses); England: data used with permission of the Health and Social Care Information Centre; Germany: BARMER GEK; the Netherlands: the Netherland Research Center acknowledges that the Netherlands data are based on the authors' calculations using data files from Statistics Netherlands, which include data of causes of death, and the Hospital Discharge Register (Dutch Hospital Data, Utrecht) linked to the municipal registration (Gemeentelijke Basis Administratie [GBA]), and from the Achmea Health Database; Norway: Anne K. Knutsen, MD, PhD, and Camilla Beck Olsen; United States: Gabrielle Anderson and Harlan Rosen (ICELR project managers), Rebecca Zaha (data analyst). We also acknowledge Michael Mueller, PhD, and Luca Lorenzoni, MSc, of the Organisation for Economic Co-operation and Development for helpful counsel on price conversions between countries. None of the contributors named here were additionally or directly compensated for their work on this study.

REFERENCES

1. Institute of Medicine. *Dying in America: Improving Quality and Honoring Individual Preferences Near the End of Life*. Washington, DC: National Academies Press; 2014.

2. Gruneir A, Mor V, Weitzen S, Truchil R, Teno J, Roy J. Where people die: a multilevel approach to understanding influences on site of death in America. *Med Care Res Rev*. 2007;64(4):351-378.

3. Riley GF, Lubitz JD. Long-term trends in Medicare payments in the last year of life. *Health Serv Res*. 2010;45(2):565-576.

4. Emanuel EJ. Cost savings at the end of life: what do the data show? *JAMA*. 1996;275(24):1907-1914.

5. National Research Council; Institute of Medicine. *US Health in International Perspective: Shorter Lives, Poorer Health*. Washington, DC: National Academies Press; 2013.

6. Marik PE. The cost of inappropriate care at the end of life: implications for an aging population. *Am J Hosp Palliat Care*. 2015;32(7):703-708.

7. Gomes B, Higginson IJ, Calanzani N, et al; PRISMA. Preferences for place of death if faced with advanced cancer: a population survey in England, Flanders, Germany, Italy, the Netherlands, Portugal and Spain. *Ann Oncol*. 2012;23(8):2006-2015.

8. Higginson IJ, Sen-Gupta GJ. Place of care in advanced cancer: a qualitative systematic literature review of patient preferences. *J Palliat Med*. 2000;3(3):287-300.

9. Barnato AE, Anthony DL, Skinner J, Gallagher PM, Fisher ES. Racial and ethnic differences in preferences for end-of-life treatment. *J Gen Intern Med*. 2009;24(6):695-701.

10. Foley KM, Gelband H, eds. *Improving Palliative Care for Cancer*. Washington, DC: National Academies Press; 2001.

11. Wentlandt K, Zimmermann C. Aggressive treatment and palliative care at the end of life. In: Cohen J, Deliens L, eds. *A Public Health Perspective on End-of-Life Care*. New York, NY: Oxford; 2012:73-85.

12. Rosenwax LK, McNamara BA, Murray K, McCabe RJ, Aoun SM, Currow DC. Hospital and emergency department use in the last year of life: a baseline for future modifications to end-of-life care. *Med J Aust*. 2011;194(11):570-573.

13. Cohen J, Houttekier D, Onwuteaka-Philipsen B, et al. Which patients with cancer die at home? a study of six European countries using death certificate data. *J Clin Oncol*. 2010;28(13):2267-2273.

14. Heron M. Deaths: leading causes for 2010. *Natl Vital Stat Rep*. 2013;62(6):1-96.

15. Emanuel EJ, Ash A, Yu W, et al. Managed care, hospice use, site of death, and medical expenditures in the last year of life. *Arch Intern Med*. 2002;162(15):1722-1728.

16. Health and Social Care Information Centre, Office of National Statistics. Cancer data from the Office for National Statistics. http://www.hscic.gov.uk/onscancer. Accessed January 27, 2015.

17. Institute for Clinical Evaluative Sciences. Data dictionary. https://datadictionary.ices.on.ca/Applications/DataDictionary/Default.aspx. Accessed December 26, 2014.

18. Melberg HO, Godager G, Gregersen FA. Hospital expenses towards the end of life. *Tidsskr Nor Laegeforen*. 2013;133(8):841-844.

19. Blankart CR. Does healthcare infrastructure have an impact on delay in diagnosis and survival? *Health Policy*. 2012;105(2-3):128-137.

20. Lammens L, De Spiegelaere M, Deboosere P. *Feasibility Study About the Use of the IMA Data for Health Indicators at Neighborhood Level* [in Dutch]. Brussels, Belgium: Observatory for Health and Wellbeing Brussels–Capital Region; 2009.

21. Morden NE, Chang CH, Jacobson JO, et al. End-of-life care for Medicare beneficiaries with

cancer is highly intensive overall and varies widely. *Health Aff (Millwood)*. 2012;31(4):786-796.

22. Smeets HM, de Wit NJ, Hoes AW. Routine health insurance data for scientific research: potential and limitations of the Agis Health Database. *J Clin Epidemiol*. 2011;64(4):424-430.

23. Berke EM, Smith T, Song Y, Halpern MT, Goodman DC. Cancer care in the United States: identifying end-of-life cohorts. *J Palliat Med*. 2009; 12(2):128-132.

24. Brooks GA, Li L, Sharma DB, et al. Regional variation in spending and survival for older adults with advanced cancer. *J Natl Cancer Inst*. 2013;105 (9):634-642.

25. Earle CC, Landrum MB, Souza JM, Neville BA, Weeks JC, Ayanian JZ. Aggressiveness of cancer care near the end of life: is it a quality-of-care issue? *J Clin Oncol*. 2008;26(23):3860-3866.

26. Goodman DC, Morden NE, Chang C-H, Fisher ES, Wennberg JE. *Trends in Cancer Care Near the End of Life: A Dartmouth Atlas of Health Care Brief*. September 4, 2013. http://www.dartmouthatlas.org /downloads/reports/Cancer_brief_090413.pdf. Accessed October 6, 2014.

27. Murthy S, Wunsch H. Clinical review: international comparisons in critical care—lessons learned. *Crit Care*. 2012;16(2):218.

28. Quentin W, Scheller-Kreinsen D, Blümel M, Geissler A, Busse R. Hospital payment based on diagnosis-related groups differs in Europe and holds lessons for the United States. *Health Aff (Millwood)*. 2013;32(4):713-723.

29. Koechlin F, Konijn P, Lorenzoni L, Schreyer P. *Comparing Hospital and Health Prices and Volumes Internationally: Results of a Eurostat/OECD Project*. OECD Health Working Paper 75. August 26, 2014. http://dx.doi.org/10.1787/5jxznwrj32mp-en. Accessed December 22, 2015.

30. Eddy DM. Comparing benefits and harms: the balance sheet. *JAMA*. 1990;263(18):2493; 2498; 2501.

31. Center MM, Jemal A, Lortet-Tieulent J, et al. International variation in prostate cancer incidence and mortality rates. *Eur Urol*. 2012;61(6):1079-1092.

32. Teno JM, Gozalo PL, Bynum JP, et al. Change in end-of-life care for Medicare beneficiaries: site of death, place of care, and health care transitions in 2000, 2005, and 2009. *JAMA*. 2013;309(5):470-477.

33. Flory J, Yinong YX, Gurol I, Levinsky N, Ash A, Emanuel E. Place of death: US trends since 1980. *Health Aff (Millwood)*. 2004;23(3):194-200.

34. Evans N, Costantini M, Pasman HR, et al; EURO IMPACT. End-of-life communication: a retrospective survey of representative general practitioner networks in four countries. *J Pain Symptom Manage*. 2014;47(3):604-619.

35. Fields M, Cassel C. *Approaching Death: Improving Care at the End of Life*. Washington, DC: National Academies Press; 1997.

36. De Roo ML, Leemans K, Claessen SJ, et al; EURO IMPACT. Quality indicators for palliative care: update of a systematic review. *J Pain Symptom Manage*. 2013;46(4):556-572.

37. National Hospice and Palliative Care Organization. *Hospice Care in America*. 2012 ed. http://www.nhpco.org/sites/default/files/public /Statistics_Research/2012_Facts_Figures.pdf. Accessed December 22, 2015.

38. Emanuel EJ. A review of the ethical and legal aspects of terminating medical care. *Am J Med*. 1988;84(2):291-301.

39. Scheller-Kreinsen D, Quentin W, Busse R. DRG-based hospital payment systems and technological innovation in 12 European countries. *Value Health*. 2011;14(8):1166-1172.