

# **Influence of Hospice Use on Hospital Inpatient Mortality: A State-Level Analysis**

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## Abstract

**Objective:** To test the hypothesis that higher hospice use is associated with lower hospital inpatient mortality.

**Setting:** United States in 2000, with the state as a unit of analysis.

**Method:** Retrospective multiple regression analysis of cross-sectional data collected from the 50 states and the District of Columbia.

**Measurements:** Inpatient mortality per 1,000 65+ individuals as determined by hospice population per 1,000 65+ individuals, and with controls for supply of hospital beds, number of medical specialists per 100,000 general population, percent of population 65 years of age or older, HMO penetration rate, overall death rate in the general population, and percent of Black or African American population.

**Results:** A statistically significant relationship is found between hospice patients per 1,000 65+ individuals and inpatient mortality rate per 1,000 65+ individuals. Specifically, an increase in hospice population by 100 individuals is associated with a reduction of 23 inpatient deaths in a state, *ceteris paribus*.

## **Influence of Hospice Use on Hospital Inpatient Mortality: A State-Level Analysis**

### **Introduction**

In recent years, Internet-based hospital quality rating web sites have gained increased attention. Some of these sites, such as the one maintained by the nonprofit Leapfrog Group for Patient Safety (<http://www.leapfroggroup.org>), provide process-based hospital quality information for a large number of participating community hospitals that have agreed to comply with a set of predetermined quality improvement guidelines and data disclosure requirements. Other sites base their rating primarily on risk-adjusted outcome measurements such as inpatient mortality rates for major hospital services. Typically, these sites utilize risk-adjustment tools that concentrate primarily upon a variety of demographic and severity of illness factors with minimal recognition of the external market forces that can also influence the clinical outcomes of a hospital. The lack of attention to these external forces can seriously bias the accuracy of the rating data.

This study investigates the influence of these external market forces, with a focus on the use of hospice care, on hospital mortality rates among the 50 states and the District of Columbia. Furthermore, the study tests the hypothesis that higher hospice use is associated with lower hospital inpatient mortality using retrospective multiple regression analysis and cross-sectional data for 2000. This relationship, if confirmed, questions the validity of outcome-based quality rating

data that fail to encompass the factors representing the external market environment in which the rated hospitals operate.

## **Background**

Patient safety and the reduction of medical errors have received national attention in recent years. The origin of this patient safety movement can be traced to the publication of a two-article series in the *New England Journal of Medicine* based on the results of the Harvard Medical Practice Study on the incidence and nature of hospital adverse events (Brennan et al. 1991; Leape et al. 1991). The subsequent Institute of Medicine landmark study, *To Err is Human: Building a Safer Health System* (IOM 1999), documented the extent of unnecessary deaths and injuries caused by preventable human and systemic errors, and made patient safety a national health care priority.

Public awareness and interest in patient safety issues were also intensified by the establishment of research institutions such as the Institute of Health Care Improvement (IHI), a Boston-based patient safety and quality improvement research institute. Under the leadership of Dr. Donald Berwick of Harvard Medical School, the IHI has become a leader in promoting aggressive reforms to save lives and improve clinical outcomes by reducing medical errors.

Another concurrent force propelling the current patient safety movement is the phenomenal growth of Internet use by consumers and purchasers of healthcare for evaluation and selection of healthcare providers, as noted by the IHI report *Move Your Dot: Measuring, Evaluating, and Reducing Hospital Mortality*

*Rates* (2003). For example, Healthgrades.com, an on-line for-profit provider of health quality information, provides mortality-based quality rating information for hospitals, nursing homes, and physicians in the 50 states and the District of Columbia. Healthgrades.com uses a risk-adjustment methodology to account for differences in patient demographics and clinical risk factors such as age, sex, specific procedures performed, and co-morbid conditions. However, its hospital rating methodology pays little attention to the external business and regulatory forces that have been shown to have significant effects on the clinical outcomes of hospitals. One such external factor overlooked is the availability and prevalence of use of hospice care.

### **Hospice Use and Hospital Mortality**

Medicare defines hospice care as "... a special way of caring for people who are terminally ill, and for their families. This care includes physical care and counseling. Hospice care is given by a public agency or private company approved by Medicare. It is for all age groups, including children, adults, and the elderly during their final stages of life. The goal of hospice is to care for the patients and their families, not to cure their illnesses." (Center for Medicare and Medicaid Services, available at: <http://www.cms.hhs.gov/providers/hospiceps/>)

Studies have shown that hospice use is a predictor of place of death for individuals. Miller, Gozalo and Mor (2001) analyzed a retrospective cohort of Medicare beneficiaries in five states including 9,202 nursing home residents, who enrolled in hospice between 1992 and 1996 and who died before 1998, and

27,500 non-hospice residents meeting similar inclusion criteria. These researchers found that Medicare decedents who were hospice residents had a lower rate of hospitalization in the last 30 days of life than non-hospice residents. Pritchard et al. (1998), Emanuel et al. (2002) and Weitzen et al. (2003) noted the influence of hospice use on the place of death of individuals when using data from selected states or regions in the United States. Studies have also shown that hospice use varies greatly among different geographic areas across the U.S., which suggests opportunities exist for potential saving of resources and improvement in the quality of end-of-life care (Virnig et al. 2000; Emanuel et al. 2002; Pyenson et al. 2004).

Subsequent national studies sponsored by the Robert Wood Johnson Foundation, the IHI, the Hastings Center, the Center to Advance Palliative Care, and the Milbank Fund have identified at an organizational level that comprehensive palliative care provided in conjunction with a hospice program can reduce hospital lengths of stay for high-risk patients, reduce the overall cost of care per patient, identify and refer patients earlier to palliative care and/or hospice care, improve the quality of end-of-life care, and reduce the number of inpatient acute care deaths. Among the programs highlighted in these national studies for implementing successful (from a quality and an economic perspective) palliative care and hospice programs are: Virginia Commonwealth University Medical Center, Hospice of the Bluegrass (in conjunction with the University of Kentucky Markey Cancer Center, Central Baptist Hospital and St. Joseph Hospital), University of

Pittsburgh Medical Center - Presbyterian Hospital, Beth Israel Medical Center, Northwestern Memorial Hospital, and Mt. Carmel Health System.

To date, however, no national studies exist to determine whether greater use of hospice care is associated with lower inpatient mortality rates for the country as a whole. This association, if confirmed, suggests that the currently available hospital rating data based on mortality rates are biased against states with low hospice use because the rating methodology fails to take into account a significant factor that can distort the true quality rating – the availability and use of end-of-life care services such as hospice and palliative care.

## Method and Data

*The Empirical Model.* A simple multiple regression model of hospital inpatient mortality in the present context may be specified as:

$$\text{Mortality}_i = \beta_0 + \beta_1 \text{Hospice}_i + \beta_2 X_i + \beta_3 Y_i + u_i \quad i = 1, 2, 3, \dots, 51$$

where,

$\text{Mortality}_i =$  Number of deaths of Medicare enrollees in the  $i$ th state per 1,000 65+ individuals

$\text{Hospice}_i =$  Hospice enrollment in the  $i$ th state per 1,000 65+ individuals

$X_i =$  A vector of social demographic variables that influence hospital inpatient mortality

$Y_i =$  A vector of variables that influence and define the structure of the health care delivery system in the  $i$ th state

$u_i =$  the residual (or error) term assumed to be normally distributed with a constant variance

$i =$  the  $i$ th observation.

*Data Used.* We calculated the data for the dependent variable, Medicare deaths per 1,000 individuals 65 years of age or older, using a combination of CMS mortality data for 2000 and population estimates from Census 2000. The data for the key independent variable, Hospice patients per 1,000 individuals 65 years of age or older, came from a CMS report titled, *CMS Medicare-Hospice Patients by State, Calendar Year 2000*, downloaded from the CMS website (<http://www.cms.hhs.gov/statistics/feeforservice/HospiceUtil00.pdf>).

*Preliminary Analysis of Data.* Chart 1 presents a scatterplot of Medicare inpatient mortality rates and hospice enrollment data for the 50 states and the District of Columbia for 2000. A visual examination of the Chart suggests a relationship of association between the dependent variable of Medicare inpatient mortality and the key independent variable of hospice enrollment. It is also interesting to note that three Western states, Arizona, Colorado, and Oregon, lie in the extreme southeast quadrant of the Chart signifying high levels of hospice enrollment and low rates of Medicare inpatient mortality in these states. Maine and several other states, on the other hand, have extremely low levels of hospice enrollment and high rates of Medicare inpatient mortality. Oklahoma and Hawaii are contrarians, with Oklahoma having a considerably high level of Medicare inpatient morbidity despite its high level of hospice enrollment and with Hawaii

having extremely low levels of both hospice enrollment and Medicare inpatient mortality.

*Control Variables.* Additional independent variables are used to control for other confounding factors. These include a set of social demographic variables and several market environment variables. The theoretical justification for supporting the inclusion of these social demographic variables and their data sources are as follows:

*Percentage of Population 65 Years of Age or Older*

- Theory – A higher concentration of older individuals ages 65 and older should be associated with a higher rate of deaths including deaths in hospitals.
- Data source – CMS, Medicare Hospice Patients by State, Calendar Year 2000 (<http://www.cms.hhs.gov/statistics/feeforservice/HospiceUtil00.pdf>)

*Black or African American Population as a Percentage of Total Population*

- Theory – Previous studies have found that African Americans are more likely to die in hospitals than other places such as the decedent's home or a nursing home (Flory et al. 2004; Weitzen et al. 2003; Iwashyna and Chang 2002; Bruera et al. 2003; Greiner, Perera and Ahluqahlia 2003). We thus expect that the percent of African Americans in a state is associated with a higher rate of hospital mortality in that state.
- Data source – U.S. Census Bureau, Census 2000 Summary File 1 (SF 1) 100-Percent Data

*Number of Deaths per 100,000 General Population*

- Theory – It is hypothesized that a higher death rate among the general population is associated with a higher rate of death among the 65 and older group of individuals.
- Data source – The Kaiser Family Foundation, Kaiser State Health Facts - Health Status - Death Rates Per 100,000, 2001  
(<http://www.statehealthfacts.org>)

The variables representing the external market environment include:

*The supply of hospital beds and concentration of specialists*

- Theory – Wennberg and his colleagues have in numerous studies shown that higher rates of utilization of health services are associated with the supply of facilities and specialists , and that the higher rates of utilization of health services are by and large not associated with better clinical outcomes (Wennberg and Cooper, 1999; Wennberg, Fisher, and Skinner 2002). Further, other authors such as Pritchard et al. (1998) and Hansen, Tolle, and Marten (2002) have demonstrated that the supply of hospital beds is associated with a higher risk of in-hospital death. We thus use three variables to control for the supply and hospital beds and the concentration of medical specialists.
  1. Number of ICU Beds per 1,000 General Population
    - Data source – AHA 2002 Hospital Database
  2. Number of Medical/Surgical Beds per 1,000 General Population
    - Data source – Dartmouth Atlas of Health Care, 2004, using CMS Medicare data for 2000

### 3. Number of Medical Specialists per 100,000 General Population

- Data source – U.S. General Accounting Office. Physician Workforce: Physician Supply Increased in Metropolitan and Nonmetropolitan Areas But Geographic Disparities Persisted, GAO-04-124. Washington, D.C.: October 2003.

#### *HMO Penetration Rate*

- Theory – Managed care concentration and the prevalence of HMO practices tend to encourage patients to use lower-cost alternatives to the more expensive inpatient care. For example, Virnig et al. (2001) concluded that rates of hospice use were significantly higher for Medicare managed care enrollees than for fee-for-service enrollees.
- Data source – The Kaiser Family Foundation, Kaiser State Health Facts – Managed Care and Health Insurance – HMO Penetration Rate, 2004 (<http://www.statehealthfacts.org>).

## **The Results**

*Descriptive Statistics.* Descriptive statistics such as the mean, standard deviation, and maximum and minimum values of the variables are presented in Table 1. There appears to be substantial variation in the dependent and independent variables. For example, the dependent variable ranges in value from 5.91 Medicare inpatient deaths per 1,000 of individuals 65 years of age or older to 23.98, with a standard deviation of 3.69. Geographically, many Western states, such as Arizona, Colorado, Oregon, Hawaii, California, New Mexico, and Washington, have relatively low levels of Medicare inpatient deaths. In contrast,

most of the states in the South have relatively high levels of Medicare inpatient mortality.

There is also wide variation in the independent variables among the 50 states and the District of Columbia. For example, the key independent variable, hospice enrollment, ranges from 5.64 per 1,000 individuals 65 years of age or older (Maine) to 23.97 (Arizona), with a mean of 14.31 and standard deviation of 4.07. Similar patterns of variation are found for other independent variables as well. For example, the supply of ICU beds varies substantially in our data. With 81 ICU beds per 100,000 general population, Washington, D.C. has the highest concentration of ICU beds while New Mexico has the lowest concentration with only 19 ICU beds per 100,000 general population. The (death) Death rate per 100,000 population (ratio) is particularly interesting. Hawaii has the lowest death rate, with 653 deaths per 100,000 population, while Washington, D.C., Mississippi, and Louisiana have the highest rates at, respectively, 1,039, 1,024, and 1,007 deaths per 100,000 general population. New England and most Western states have lower than average death rates while the South tends to have above-average death rates.

The normality assumption for the dependent variable is examined graphically by a histogram of the dependent variable as shown in Figure 2. The dependent variable appears to be normally distributed and hence the data are not transformed into logarithms or squared roots as is the usual practice when the normality assumption is violated.

*Regression Results.* Three models of regression analysis are presented in Table 2. Model 1 has all eight of the independent variables for which data have been collected while Models 2 and 3 exclude some of the select independent variables that are found to be statistically insignificant in Model 1. All three of the regression models have satisfactory goodness of fit as evidenced by the high adjusted  $R^2$  values and statistically significant F statistics. Figure 3 presents the normal probability plot (NPP) of the regression residuals from Model 1 to provide a visual check of the normality assumption of the residual term,  $u_i$ . The NPP appears to approximate a straight line suggesting normally distributed residuals. We also plotted the regression residuals from Model 1 against the predicted values of the dependent variable to see if the variance of the residuals is constant. The residual plot presented in Figure 4 for this purpose does not seem to exhibit a discernable systematic pattern of relationship between the regression residuals and the dependent variable thus suggesting constant variance of the residuals and absence of heteroscedasticity in the data.

In Model 1, all of the eight independent variables thought to have a significant impact on the dependent variable have the expected signs. However, only five of the eight independent variables are statistically significant; three independent variables, percent of African American population in the state, percent of population 65 years of age or older, and medical Specialists per 100,000 population, are not statistically significant. They were found to be significantly correlated with the independent variable ICU beds per 1,000 population and were dropped from the regression, one at a time, to determine which of the three could

be dropped without a substantial loss of explanatory power of the resulting estimation equation. Model 2 presents the results without the independent variable Specialists per 100,000 population while Model 3 presents the results with both the “Specialists” and the “Percent of population 65+ years of age” variables dropped from the regression.

*The Marginal Effect of Hospice Enrollment.* The key independent variable, “Hospice Patients per 1,000 65+ People,” is statistically significant at the 1% level in all three regressions models. The regression coefficient of this variable, which reflects the impact on the dependent variable of a one-unit change of the independent variable, varies little across the three models and ranges in value from -0.23 to -0.24. This suggests that other things being equal, an increase in hospice enrollment in a state by 100 patients is associated with a reduction of inpatient mortality by about 23 to 24 deaths – a significant reduction in hospital inpatient mortality.

*The Elasticity of Hospice Enrollment.* The marginal effect of hospice enrollment on Medicare inpatient mortality calculated above applies to the sample as a whole. To extend this average measure of relationship to each of the individual states, we now calculate the elasticities of Medicare mortality with respect to hospice enrollment for the individual states.

This measure of elasticity, similar to the familiar concept of the price elasticity of demand in business economics, computes the percentage change in the dependent variable associated with a one-percent change in the value of the independent variable for a particular state. This value varies from state to state

depending upon each state's own Medicare inpatient mortality and hospice enrollment. The results of elasticity estimates are presented in descending magnitude in Table 3.

Again, most Western states such as Arizona, Colorado, and Oregon have larger absolute values of elasticity while most of the Southern states have lower absolute values. For example, Arizona's elasticity is estimated to be -0.93 suggesting that a 1 percent increase in hospice enrollment, other things being equal, is associated with a 0.93 percent of reduction in Medicare mortality rate in that state – an almost one-for-one reduction! In Maine, in contrast, a one-percent increase in hospice enrollment is likely to bring about only 0.08 of a percentage point of reduction in Medicare mortality. In general, states with a high level of hospice use relative to their own Medicare mortality rate tend to have elastic Medicare mortality while the opposite is true for states with a low level of hospice enrollment relative to their Medicare inpatient mortality.

## **Conclusion**

This study investigates the impact of hospice use on Medicare inpatient mortality at the state level. The purpose is to test the hypothesis that high hospice enrollment is associated with lower Medicare inpatient mortality rate. The empirical results show that Medicare mortality can be explained by hospice enrollment and a host of demographic and market environment variables such as the supply of ICU beds, HMO penetration rate, and the percent of population who are 65 years of age or older. Most significantly, hospice enrollment is found to

have a significant impact on the Medicare inpatient mortality rate. At the very least, our results suggest that the mortality-based quality data such as those provided by “Healthgrades.com” may be over estimated for states with low hospice enrollment. This is because they fail to take into account the regional differences in the structure of health care delivery system such as the supply of hospice beds and the rate of utilization of palliative care and hospice. When combined with the observation that hospice utilization varies significantly across the 50 states and the District of Columbia, our results further suggest that opportunities exist for greater expansion of hospice capacity in low utilization states to reduce deaths in the expensive hospital setting and improve the quality of end-of-life care for terminally ill patients.

## Tables

Table 1 - Descriptive Statistics of Variables

Variables	Mean	S. D.	Minimum	Maximum
<u>Dependent Variable:</u>				
No. of Medicare Deaths per 1,000 65+ People	13.92	3.69	5.91	23.58
<u>Independent Variables:</u>				
Hospice Patients per 1,000 65+ People	14.31	4.07	5.64	23.97
ICU Beds per 1,000 People	0.31	0.10	0.19	0.81
% Population 65 Years of Age or Older	0.13	0.03	0.06	0.25
Death Rate per 100,000 People	859	82	653	1,039
Medical/Surgical Beds per 1,000 People	3.16	1.02	1.90	6.00
% African American People	0.11	0.12	0.003	0.60
HMO Penetration Rate	0.18	0.11	0.00	0.48
Specialists per 100,000 People	178	43	116	373

Table 2 - Regression Results

Independent Variables	Model 1			Model 2			Model 3		
	Coefficient	t Stat		Coefficient	t Stat		Coefficient	t Stat	
Intercept	-9.1021	-1.7920	*	-8.3737	0.0787	*	-7.4259	0.0980	*
Hospice per 1000 +65 Population	-0.2287	-2.5527	***	-0.2421	0.0047	***	-0.2278	0.0054	***
ICU Beds/1000 Pop	-17.2288	-3.5459	***	-16.7768	0.0008	***	-15.9351	0.0009	***
Death Rate/100,000	0.0303	5.4541	***	0.0300	0.0000	***	0.0294	0.0000	***
Med/Surg Beds/1000	1.4258	3.0223	***	1.4754	0.0020	***	1.5164	0.0013	***
HMO Penetration 2003	-5.8274	-1.7605	*	-5.3523	0.0843	*	-5.0080	0.0982	*
% Black or AA	3.4551	0.8633		3.8954	0.3097		3.5043	0.3511	
% Population +65 Yrs	8.1708	0.6524		8.1738	0.5133				
Specialists/100,000	0.0039	0.3763							
N	51			51			51		
Adjusted R <sup>2</sup>	0.70			0.70			0.71		
F Statistics	15.25			17.76			20.92		
P-value	0.0000			0.0000			0.0000		

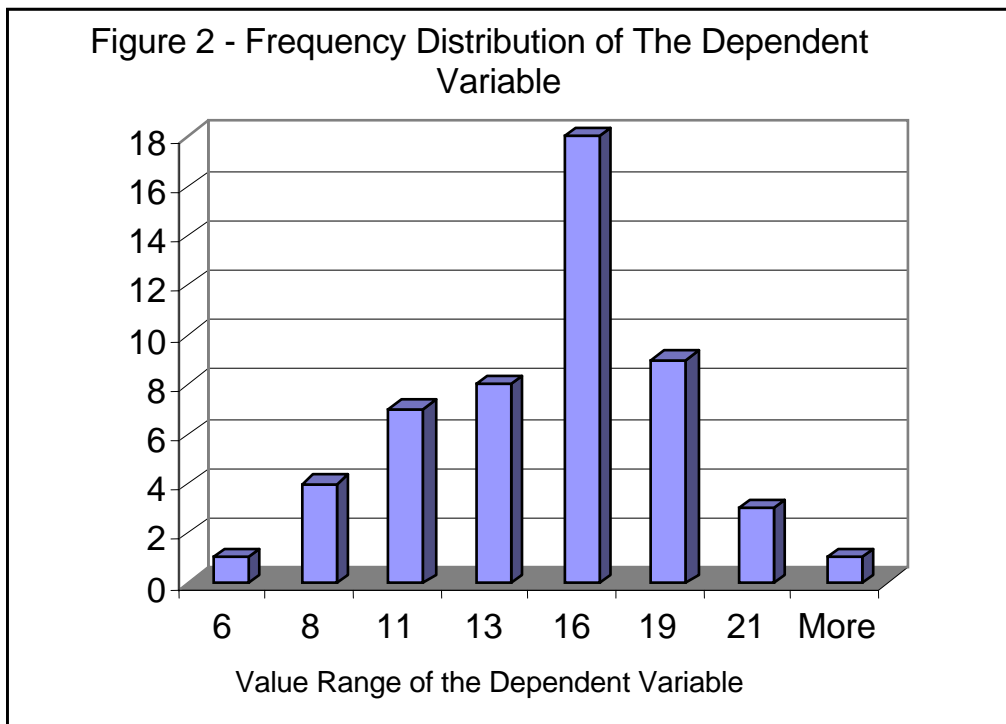
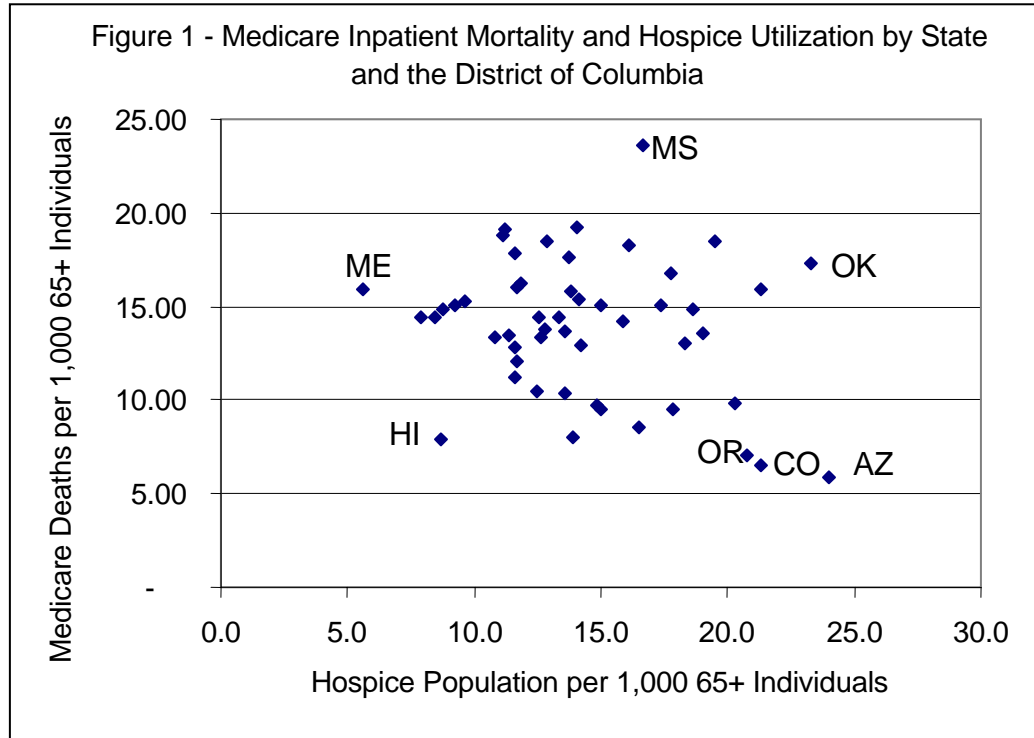
The symbols \*\*\*, \*\*, and \* denote statistical significance at the 1%, 5%, and 10% levels, respectively.

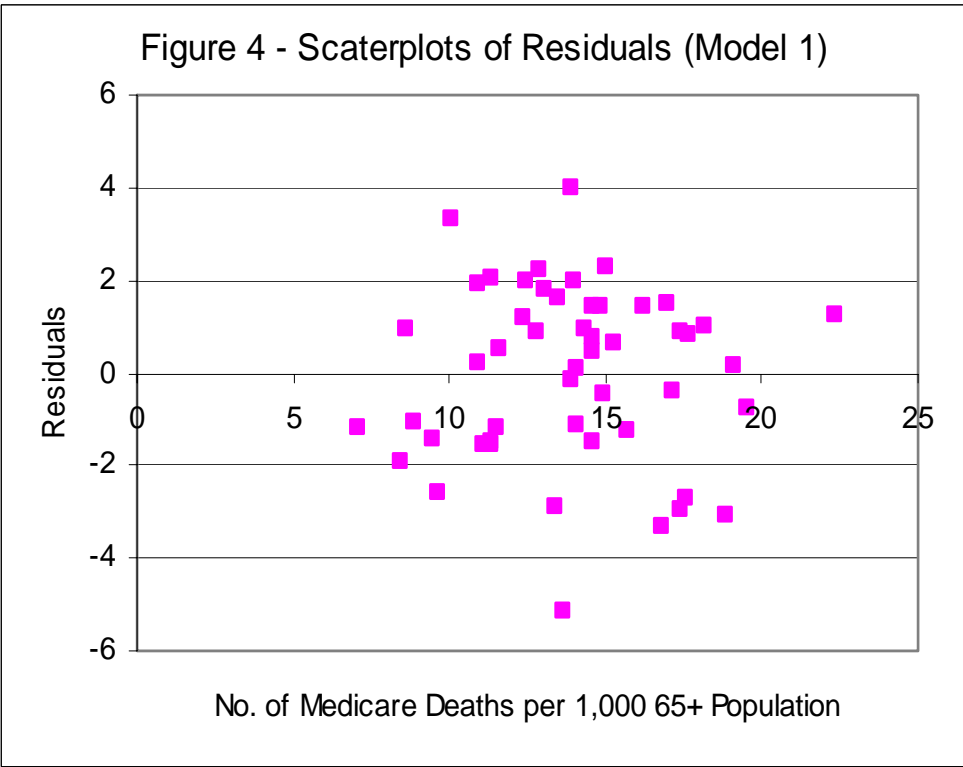
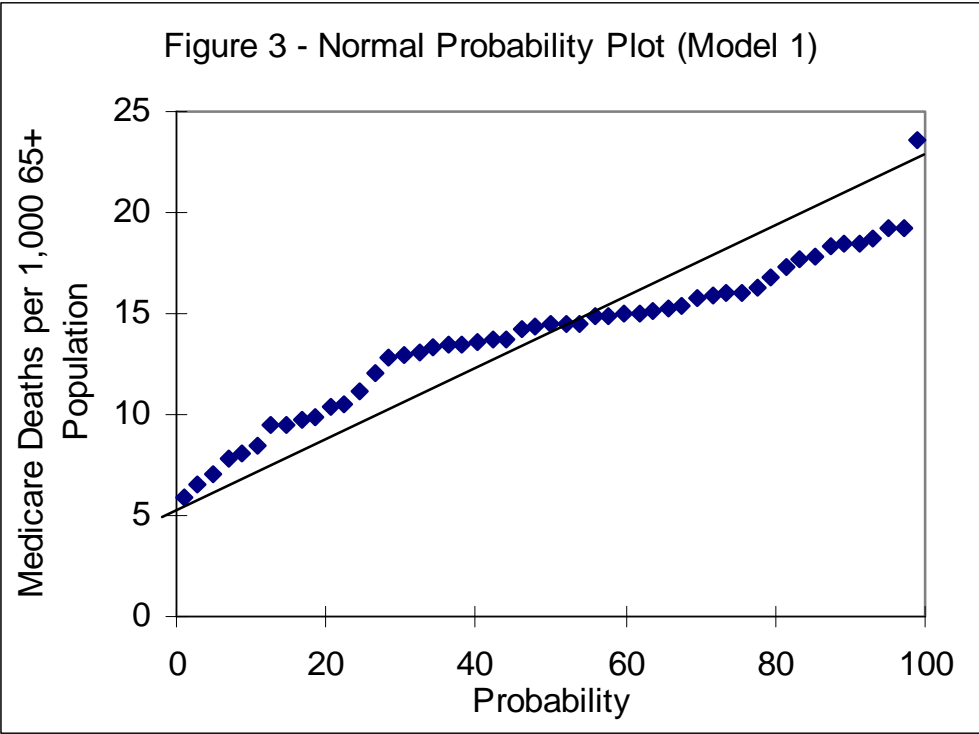
Table 3 - Elasticity Estimates of the Effect of Hospice Use on Medicare Inpatient Deaths

State	No. of Medicare Deaths per 1,000 65+ People	Hospice per 1,000 65+ People	Elasticity
AZ	5.91	23.97	-0.93
CO	6.57	21.34	-0.74
OR	7.03	20.77	-0.68
FL	9.82	20.30	-0.47
NV	8.52	16.49	-0.44
NM	9.54	17.81	-0.43
CA	8.02	13.86	-0.40
UT	9.53	15.03	-0.36
WA	9.74	14.84	-0.35
OH	13.07	18.31	-0.32
TX	13.59	18.99	-0.32
OK	17.27	23.30	-0.31
IN	15.97	21.34	-0.31
MN	10.35	13.55	-0.30
MI	14.82	18.66	-0.29
ID	10.47	12.51	-0.27
MO	15.03	17.35	-0.26
IL	14.18	15.86	-0.26
HI	7.86	8.70	-0.25
PA	12.97	14.23	-0.25
GA	16.80	17.78	-0.24
AL	18.45	19.47	-0.24
RI	11.19	11.60	-0.24
IA	15.06	15.02	-0.23
AK	13.72	13.57	-0.23
MA	12.08	11.65	-0.22
WI	13.40	12.60	-0.21
MD	13.77	12.79	-0.21
NE	14.45	13.34	-0.21

DE	15.39	14.15	-0.21
CT	12.79	11.60	-0.21
KY	18.28	16.13	-0.20
LA	15.81	13.85	-0.20
ND	14.39	12.57	-0.20
MT	13.45	11.37	-0.19
NH	13.39	10.78	-0.18
NC	17.66	13.71	-0.18
AR	19.25	14.07	-0.17
VA	16.28	11.86	-0.17
KS	16.04	11.69	-0.17
MS	23.58	16.62	-0.16
SC	18.52	12.86	-0.16
NJ	17.85	11.64	-0.15
VT	15.24	9.65	-0.14
NY	15.10	9.24	-0.14
WV	18.77	11.14	-0.14
DC	14.86	8.72	-0.13
TN	19.18	11.18	-0.13
SD	14.46	8.43	-0.13
WY	14.43	7.86	-0.12
ME	15.89	5.64	-0.08
Mean	13.92	14.31	-0.27
Standard Deviation	3.72	4.11	0.16

**Figures**





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