

**Returns to Local-Area Healthcare Spending:  
Using Health Shocks to Patients Far From Home**

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Abstract

Healthcare spending varies widely across markets, and previous empirical studies find little evidence that higher spending translates into better health outcomes, possibly due to endogeneity bias. The main innovation in this paper compares outcomes of patients who are exposed to different healthcare systems not designed for them: patients who are far from home when a health emergency strikes. Visitors to Florida who become ill in high-spending areas have significantly lower mortality rates compared to visitors in lower-spending areas. The results are robust within groups of similar visitors and within groups of destinations that appear to be close demand substitutes—areas that likely attract similar visitors.

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## 1. Introduction

Healthcare spending is a major concern in the U.S., amounting to over \$2 trillion per year or 16% of GDP (Catlin et al., 2007). These figures are expected to increase with the aging of the population and are likely to strain government budgets and limit private-sector profitability (Lee and Skinner, 1999).

There is some debate over the returns to healthcare spending. When countries or regions within the U.S. are compared, large disparities in spending are found yet health outcomes are remarkably similar.<sup>1</sup> Fisher et al. (2003) studied Medicare expenditure data and found a 60% difference between high- and low-spending areas in the U.S. Nevertheless, no mortality difference was found following a health event such as a heart attack or hip fracture. This evidence has been cited in support of reducing Medicare spending by 20-30% without adversely affecting health outcomes (Fisher, Bynum and Skinner, 2009). In contrast, instrumental-variable and panel-data evidence suggests that higher spending is associated with significantly lower mortality.<sup>2</sup>

One issue that arises with cross-country or cross-region comparisons is that greater treatment levels may be chosen for populations in worse health. For example, higher spending is strongly associated with higher mortality rates at the individual level, as more is spent on patients with greater health problems. At the regional level, summary measures of treatment intensity may reflect the underlying health of the population as well.

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<sup>1</sup> This is a large literature. See, for example, Fisher et al., 1994; Pilote et al., 1995; Kessler and McClellan, 1996; Tu et al., 1997; O'Connor et al., 1999; Baicker and Chandra, 2004; Fuchs, 2004; Stukel, Lucas, and Wennberg, 2005; Sirovich et al., 2006; Garber and Skinner, 2008.

<sup>2</sup> For example, see McClellan, McNeil and Newhouse 1994; Stukel et al., 2007; Cutler 2007; Stukel, Lucas and Wennberg, 2005; Chandra and Staiger, 2007; McClellan and Newhouse, 1997; Cutler, McClellan, Newhouse, and Remler, 1998,; Cutler and McClellan, 2001; Murphy and Topel, 2003; Nordhaus, 2005; Cutler, Rosen and Vijan, 2006; Luce et al., 2006; and Hall and Jones, 2007.

The main innovation in this paper exploits the large cross-sectional variation in spending intensity in a new way by comparing patients who are exposed to different healthcare systems that were not designed for them: patients who are far from home when a health emergency strikes. These visitors may have an emergency in an area that spends a great deal on patients or one that tends to spend less. To the extent that the health shocks are unanticipated, patients are unlikely to choose the destination based on the healthcare intensity in the area. Further, by comparing close demand substitutes in terms of destinations, it may be possible to compare “close substitutes” in terms of patients. As a result, geographic variation in spending practices may be considered plausibly exogenous for this group of patients, and a comparison of health outcomes for similar visitors across these locations can shed light on the returns to healthcare spending, at least in emergency situations.<sup>3</sup>

The analysis uses the universe of hospital discharges in the state of Florida—one of the most frequently visited states that provides detailed patient characteristics. The results show that patients who have a health emergency in high-spending areas have significantly lower inpatient mortality rates compared to those visiting low-spending areas. The results are less informative with regard to the mechanisms of the decrease in mortality. Suggestive evidence shows that high-spending areas offer a bundle of services, most notably a greater reliance on intensive-care-unit services and a higher likelihood of treatment in a teaching hospital.

Of course, visitors are not randomly assigned to destinations. If relatively healthy individuals were to choose high-spending areas, or if high-spending areas tend to admit relatively

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<sup>3</sup> Previous papers considered variation in healthcare inputs due to the distance of patients to services (McClellan, McNeil, and Newhouse 1994; Gowrisankaran and Town 1999; Stukel et al., 2007, Cutler, 2007). This paper also considers patients who use the nearest healthcare system, although the starting point is more likely to be exogenous as the healthcare system is less likely to be designed for visitors. Further, the healthcare market is considered rather than individual hospitals, as the market is also more likely to be exogenous than the particular hospital chosen by a patient or emergency medical services. Results at the hospital level will be shown as well.

healthy visitors into the hospital, then the results would reflect these differences. Much of the results section demonstrates that the estimates are robust within groups of similar patients and that selection into the hospital is unlikely to drive the results.

The outline of the paper is as follows. Section 2 presents the empirical framework. Section 3 describes the data, including a comparison of high- and low-spending areas in terms of patient characteristics. Section 4 presents the main estimates of the relationship between inpatient mortality and local-area healthcare spending. The analysis focuses on heart conditions, although results for other common emergencies are reported as well. Section 5 interprets the results by considering how treatment in local areas that spend more differs from treatment provided in less costly areas. Section 6 concludes.

## **2. Empirical Framework**

A large literature documents the remarkable geographic variation in healthcare spending, as well as relatively similar health outcomes for patients who experience a health problem such as a heart attack. The main estimating equation for such an analysis for patient  $i$  treated in geographic area  $g(i)$  is:

$$(1) M_i = \beta_0 + \beta_1 T_{g(i)} + \beta_2 X_i + \varepsilon_i$$

where  $M$  represents mortality,  $T$  represents a measure of treatment intensity in the area, and  $X$  includes controls for individual characteristics such as age, race, sex, and diagnoses.

End-of-life spending, such as average expenditures in the area for patients' last hospital stays, is a commonly used proxy for treatment intensity in an area (Fisher et al., 2003). For patient  $i$  treated in geographic area  $g(i)$ , the proxy is defined by taking an expectation at the area level:

$$(2) T_{g(i)} = E(T|M = 1)$$

The aim of the measure is to compare similar patients, as they are all close to death. In the data used below, area rankings of treatment intensity are similar regardless of whether or not they are restricted to end-of-life care. This suggests that end-of-life spending is informative of intensity in general, but also calls into question whether the spending measure is unrelated to treatment decisions for those not close to death.

The source of the geographic variation is less well known. Observable patient characteristics do not appear to be related to area spending levels (Pilote et al. 1995; O'Connor et al., 1999; Phelps, 2000; Stukel, Fisher et al., 2003; Lucas, and Wennberg, 2005). For example, higher-spending areas are not wealthier areas, although they do tend to be more urban. A remaining question is whether geographic variation in spending is associated with the unobserved health characteristics. Empirically, patients who receive higher treatment levels have substantially higher mortality rates, even after controlling for observable patient characteristics. Abstracting from iatrogenic effects, this implies that additional care is provided to patients in worse health. When the treatment measure is aggregated, areas with patients in worse health may spend more on patients, which would bias the estimate of  $\beta_1$  upward.<sup>4</sup> In contrast, areas that provide greater treatment intensity may admit more patients to the hospital, resulting in healthier patients at the margin and a downward bias.

Previous work highlights provider preferences as the remaining explanation (for summaries, see Gold (2004) and Congressional Budget Office (2008). Greater capacity for care

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<sup>4</sup> Note, for example, that if the true model at the individual level were  $M_i = \alpha_0 + \alpha_1 T_i + \omega_i$ , then taking expectations at the geographic area level:  $E(M|M = 1) = 1 = \alpha_0 + \alpha_1 E(T|M = 1) + E(\omega|M = 1)$ . If  $\alpha_1 < 0$ , then the area-level proxy for spending,  $T_g = E(T|M = 1)$ , is directly related to unobserved illness severity of patients who died in the area. If individuals within a geographic area are similar to one another, then  $T_g$  would be related to unobserved characteristics of other local patients as well.

has been shown to be associated with greater usage, although capacity may be a result of the interaction of both supply and demand factors.

This paper attempts to circumvent these concerns by estimating equation (1) for a group of visitors. Visitors are unlikely to impact the treatment intensity policy and practice in their destinations. In the episodes analyzed below, for example, visitors constitute only 5% of the cases. Further, if the incidents were truly shocks, then healthcare intensity in the area would not enter into the travel decision. This should ameliorate the selection bias caused by greater treatment provided to populations in worse health, as the bias disappears when the treatment level in the area is not associated with a group's gain (Bjorklund and Moffitt, 1987, Heckman, Lalonde, and Smith, 1999). Last, in the extreme of a discrete choice between perfect substitutes, the destination choice may approximate a random assignment, and the treatment intensity of the hospital system in the tourist destinations would be exogenous.

Previous evidence also provides support for the use of visitors as participants in a natural experiment. Visitors with a health shock in an area that tends to spend relatively more on locals should also receive relatively more care compared to visitors in areas that spend less. For example, Fisher et al. (1994) and Stukel, Lucas and Wennberg (2005) demonstrate that treatment intensity in an area tends to be similar across patients in the area. It appears that high-spending areas have a lower short-run marginal cost of providing state-of-the-art treatment following previous investments physical and human capital.

### **3. Data Description**

The patient-level data represent the universe of hospital discharges in the state of Florida from 1996 to 2003. These reports are submitted to the Florida Agency for Healthcare

Administration and are available for research purposes. Florida offers three main advantages: it is a top travel destination state, which allows for large samples of visitors; the state provides detailed discharge data; and there is a great deal of variation in spending across the state. Florida has been noted to have large geographic variation in spending, with especially large spending levels in South Florida (Fuchs, 2003, Skinner and Wennberg, 2003). These differences are attributed to differing attitudes about health and healthcare among patients and providers in ways that are difficult to separate, as well as a smaller influence from HMOs in the area (Bertko, 2003).

Available data elements include the patient's age, race, sex, and ZIP code of residence. Visitors are defined as an out-of-state patient. Procedure and diagnosis codes, primary payer, day of the week, and quarter of the year also describe the episode. To focus on health shocks rather than planned travel for healthcare, the analysis is restricted to patients who are admitted into the hospital from the emergency room with an admission type of "emergency". Hospital markets are defined at the level of the Health Service Area (HSA), defined by the *Dartmouth Atlas of Healthcare*. These areas typically encompass one or two hospitals whose acute-care patients come from similar ZIP codes: areas that appear appropriate for the health shocks employed here.

The main measure of resource use is total costs reported in the discharge summary, which is the sum of the list prices for each of the services provided deflated by a cost-to-charge ratio calculated by the Centers for Medicare and Medicaid at the hospital-year level.<sup>5</sup>

The end-of-life spending measure was calculated as the mean of log costs in the HSA among patients from Florida who were admitted on an emergency basis and who died in the hospital. The mean is weighted by the fraction of visitors who visit each hospital in an HSA to

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<sup>5</sup> The results here substitute the median cost-to-charge ratio for outliers as suggested by CMS. In particular, the data are replaced when the cost-to-charge ratio for the hospital is in the top or bottom 2%. Results were not sensitive to outlier definitions. Results are also similar when the raw facility charge measure was used.

reflect the exposure to spending levels across visitors (similar results are found without these weights). Algebraically, this measure is the HSA fixed effect in a model predicting end-of-life log costs for this sample of locals, weighted by each hospital's visitor share in the HSA.

The health outcome available in the discharge data is inpatient mortality: a frequent and important outcome. An advantage of the discharge data compared to previous studies that use Medicare administrative data is that younger patients can be compared, as well as patients enrolled in Medicare HMOs who are generally not included in Medicare expenditure files. In addition, for the visitor group inpatient mortality is tied more directly to the acute care provided by Florida healthcare systems, whereas long-term outcomes may be influenced by the care received once the patient returns home.<sup>6</sup>

U.S. Census data from 2000 are used to describe the patient's ZIP code of residence, including the seven median household income categories, median rent, racial composition, educational composition among individuals older than 25-years old, and the percent rural. One issue is that visitors who are not from the U.S. do not have a ZIP code. In addition, the Census Bureau does not publish data for small ZIP codes due to confidentiality concerns (especially income categories). In total, ZIP code information is missing for 16% of the visitor sample. The main results will retain these observations by filling in the missing information with sample means and including an indicator for missing ZIP code information in the model. Results are similar when these observations are excluded, as shown below. Similar U.S. Census measures for the destination county in Florida are used in some specifications as well.

Prices faced by visitors in particular are used to categorize counties in Florida. These prices come in the form of per-diem rates calculated by the U.S. General Services Administration

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<sup>6</sup> Future work will consider Medicare Inpatient Claims to examine longer-term mortality. Initial estimates suggest similar results for one-year mortality among the Florida visitors considered here.



(GSA) and are based on lodging and meal prices in each county. Given the seasonal variation in these rates, two measures are used: the per diem for January and June.<sup>7</sup> Each measure should reflect local-area cost structures, and the difference in the two measures should identify areas that are desirable for winter vacations. Results will be reported with and without these controls.

The 1995 American Travel Survey describes visitors to each of 13 metropolitan areas. These data are used in a specification check that controls for these characteristics on this subset of cities. Last, American Hospital Association data that provide detailed information about each hospital in Florida are used to describe the different areas in terms of staffing ratios.

### *Main Analysis Sample*

The main analysis focuses on common heart-related emergencies: patients who are admitted with a primary diagnosis of acute myocardial infarction (AMI), cardiac dysrhythmias, or heart failure.<sup>8</sup> These are among the top-10 diagnoses for emergency admissions with a mortality rate over 3%. They hold the potential to represent health shocks where the patient is less likely to investigate the healthcare spending in the area prior to choosing the destination.<sup>9</sup>

The sample is restricted to HSAs with at least 30 visitors with a heart-related emergency, for a total of 97. Further, the analysis uses within-home-state variation in treatment and outcomes, and the sample is limited to visitors from U.S. states with at least five observations or visitors from outside the U.S. The sample includes over 37,000 hospitalizations for patients whose residence is outside the state of Florida, or 5% of heart-related emergency admissions in Florida.

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<sup>7</sup> 1997 is the first year this lodging-rate data are available. 1996 per-diems were computed using a time trend through the 1997-2003 series. Results were similar when only the 1997 per-diem data were used instead.

<sup>8</sup> These are three-digit ICD9-CM primary diagnosis codes of 410, 427, and 428.

<sup>9</sup> Only 0.16% of the AMIs among visitors were the result of a “subsequent episode of care” versus 0.4% among locals, although this is defined by an ICD-9CM code suffix that is generally unrelated to reimbursement and is thought to be unreliable.

## Comparison of Health Service Areas

To describe the data further and compare visitors with local patients who had a heart-related emergency across different areas in Florida, Figures 1-4 and Table 1 demonstrate how high-spending areas differ from low-spending ones.

Figure 1 shows a map of Florida where the 97 HSAs are located, and four quartiles of the end-of-life cost measure are shown. The higher-spending areas are distributed across the state. Perhaps the most striking variation is along the eastern coast, where all four quartiles are represented in popular destination areas.

To investigate whether high-cost healthcare markets are more expensive areas in general that happen to attract wealthier (and healthier) visitors, Figures 2 and 3 consider median income levels of the Florida counties and the visiting patients' ZIP codes. The x-axis in each Figure is the rank of the area in terms of end-of-life spending. The graphs show that while the spending measure increases with its rank, the income measures are not related to it. It does not appear that high-spending areas reflect the income level of residents or travelers.

Figure 4 is similar to Figure 3, but reports the average age of the visitors. Age is relatively unrelated to hospital spending for most of the spending distribution. A noticeable decline in age is seen for the top 17 HSAs, where 30% of the visiting patients are found. These areas are more urban, including HSAs in Miami. This decline in age is an important limitation, as age is a strong predictor of mortality, and it is addressed in three ways. First, the analysis flexibly controls for age with indicators for each year of age. Second, results are shown separately by age group. Third, the results are shown to be robust when patients found in these highest-cost HSAs are excluded from the analysis: a subset of HSAs that is shown to have similar observable characteristics (including age) regardless of the healthcare spending level.

Table 1 reports means of the patient characteristics for both local Floridians and visitors.<sup>10</sup> The HSAs were divided into quartiles based on the end-of-life spending measure: the first row shows that HSAs in the top quartile have mean end-of-life costs that are over 65 log points (or \$7000) greater than the average HSA in the bottom quartile. The next row shows that mortality is lower in the top two quartiles, both among local Floridians and visitors. As shown in Figure 4, part of this decrease is found in the highest-spending HSAs have somewhat lower average ages. The overall mortality rate is similar between the visitors and locals (5.8% vs. 5.7%), which suggests that results for the visitor group may be informative of returns to spending for the local group as well.

As in the previous cross-sectional work, Table 1 shows that patients' observable characteristics are fairly similar regardless of the spending intensity of the area, at least for the bottom three quartiles. The top quartile, which includes Miami, shows greater differences. The best case in favor of using visitors instead of locals to compare relatively similar patients across markets is in terms of race, where approximately 95% of visitors are white across the bottom three quartiles of spending intensity, falling to 75% in the top quartile. Among locals, these percentages fall across the quartiles (from bottom to top they are 91%, 85%, 76%, and 54%). Income levels of the ZIP codes where the locals and the visitors reside are similar, as in the figures described above. Meanwhile, the younger ages of patients in the top quartile lead to lower Medicare coverage rates and somewhat lower rates of comorbidity. These differences motivate investigation of the main results within subgroups of patients, defined by these characteristics.

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<sup>10</sup> Table 1 shows a representative subset of characteristics for ease of display. See Table A1 for a wider set of variables.

Table 1 also shows that locals differ from visitors regardless of the HSA spending level in several ways. Visitors with heart-related emergencies are more likely to be male compared to locals (62% vs. 52%), they are more likely to live in rural areas, and are more likely to be found in the popular travel time of the first quarter of the year.<sup>11</sup>

In terms of the areas, the per-diem rates are higher for the larger urban areas that comprise higher-spending areas. The analysis controls for these lodging prices and also compares results within destinations with similar lodging prices.<sup>12</sup> In addition, the American Travel Survey (ATS) provides summaries of the types of visitors and trips to Florida. While the ATS limits the analysis to 13 metropolitan areas, the evidence suggests that visitors are generally similar across these cities, including the reason for travel and income measures (see Appendix Table A2).<sup>13</sup>

## 4. Results

### 4A. Main Estimates

Following the framework in Section 2, the empirical models consider the outcome of inpatient mortality,  $M_i$ , for patient  $i$  hospitalized in the geographic area (defined by the HSA)  $g$ , within Florida county  $c$ , from ZIP code  $z$  in state  $s$ , in year  $t$  as:

$$(3) M_i = \beta_0 + \beta_1 T_{g(i)} + \beta_2 X_i + \beta_3 W_{z(i)} + \beta_4 P_{c(i)} + \theta_{s(i)} + \delta_{t(i)} + \varepsilon_i$$

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<sup>11</sup> The first quarter may have more visitors who spend the entire winter in Florida. These “snow birds” are considered in more detail below.

<sup>12</sup> Fortunately, healthcare spending varies widely even within destinations with similar lodging and meal prices. When counties were broken into quartiles based on the January per-diem rate, the average, end-of-life log spending from the least to most expensive are 9.9, 9.9, 10.2, and 9.9, with standard deviations of 0.24, 0.23, 0.14, and 0.11, respectively.

<sup>13</sup> Given that each metropolitan area contains multiple HSAs, the spending intensity proxy for this table is calculated at the metropolitan-area level, and the comparison is somewhat different from Table 1. The 2<sup>nd</sup> highest quartile contains cities close to the northern Florida border, and has more visitors coming from the South, which results in somewhat different characteristics than the other quartiles. In terms of patient characteristics along these city-based quartiles, the average age of visiting *patients* across the quartiles used in Table A2 does not monotonically decrease, with average ages across the quartiles (from bottom to top) of 71.3, 72.2, 69.1 and 67.2.

T is the measure of local-area, end-of-life spending in the HSA visited by patient  $i$ , as described above;  $X$  is a vector of personal characteristics listed in Table 1 with indicators for each age, admission day of the week, an indicator that the patient is white interacted with 5-year age categories, and three-digit diagnosis indicators;  $W$  is the set of ZIP code of residence characteristics described above; and  $P$  is the vector of county per-diem rates in January and June.<sup>14</sup> Home-state fixed effects are used to compare individuals from the same state who visit different HSAs in Florida, and year indicators are used to capture overall changes in survival rates over time.<sup>15</sup> The outcome is binary, and the results are shown using a linear probability model to estimate differences in means across HSAs. Results are similar when a probit model is used as shown below. The standard errors are clustered at the HSA level to reflect variation in the local-area spending measure.

The top panel of Table 2 reports results for the local Florida population. The first two columns show results from a model similar to (3), but with costs accrued by a particular patient,  $T_i$ , instead of the local-area treatment measure,  $T_{g(i)}$ . Column (1) reports a coefficient of 0.025. The interquartile range of log costs among the local population is 113 log points. The estimated coefficient suggests that such a difference in costs is associated with a 2.8 percentage-point *increase* in mortality, or nearly 50% of the mean. When the controls are employed, the coefficient decreases to a 0.13 percentage-point increase in mortality. These results are consistent with the hypothesis that more is spent on patients who are in worse health in ways that are not controlled.

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<sup>14</sup> Individual age categories are used, with the exception of wider categories for patients under the age of 20, between 20 and 30, and above 100 years old.

<sup>15</sup> In addition to indicators for each U.S. state, indicators for Canada, the Americas, and “unknown” state of residence, which is used to describe foreign visitors, are included as well. Estimates are similar when patients from outside the U.S. are excluded, as shown below.

When the mean end-of-life spending measure for the HSA,  $T_{g(i)}$ , is used to compare healthcare systems, mortality appears unrelated to the spending level in the HSA among Florida locals. The coefficient on HSA spending intensity ranges from -0.002 to 0.005 with standard errors on the order of 0.004. These results match findings in the prior literature that higher spending is associated with a small, statistically-insignificant differences in mortality.

Panel B shows results using the sample of visitors. The first two columns show nearly identical coefficients as in the Florida sample, which is consistent with providers taking observable factors such as age and comorbidity into account in a similar manner when making treatment decisions, regardless of whether the patient is a visitor or a local. Columns (3)-(6) show that contrary to the previously established result for locals, end-of-life spending is strongly negatively related to mortality, with a coefficient closer to -0.028. A 2 standard deviation increase in spending intensity of roughly 50% is associated with mortality rates that are 1.4 percentage points lower, or 24% lower than the mean.

For context, the estimated coefficients for the control variables are shown in Appendix Table A3. Patients with comorbidities and older patients have higher mortality rates, with 85 year olds having a 4 percentage-point higher mortality rate than 60 year olds, conditional on the other controls. Visitors in the 1st quarter have a one percentage-point lower mortality rate compared visitors at other times of the year. The uninsured have a 1 to 3 percentage-point higher mortality rate compared to insured patients. Meanwhile, the ZIP code characteristics tended not to be related to mortality, most notably the fraction rural—a characteristic that differed between the visitors and locals.

To test the shape of the relationship between local-area costs and mortality, a model that included indicators for the HSA quartiles (described in Table 1) were used rather than the level

of the end-of-life spending measure. The bottom quartile appears to have higher mortality rates, with the second least expensive quartile showing a 0.8 percentage-point lower mortality rate and the top two quartiles each showing a 1.7-1.8 percentage-point reduction in mortality. This suggests that the effectiveness of spending intensity may fade for the most expensive areas, although some caution is warranted in the interpretation given that the top quartile appeared somewhat different from the bottom three in Table 1.<sup>16</sup>

#### **4B. Robustness**

The main results suggest that more expensive healthcare systems do achieve lower inpatient mortality rates among visitors, but alternative explanations include the possibility that high-spending areas attract healthier patients, areas that provide better care for heart-related emergencies happen to be high-spending areas overall but not necessarily for cardiac care, or that high-spending areas admit healthier patients into the hospital. The remaining sets of results consider these explanations by estimating the model within similar groups of patients and within similar groups of destinations—areas that are more likely to attract similar patients; considering a wider set of diagnoses; and providing additional evidence on the potential role of sample selection bias.

#### **Patient Characteristics**

Section 3 makes clear that there are differences among the patients across the areas. To consider whether these differences drive the main results, and begin to investigate heterogeneous treatment effects, Table 3 explores the robustness of the results across subgroups of patients.

Panel A considers the age and location of the patient. The over-65 group is mostly covered by Medicare (with the exception of foreign visitors). The first two columns show that

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<sup>16</sup> These estimates are reported in Appendix Table A5. This result is less robust, however. When markets were defined at the county level, mortality was found to decrease for each of these quartiles.

the results are similar when the group is either older or younger than 65 years old: a 10% increase in end-of-life spending is associated with a 0.36 percentage-point decline in mortality among the 65+ group, or 5.2% of the mean, and such an increase is associated with a 0.19 percentage-point decline in mortality among the younger group available in these hospital discharge data, or 5.8% of its mean.

The next three columns compare the results for patients who are increasingly likely to be business travelers. Business travelers have the advantage of being even less likely to choose the destination based upon its healthcare spending practices. First, the ATS was used to categorize metropolitan areas as business travel destinations. The sample was then divided into two groups based on the median rate of business travel.<sup>17</sup> Column (3) shows that for travelers under the age of 65 in these destinations, the coefficient is similar to under-65 subgroup overall, with a coefficient of -0.023. When privately insured individuals are considered, largely dropping those who qualify for disability claims and thereby not likely to be business travelers, the magnitude of the coefficient increases to -0.034. Last, when the first quarter is dropped—the most popular quarter for leisure travel—the coefficient is again qualitatively similar: -0.032. The sample size decreases from 10,571 for all patients under the age of 65 to 1,841 for the most refined category of patients most likely to be business travelers, yet the estimate increases in magnitude.

One concern is that high spending areas will attract wealthier (and healthier) patients. Panel B shows that the results are similar across ZIP code income levels, and when ZIP code fixed effects are included. Panel C shows that the results are similar regardless of the comorbidity level, as defined by the Charlson severity index that takes on values of 0, 1, and 2

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<sup>17</sup> A trip was categorized as a business trip if the reason for travel was: business, combined business/pleasure, convention, conference, or seminar, or other reason (i.e., not a vacation). The results were robust to the definition of business travel. In areas that were categorized as business destinations, 28% (range: 19-55%) of the trips were for business reasons, compared to 14% in non-business destinations. Among 40-60 year olds, the business-trip rates ranged from and 8% to 17%.



(Quan et al., 2005): a 10% increase in spending intensity is associated with mortality reductions of 5.3%, 5.9%, and 4.7% compared to the mean mortality rates for the three groups, respectively. Results are also shown to be similar across the quarters of the year in Panel D. The results do not appear to be driven by “snow birds” who winter in Florida and may take more care in choosing the destination. Appendix Table AX provides additional evidence of the robustness of the results across patient types, including by sex, race, insurance status, and region of primary residence.xxx

Panel E considers the top 100 emergency diagnoses, where the coefficient on end-of-life spending in the HSA is  $-0.012$  (s.e.= $0.0050$ ).<sup>18</sup> That is, a 2 standard deviation increase in the spending intensity measure is associated with a 0.6 percentage-point reduction in mortality, or 15% of the mean: similar to the heart-related emergency results. Panel E also shows statistically and economically significant reductions in mortality among diagnoses with higher mortality rates. In the top quartile of mortality rates, a 2 standard deviation increase in the spending measure is associated with a 1.5 percentage-point reduction in mortality (13% of the mean). The comparable figure for the third quartile is 24% of the mean. These results suggest that high-spending areas achieve better health outcomes across a wide range of emergency situations. For further disaggregation, Appendix Table AX reports results for the top 10 most common emergency diagnoses. The results are similar for stroke patients, with a coefficient of  $-0.029$  compared to a mortality rate of 6.3%.

### **Comparison of Close Substitutes in Destinations**

As in the comparisons across patient types, HSAs that differ by local-area healthcare spending may differ along a number of other dimensions. These differences may attract different

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<sup>18</sup> Similar results are found for all emergency diagnoses (Appendix Table AX)xxx. The top 100 include a wide range of conditions ranging from intestinal infections (n=1052) to skull base fracture (n=914).

types of visitors and different types of hospital staff. To test whether these HSA differences drive the main results, Table 4 reports results across subsets of similar destinations.<sup>19</sup>

If hospital-spending levels do not enter the visitor's decision to choose a destination, then visitors to areas that are close substitutes are likely to be similar to one another as well. In that spirit, Table 4 reports the results for sub-samples defined by quartiles of the per-diem rates to compare destinations with similar prices. This is a coarse categorization given the 97 HSAs studied, although the measures should serve to distinguish relatively expensive areas from less expensive ones. The bottom quartile represents the 17 counties where the per-diem rate is the state-level rate of \$80. These counties tend to be visited less frequently. The next three quartiles have per-diem rates that range from \$80-99, \$100-116, and \$117-214, respectively. The \$214 per-diem rate is for Monroe County, which includes the Florida Keys; the next most expensive county has a per-diem rate of \$132. The bulk of the data reside in the top quartile, which also includes Miami, Fort Lauderdale, West Palm Beach, and Tampa Bay. The results are fairly robust across the groups, with the second quartile being one of the few subgroups where no relationship is found.<sup>20</sup> That is, the main results are found in popular destinations, even within areas with similar lodging prices.

A related approach considers Spring Training sites for Major League Baseball, where teams train during February and March. The advantage of focusing on these areas is that they tend to be similarly sized cities that attract similar visitors as well. Appendix Table A4 shows that high- and low-spending areas that host the teams are similar in terms of patient age, race, sex,

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<sup>19</sup> HSA and county fixed effects were also considered, although the change in hospital-area spending levels within these eight years is not associated with changes in mortality. High-spending areas tend to remain so, with a spending measure defined on a county-by-year basis having a 1-year correlation of 0.95. The idea of this paper is that the large amount of cross-sectional variation in local-area spending can be exploited using a visitor sample where the variation is more likely to be exogenous.

<sup>20</sup> As shown in the working paper version of this paper, when the quartiles were constructed based on the number of patients in each county, rather than the equal weights shown in Table 4, the coefficients were consistently negative.

comorbidity levels, and especially lodging and meal prices. Column (5) shows that the result is similar when the analysis focuses on these 13 counties during the first quarter, with an estimated coefficient on local-area, end-of-life spending of -0.026 (s.e. = 0.010).

Recall from Figure 4 that the most expensive HSAs tend to have younger patients, especially for the top 17 HSAs where 30% of the patients are found. When these HSAs were excluded, the observable characteristics are quite similar (see Appendix Table AX), as are the main estimates of interest. The main results do not appear to be driven by the cities that attracted the youngest, and perhaps healthiest, patients. Last, results were similar when Census data were used to control for characteristics of the destination county and when American Travel Survey data were used to control for characteristics of the typical visitors (Appendix Table AX).

### **Sample Selection Bias**

The hospital discharge data include only patients who were admitted to the hospital. A number of selection biases could result in estimates of returns to healthcare spending that are too large or too small: high-spending areas may admit healthier patients; they may be in areas where characteristics such as traffic congestion affect the time to the hospital; and previous evidence suggests that high-spending areas are more likely to keep patients in the hospital until death rather than discharging patients, which would result in higher inpatient mortality rates in high-spending areas (Pritchard et al., 1998; Wennberg et al., 2004). The focus on health shocks, such as heart attacks, strokes, and hip fractures, as well as the result for patients with high-levels of comorbidity shown in Table 3, aims to estimate the relationship for patients where the probability of admission is close to 1 (and the estimate would be identified “at infinity”). In addition, rough estimates of admission rates, and in-hospital death rates (as opposed to outside of

the hospital), do not appear to be systematically related to area-spending levels, especially among the visitors.<sup>21</sup>

A number of other robustness checks were carried out as well as those presented above (shown in the Appendix Tables 7-8). For example, the results were similar when the model was estimated using a probit specification and across alternative measures of area-level spending intensity.

## **5. Interpretation**

### **A. Mechanisms: Treatment Differences Across HSAs**

As described in Section 2, a large medical literature describes the types of services provided in high- vs. low-spending areas. The Dartmouth Atlas of Healthcare also shows that surgical interventions are correlated with end-of-life spending (a correlation close to 0.25), and a higher correlation (close to 0.5) with intensive care unit services.<sup>22</sup> Meanwhile, differences in prices account for less than 30% of the variation in expenditures.

To compare different types of treatment in the current data and population studied, Table 5 reports results separately for AMI patients, as well as all heart-related emergency patients. Panel A of Table 5 considers spending at the patient level, which is shown to be strongly associated with the spending intensity proxy for the area. In particular, the summary measure of total costs averages \$16,400 (in 2003 dollars) for AMI emergency visitors, and a 2 standard

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<sup>21</sup> See Appendix Figure A1 that uses American Travel Survey data to estimate the denominator in the visitor admission rate. Further, the detailed mortality file of the National Vital Statistics System provides information on whether deaths occur in the hospital or outside the hospital, and these data have the advantage of listing the home state of the decedent to identify locals and visitors. The fraction of descendants listed as in-hospital is unrelated to spending intensity, although some evidence suggests a positive relationship among locals, consistent with earlier work (Mitchell, 1992; Wennberg, Fisher and Skinner, 2002; Fisher and Wennberg, 2008.) Results are shown in the Appendix.

<sup>22</sup> Author's calculations based on *Dartmouth Atlas of Health Care* data.

deviation increase in area-spending intensity is associated with a \$5,840 increase in total costs at the patient level.

The types of care provided can also be described by revenue categories available in the discharge data, such as charges for intensive care units or diagnostic tests. One caveat is that these revenue codes may be treated differently across hospitals (and, therefore, across HSAs), and the results should be taken with caution. For comparability to the main results, these categories of charges have been deflated by the hospital's cost-to-charge ratio in the year of admission. Four representative categories of costs are shown in Table 5: intensive care services, diagnostic services, surgical costs, and other costs (see Appendix Table A7 for each cost category separately). The strongest relationship between patient costs and the local-area spending intensity proxy is found for intensive care services, followed by diagnostic services, and then surgical care. To place the cost categories on the same log scale (dropping patients with zero costs), for AMI patients the coefficient on  $\log(\text{total costs})$  is 0.61 compared to 0.84 for  $\log(\text{icu costs})$ , 0.65 for  $\log(\text{diagnostic costs})$ , and 0.38 for  $\log(\text{surgical costs})$ .<sup>23</sup> This strong relationship between area spending intensity and the use of intensive care units suggests that such care is a driver of the improved outcomes, which is consistent with prior research that intensive care units are associated with significantly higher costs and significantly survival rates as well (Ridley and Morris, 2007).<sup>24</sup>

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<sup>23</sup> A 2 standard deviation in the spending intensity measure would be associated with \$4000 in additional costs, which is also associated with a 1.4 percentage point reduction in mortality. Dividing the two would provide an instrumental variables estimate of the effectiveness of spending at the individual level, and imply a \$285,000 cost of a life saved (among patients with an average age of close to 70). Similar results are found for the entire sample of emergency patients.

<sup>24</sup> There is a large literature documenting the survival benefits of ICU care. Ridley and Morris (2007) review 8 studies that consider variation in ICU entry due to temporary crowding. The median estimate for the relative risk of death for patients who are denied access to an ICU is 1.68. Another review of 10 similar studies by Sinuff et al. (2004) finds a relative risk of death of 3.04. Chalfin et al. (2007) compared patients who were delayed entry into an ICU to those who were not and found in-hospital mortality rates of 17.4% (delayed) vs. 12.9% (non-delayed), controlling for age, sex, diagnosis, and health evaluation.

## Procedure Differences

Third, the main results focus on patient with heart-related emergencies, and an issue when comparing outcomes after heart attacks is that recent evidence suggests that low-cost treatments, such as the use of beta blockers, yield large benefits (Phillips et al., 2000; Heidenreich and McClellan, 2001; Stukel et al., 2005). High-spending areas tend to spend more on AMI patients as well, however (Appendix Table AX). In addition, to consider quantities of care rather than costs, Panel B shows procedure rates for visitors. Estimates are reported from models that regress an indicator that a common procedure is conducted on the end-of-life spending measure and full controls. The top-10 most frequent three-digit ICD-9 procedures for AMI patients in these data are shown, and high-spending areas generally have higher procedure rates. A 2 standard deviation increase in the spending measure is 0.5, and such a difference is associated with an 8 percentage-point increase in catheterization procedures, compared to a mean of just over 50%; a 7 percentage-point increase in the likelihood of the insertion of a stent, compared to a mean of 25%; and a 6 percentage-point increase in the bypass rate, compared to a mean of only 10%. Similar differences are found for all heart-related emergencies as well.

These estimates tend to be imprecisely measured, however, which is partly due to the disaggregation of procedures. Among the top 25 procedures (not shown), 20 are more common in high-spending areas. Those that are more common in low-spending areas tend to be lower-cost procedures. For example, arteriography is a lower-cost substitute for angiocardiography, and arteriography is more common in low-cost areas whereas angiocardiography is more common in high-cost areas. Taken together, it appears that higher-spending areas do provide a greater quantity of services.

One caveat is that the positive association with surgical intensity, both in terms of costs and quantities, suggests that the inpatient mortality differences may be understated. Surgery carries its own in-hospital mortality risk. Physicians and patients must weigh this risk against potential longer-term benefits.<sup>25</sup>

### **Differences in Input Measures Across HSAs**

A further exploration of the variation in the types of services provided is shown in Panel C. First, patients who have a medical emergency in a high-spending area are much more likely to be treated in a teaching hospital. A comparison of teaching hospitals and non-teaching hospitals is similar to the main question in this paper of whether a bundle of characteristics associated with higher costs are associated with lower mortality. For example, Taylor et al. (1999) found that teaching hospitals have 20-50% higher costs compared to for-profit and government hospitals, and also had a 25% lower mortality rate overall.<sup>26</sup> In fact, a model similar to equation (3), but with mortality regressed on an indicator that the hospital was a teaching hospital reveals lower mortality for these visiting patients (coefficient=-0.013, s.e.=0.006).<sup>27</sup> Notably, this result is not found for local patients. These results are consistent with plausibly exogenous exposure to teaching hospitals among visitors but less so among locals who chose to settle in the area permanently and are more likely to know the quality of the hospitals.

Another summary measure of resource use that is related to costs but more straightforward to measure across markets is the length of stay in the hospital. Areas with greater end-of-life treatment intensity are associated with longer stays in the hospital. Among

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<sup>25</sup> In a separate analysis, volumes of coronary artery bypass surgeries and cardiac catheterizations were calculated and counties were broken into quartiles based on these counts. Counties that had particularly high volumes of local-area surgeries were associated with lower mortality rates compared to counties in the 2nd and 3rd quartiles.

<sup>26</sup> The result was found in overall, although it was less robust within specific diagnoses. The paper found that hip fracture was the only one to have a statistically significantly different mortality rate (hazard ratio of 0.54)—the condition where selection bias due to hospital admission is thought to be the least severe.

<sup>27</sup> See Appendix Table A6.

visitors, a 2 standard deviation increase in the spending proxy is associated with a 19 log point longer length of stay for AMI patients and 11 log point longer length of stay for all heart-related emergency patients.<sup>28</sup>

Last, human capital measures of the staff may explain differences in treatment intensity, possibly due to differences in the quality of care or training styles. While quality measures are part of ongoing research, the number of nurses and staff for each hospital is available from the American Hospital Association (AHA). For each HSA, a staff-to-admission ratio was calculated for the year 2000, weighting each hospital by the number of admissions reported in the AHA data.<sup>29</sup> Table 5 shows that a 2 standard deviation increase in the spending-intensity proxy is associated with a 23% increase in the staff-to patient ratio compared to its mean, and an 18% higher nurse-to-admission ratio.

### **Locals vs. Visitors**

The results suggest that once similar patients are compared across different healthcare systems, higher-spending areas achieve better health outcomes. It would be useful to demonstrate how the cross-sectional comparison of locals suffers from endogeneity bias. After all, the observable characteristics tend to be similar across areas. A number of tests were considered to explain the difference, but only suggestive evidence is found that the negative

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<sup>28</sup> The main results are also robust to using end-of-life length of stay to characterize HSAs rather than costs. In a model of mortality, the coefficient on local-area, end-of-life length of stay is -0.028 (s.e.=0.021).

<sup>29</sup> The AHA data also lists staff expenses (a measure of the wage bill) and the number of physicians directly employed by the hospital (as opposed to physicians with admitting privileges). The wage bill measure was not related to spending intensity, although the relationship was imprecisely estimated. Results were similar when the number of nurses or physicians was the dependent variable and the number of admissions was included as a control. Census data on physician and nurse incomes in these Florida counties were also considered, although there was little variation in the median income categories across the counties. Further, the presence of a catheterization lab in the hospital or HSA was considered. 12% of visitors were treated in a hospital that did not have a catheterization lab, and the spending measure appears more important within these hospitals, with a coefficient of -0.058 (s.e.=0.017) versus a coefficient of -0.018, s.e.=0.008 in hospitals with a lab. The presence of a catheterization lab in an HSA or hospital was associated with moderately higher mortality rates, although this result is not statistically significant and may relate to the in-hospital mortality risk of procedures that may follow a catheterization.



relationship between spending and mortality can be found once selection or other patient characteristics are taken into account.

For example, the data were explored to consider locals who appear more and more similar to visitors. Such a comparison tests whether the returns can be found for similar locals and whether returns are higher for those who are similar to travelers. Using all of the observable characteristics, the propensity of being a visitor was estimated and the sample was divided into deciles. Among visitors, the results were fairly stable across the deciles, again demonstrating the robustness of the main results. Meanwhile, there is only suggestive evidence that locals who appear more like visitors have better outcomes when treated in high-spending areas. The coefficient on the local-area end-of-life cost measure becomes increasingly negative as the propensity of being a visitor increases, with the top decile associated with a coefficient of -0.008 (s.e.=0.006). In addition, all of the analyses that were done for visitors were conducted for locals as well, and the lack of relationship between spending intensity and inpatient mortality was generally robust.<sup>30</sup>

It should not be surprising that the lack of an effect of spending intensity on mortality among the local population is robust to controls and across subgroups of patients or hospitals. This result has been found in scores of previous studies. Rather, the potential of endogeneity bias in cross-country or cross-region comparisons described in Section 2 is in terms of characteristics of patients that are unobservable to the researcher (such as lifestyle) and, thus, not possible to compare directly.

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<sup>30</sup> Another potential explanation for the lower mortality rate found for visitors in high-spending areas is that they may frequent relatively better hospitals than the locals, and the local-area measures obscure within-HSA differences in treatment intensity. Popular hospitals among locals are popular among visitors, however. When the fraction of visitors that visit a particular hospital in an HSA is regressed on the fraction of locals who visit that hospital, the coefficient is 0.97 (C.I. = 0.93, 1.01).

## 6. Conclusions

Estimates of returns to healthcare spending can be confounded by the fact that individuals in worse health receive more care. In fact, there is a strong positive correlation between spending and mortality at the individual level, even after controlling for observable characteristics such as age and comorbidity levels. Regional measures of spending intensity aggregate the choices made at the individual level, which can again confound comparisons.

When patients who experience an emergency when they are far from home are considered, those in high-spending areas have significantly lower mortality compared to those in low-spending ones. These results were found within similar groups of patients, similar destinations, and across a wide variety of emergency conditions. Areas that spend more are most highly associated with greater levels of intensive care services, as well as treatment in teaching hospitals. Higher staff-to-patient ratios are also found in high-spending areas. The finding that this bundle of characteristics is associated with higher costs and lower mortality is in contrast to prior cross-sectional evidence, but is consistent with prior instrumental-variable estimates that higher intensity care is associated with better health outcomes. While these results may relate in particular to the types of patients who are likely to travel, they suggest that high returns may be present, at least for emergency care.

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Figure 1: 97 Health Service Areas in Florida

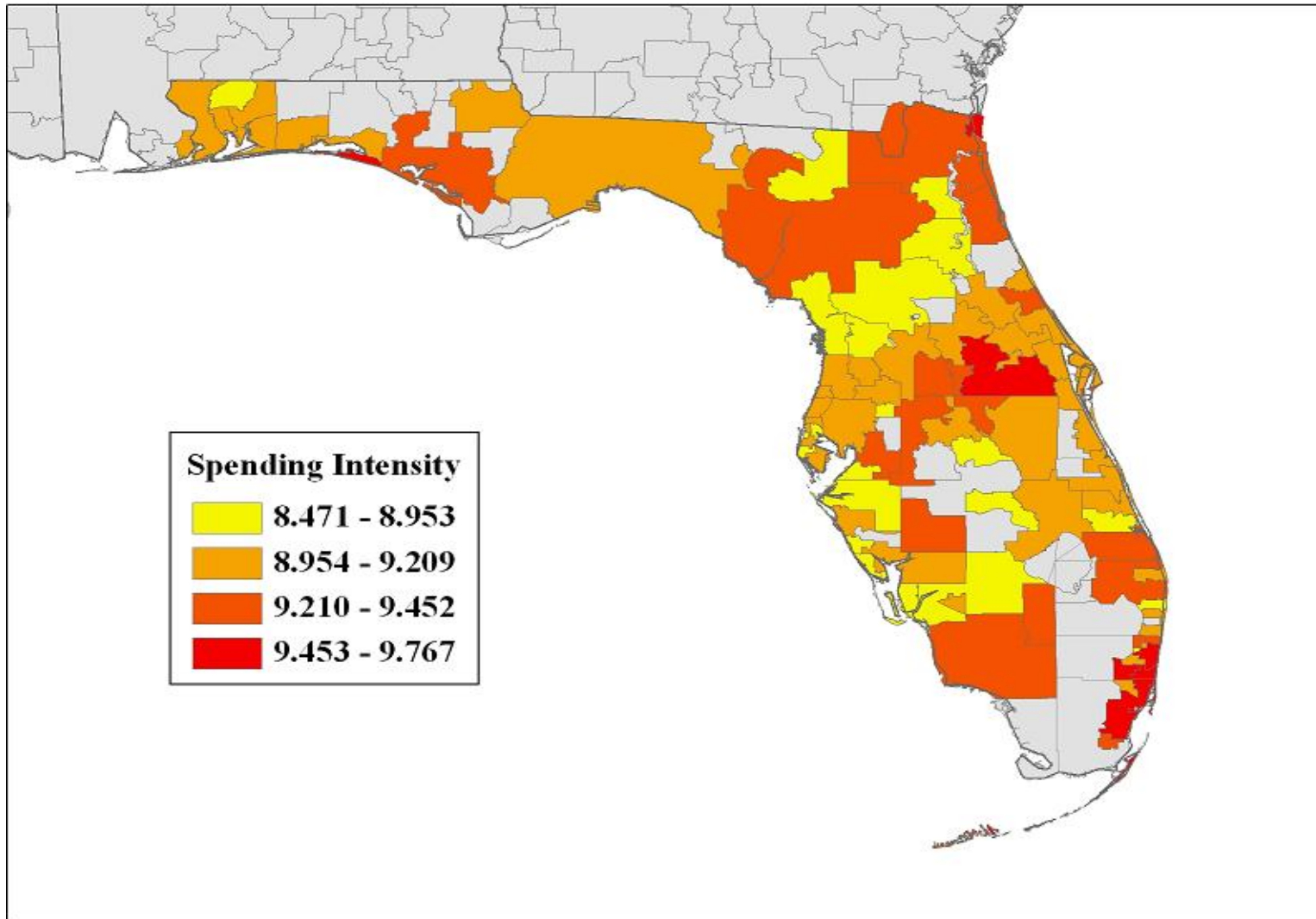


Figure 2: Florida County Median HH Income vs. HSA Cost Rank

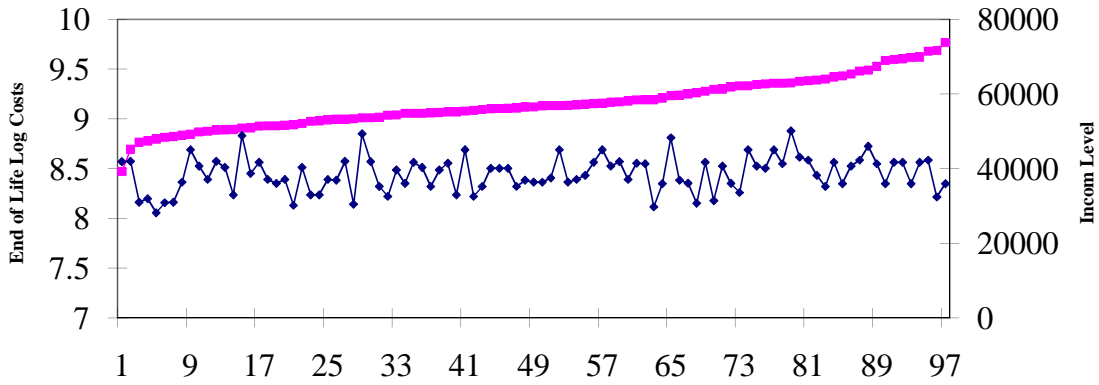


Figure 3: ZIP Code Median HH Income vs. HSA Cost Rank

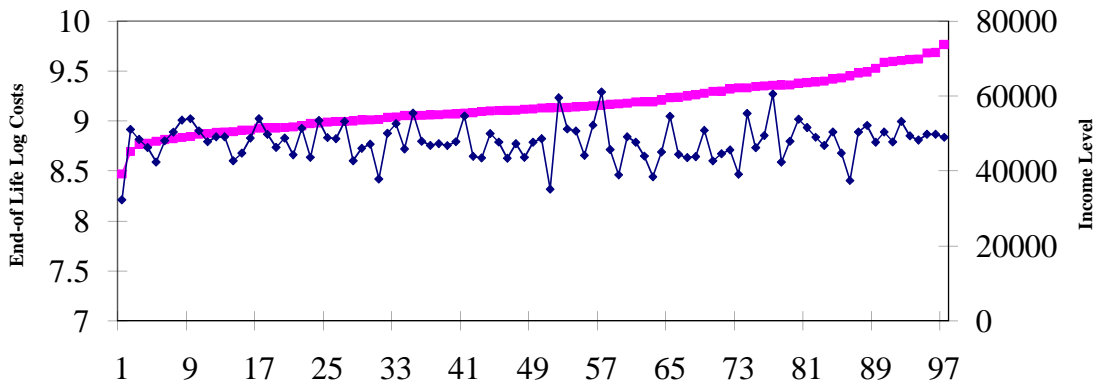
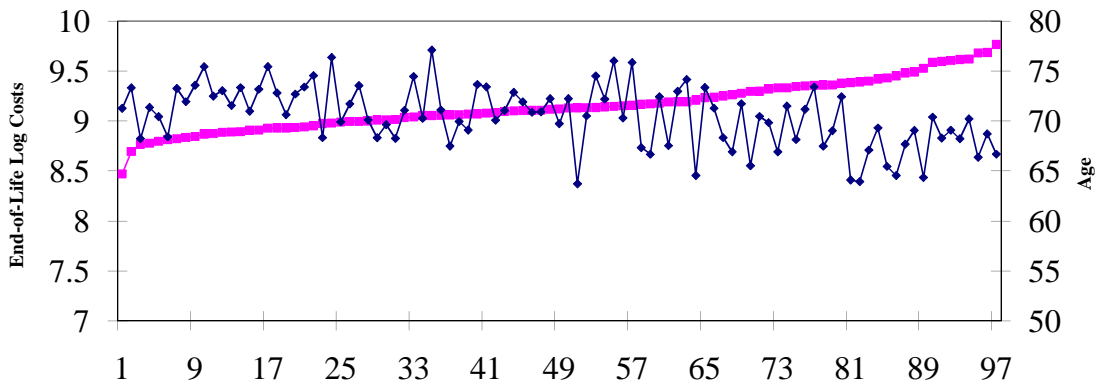


Figure 4: Age vs. HSA Cost Rank





**Table 1: Selected Characteristics, by Quartile of Spending Intensity**

		Patient Group:							
		Local Floridians				Visitors			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Area-level									
Intensity Proxy:	mean log(costs)   mortality	8.90	9.12 *	9.31 *	9.57 *	8.89	9.11 *	9.31 *	9.56 *
Outcome	Mortality	0.058	0.061	0.052 *	0.055	0.070	0.064	0.048 *	0.049 *
Personal Characteristics	Male	0.526	0.518	0.521	0.511	0.624	0.605	0.63	0.634
	Age	73.5	72.4	71.3 *	70.4 *	72.5	71.2	70.1	67.0 *
	White	0.913	0.849 *	0.755	0.535 *	0.966	0.925 *	0.938	0.745 *
ZIP Code of Residence	Median HH Income	36825	38531	38792	38123	47357	46572	49994	45527
	Percent White	0.864	0.813 *	0.801 *	0.682 *	0.874	0.838 *	0.852	0.785 *
	Percent >65 years old	0.273	0.221 *	0.190 *	0.151 *	0.140	0.143	0.141	0.135
	Percent No HS Degree	0.198	0.188	0.226	0.260	0.161	0.173	0.158	0.186 *
	Percent Rural	0.151	0.090	0.140	0.028 *	0.304	0.302	0.244	0.235
Payer Categories	Medicare	0.652	0.616	0.577	0.439 *	0.672	0.627	0.606	0.441 *
	Medicare HMO	0.126	0.124	0.111	0.186	0.053	0.043	0.045	0.045
	Medicaid	0.026	0.035	0.052 *	0.070 *	0.006	0.012 *	0.009	0.022 *
	Private Insurance	0.148	0.172 *	0.198 *	0.227 *	0.220	0.263 *	0.297 *	0.351 *
Comorbidities	No Comorbidities	0.313	0.319	0.330 *	0.355 *	0.386	0.380	0.413	0.439 *
	Prior AMI	0.133	0.117	0.109 *	0.095 *	0.144	0.132	0.135	0.100 *
	Congestive Heart Failure	0.174	0.162	0.147 *	0.142 *	0.170	0.161	0.149 *	0.165
	Chronic Obstructive Pulmonary Disease	0.288	0.285	0.287	0.246 *	0.212	0.216	0.201	0.175 *
	Diabetes	0.237	0.240	0.252	0.263 *	0.200	0.213	0.198	0.211
Timing	1st Quarter	0.286	0.278	0.270 *	0.266 *	0.522	0.458	0.498	0.399 *
	Weekend	0.281	0.277	0.272 *	0.266 *	0.286	0.283	0.281	0.293
Area Prices	Per-diem in January	111	119	119	127 *	109	118	124	127 *
	Per-diem in July	99	107	105	115 *	96	106 *	102	116 *
Observations		169575	216209	144681	219297	8436	10149	9655	8945

\*=significantly different from bottom quartile at the 5% level, computed using standard errors clustered at the Health Service Area level. ZIP code characteristics reported for those with ZIP code information.

**Table 2: Treatment & Health Outcomes for Heart-Related Emergencies**

**A. Florida Locals**

	Dependent Variable: Mortality					
	(1)	(2)	(3)	(4)	(5)	(6)
log(costs)	0.025	0.013				
	(0.0020)	(0.0020)				
Local area: mean log(costs)   mortality			-0.0061	0.0048	-0.0020	-0.0030
			(0.0043)	(0.0038)	(0.0037)	(0.0039)
Controls for Personal Characteristics	No	Yes	No	Yes	Yes	Yes
Controls for Patient ZIP Code Characteristics	No	Yes	No	No	Yes	Yes
Controls for Area Prices	No	Yes	No	No	No	Yes
Observations	749762					
Mean of Dep. Variable	0.057					

**B. Visitors**

	Dependent Variable: Mortality					
	(1)	(2)	(3)	(4)	(5)	(6)
log(Costs)	0.025	0.012				
	(0.0025)	(0.0024)				
Local area: mean log(costs)   mortality			-0.035	-0.029	-0.028	-0.028
			(0.0094)	(0.0082)	(0.0081)	(0.0082)
Controls for Personal Characteristics	No	Yes	No	Yes	Yes	Yes
Controls for Patient ZIP Code Characteristics	No	Yes	No	No	Yes	Yes
Controls for Area Prices	No	Yes	No	No	No	Yes
Observations	37185					
Mean of Dependent Variable	0.058					

The models are estimated by OLS and the standard errors are clustered at the Health Service Area level. Personal characteristics include the variables in Table A3, as well as indicators for each age, 5-year age indicators interacted with the white indicator, day of the week, and home state.

**Table AX: Heart-Related Emergency Results Across Patient Types**

Dependent Variable: Mortality					
A. Age & Business Travelers	Age>=65	Age<65	Business Destinations:		
			Age <65	Age<65 & Privately Insured	Age <65 & Privately Insured & Quarter 2-4
	(1)	(2)	(3)	(4)	(5)
Local area: mean log(costs)   mortality	-0.036 (0.011)	-0.019 (0.008)	-0.023 (0.013)	-0.034 (0.012)	-0.032 (0.014)
Observations	26614	10571	4722	2946	1841
Mean of Dep. Var.	0.068	0.033	0.037	0.036	0.035
B. Patient Income Level	ZIP Code Income Quartile				ZIP Code Fixed Effects
	Bottom	2nd Quartile	3rd Quartile	Top	
	(6)	(7)	(8)	(9)	(10)
Local area: mean log(costs)   mortality	-0.031 (0.013)	-0.029 (0.016)	-0.025 (0.015)	-0.049 (0.012)	-0.022 (0.010)
Observations	7840	7848	7861	7839	27356
Mean of Dep. Var.	0.054	0.058	0.057	0.066	0.059
C. Comorbidities & Sex	Comorbidities: Charlson Index:				
	None	Index = 1	Index = 2		
	(11)	(12)	(13)		
Local area: mean log(costs)   mortality	-0.017 (0.009)	-0.039 (0.013)	-0.041 (0.015)		
Observations	15050	12764	9371		
Mean of Dep. Var.	0.032	0.066	0.087		
D. Quarter of Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	
	(14)	(15)	(16)	(17)	
Local area: mean log(costs)   mortality	-0.024 (0.009)	-0.036 (0.015)	-0.042 (0.018)	-0.035 (0.018)	
Observations	17439	7816	4437	7493	
Mean of Dep. Var.	0.051	0.069	0.063	0.060	
E. Top 100 Diagnoses: By Illness Severity	All	P(Mortality Diagnosis) Quartiles			
		Bottom	2nd	3rd	Top
	(18)	(19)	(20)	(21)	(22)
Local area: mean log(costs)   mortality	-0.012 (0.0050)**	0.0003 (0.0008)	-0.0028 (0.0025)	-0.016 (0.007)**	-0.030 (0.014)**
Observations	229110	0.002	0.011	0.034	0.118
Mean of Dep. Var.	0.039	57388	60335	59869	51505

Each cell represents a separate regression with full controls, including diagnosis fixed effects. The models are estimated by OLS and the standard errors are clustered at the Health Service Area level. Business destinations include the cities where the fraction of visitors whose reason for travel is business in the 1995 American Travel Survey is greater than the median city. ZIP code fixed effects models are estimated for patients with non-missing ZIP code information.

**Table 4: Heart-Related Emergency Results Across County Types**

Dependent Variable: Mortality

	Destination Demand Substitutes:					
	Visitor Price Quartiles				1st Quarter & MLB Spring Training Sites	Spending Dist'n: Exclude Top 30% of HSAs
	Bottom Quartile (1)	2nd Quartile (2)	3rd Quartile (3)	Top Quartile (4)	(5)	(6)
Local area: mean log(costs)   mortality	-0.039 (0.031)	-0.004 (0.023)	-0.049 (0.024)	-0.026 (0.009)	-0.026 (0.010)	-0.026 (0.013)
Number of Counties	17	10	8	9	13	41
Number of HSAs	23	18	18	38	45	80
Observations	4547	6848	7293	18497	8611	26360
Mean of Dep. Var.	0.069	0.057	0.060	0.055	0.048	0.063

Each column represents a separate regression with full controls. The models are estimated by OLS and the standard errors are clustered at the Health Service Area level. Visitor prices are per-diem rates calculated by the US General Services Administration. The bottom quartile represents the counties that do not have their own per-diem rate. Major League Baseball (MLB) Spring Training Sites include the 13 counties with a spring training facility.

**Table 5: Mechanisms**

<u>Dependent Variable:</u>	<u>AMI Emergencies</u>			<u>All Heart-Related Emergencies</u>		
	<u>Mean of Dep. Var.</u>	<u>Coeff on Area Intensity</u>	<u>S.E.</u>	<u>Mean of Dep. Var.</u>	<u>Coeff on Area Intensity</u>	<u>S.E.</u>
<b>A. Types of hospital costs</b>						
Total	16438	11679	(3080)**	11557	8106	(1650)**
ICU & CCU	2092	2239	(622)**	1471	1498	(409)**
Diagnostic	2520	1783	(312)**	2107	1356	(239)**
Surgical	3924	1058	(1090)	2201	838	(563)
Remaining	7902	6599	(1540)**	5778	4414	(835)**
<b>B. Indicator for Top 10 Most Frequent Procedures Among Local AMI Patients</b>						
37.2 Dx procedures on heart and pericardium (catheterization)	0.54	0.155	(0.129)	0.28	0.099	(0.069)
88.5 Angiocardiology (catheterization)	0.52	0.156	(0.134)	0.26	0.093	(0.067)
36.0 Stent(s)	0.25	0.148	(0.105)	0.10	0.066	(0.046)
99.2 Injection prophylactic substance (platelet inhibitor)	0.15	0.057	(0.046)	0.06	0.02	(0.020)
96.7 Other continuous mechanical ventilation	0.11	0.007	(0.016)	0.07	0.010	(0.011)
36.1 Bypass anastomosis for heart revascularization	0.10	0.110	(0.060)*	0.04	0.050	(0.028)*
39.6 Extracorporeal circulation	0.08	0.082	(0.058)	0.04	0.038	(0.027)
96.0 Nonoperative intubation of gastrointestinal and respiratory tracts	0.08	-0.011	(0.012)	0.06	0.001	(0.010)
88.4 Arteriography using contrast material	0.06	-0.062	(0.042)	0.03	-0.031	(0.022)
99.1 Injection prophylactic substance (excludes aspirin)	0.06	-0.05	(0.025)**	0.02	-0.021	(0.011)*
<b>C. Additional Measures of Inputs</b>						
Patient treated in Teaching Hospital	0.09	0.36	(0.163)**	0.073	0.288	(0.140)**
log(Length of Stay)	1.40	0.39	(0.142)***	1.250	0.227	(0.092)**
American Hospital Assn: FTE Nurses per 1000 admissions	27.1	9.6	(3.07)***	27.3	11.4	(2.88)***
American Hospital Assn: FTE Total Staff per 1000 admissions	94.9	43.9	(11.5)***	95.9	51.7	(10.6)***
Mean of Area Spending Intensity Proxy	9.23			9.22		
Standard Deviation of Proxy	0.25			0.25		
Observations	15069			37185		

Each coefficient is from a separate regression with full controls. The models are estimated by OLS and the standard errors are clustered at the Health Service Area level. Costs are measured by charges deflated by a cost-to-charge ratio at the hospital x year level and expressed in 2003 dollars. American Hospital Association rows have 37038 and 15034 observations due to missing AHA data. \*=10%; \*\*=5%; \*\*\*=1%.

# Appendix

**Table A1: Summary Statistics by Quartile of Spending Intensity (More Variables)**

Patient Group:		Local Floridians				Visitors			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Area-level									
Intensity Proxy:	Mean log(costs)   mortality	8.90	9.12 *	9.31 *	9.57 *	8.89	9.11 *	9.31 *	9.56 *
Outcome	Mortality	0.058	0.061	0.052 *	0.055	0.070	0.064	0.048 *	0.049 *
Personal	P(Mortality   X)	0.061	0.058	0.055 *	0.054 *	0.061	0.058 *	0.054 *	0.054 *
Characteristics	Male	0.526	0.518	0.521	0.511	0.624	0.605	0.630	0.634
	Age	73.5	72.4	71.3 *	70.4 *	72.5	71.2	70.1	67.0 *
Race	African American	0.054	0.095 *	0.103 *	0.180 *	0.015	0.035 *	0.028	0.084 *
	Hispanic	0.019	0.034	0.123	0.255 *	0.007	0.019	0.021	0.123 *
	White	0.913	0.849 *	0.755	0.535 *	0.966	0.925 *	0.938	0.745 *
ZIP Code of	Median Household Income	36825	38531	38792	38123	47357	46572	49994	45527
Residence	Percent White	0.864	0.813 *	0.801 *	0.682 *	0.874	0.838 *	0.852	0.785 *
Characteristics	Percent African American	0.079	0.126 *	0.128 *	0.228 *	0.064	0.091 *	0.077	0.117 *
	Percent Hispanic	0.080	0.082	0.174	0.315 *	0.043	0.053	0.053	0.091 *
	Percent >65 years old	0.273	0.221 *	0.190 *	0.151 *	0.140	0.143	0.141	0.135
	Percent No HS Degree	0.198	0.188	0.226	0.260	0.161	0.173	0.158	0.186 *
	Percent HS Degree	0.332	0.302 *	0.291 *	0.261 *	0.317	0.305	0.295 *	0.290 *
	Percent Some College	0.287	0.296	0.278	0.265	0.266	0.262	0.262	0.253 *
	Percent College Degree	0.118	0.138	0.132	0.134	0.159	0.161	0.175	0.165
	Percent Post College	0.065	0.076	0.074	0.081 *	0.097	0.100	0.110	0.106
	Median Rent	534	551	554	599	515	519	553	538
	Percent Rural	0.151	0.090	0.140	0.028 *	0.304	0.302	0.244	0.235
	Missing ZIP Code Information	0.037	0.020 *	0.032	0.010 *	0.115	0.127	0.129	0.258 *
Payer	Medicare	0.652	0.616	0.577	0.439 *	0.672	0.627	0.606	0.441 *
Categories	Medicare HMO	0.126	0.124	0.111	0.186	0.053	0.043	0.045	0.045
	Medicaid	0.026	0.035	0.052 *	0.070 *	0.006	0.012 *	0.009	0.022 *
	Private Insurance	0.148	0.172 *	0.198 *	0.227 *	0.220	0.263 *	0.297 *	0.351 *
	Other insurance	0.017	0.021	0.018	0.011	0.008	0.015 *	0.009	0.018
	Uninsured	0.031	0.032	0.044 *	0.067 *	0.043	0.043	0.036	0.125 *
Comorbidities	No Comorbidities	0.313	0.319	0.330 *	0.355 *	0.386	0.380	0.413	0.439 *
	AMI	0.133	0.117	0.109 *	0.095 *	0.144	0.132	0.135	0.100 *
	Congestive Heart Failure	0.174	0.162	0.147 *	0.142 *	0.170	0.161	0.149 *	0.165
	C.O.P.D.	0.288	0.285	0.287	0.246 *	0.212	0.216	0.201	0.175 *
	Diabetes	0.237	0.240	0.252	0.263 *	0.200	0.213	0.198	0.211
	Other Comorbidities	0.087	0.092 *	0.086	0.086	0.072	0.086 *	0.072	0.070
Timing	1st Quarter	0.286	0.278	0.270 *	0.266 *	0.522	0.458	0.498	0.399 *
	2nd Quarter	0.236	0.236	0.239	0.244 *	0.196	0.212 *	0.210	0.220
	3rd Quarter	0.219	0.224	0.226	0.235 *	0.091	0.128 *	0.101	0.157 *
	4th Quarter	0.258	0.261	0.264	0.254	0.191	0.202	0.192	0.223 *
	Weekend	0.281	0.277	0.272 *	0.266 *	0.286	0.283	0.281	0.293
Area	Per-diem in January	111	119	119	127 *	109	118	124	127 *
Prices	Per-diem in July	99	107	105	115 *	96	106 *	102	116 *
Patient-level	Hospital costs	7879	9022 *	9256 *	11648 *	8729	9598	10131	14614 *
treatment	log(Hospital costs)	8.61	8.75 *	8.78 *	8.92 *	8.70	8.79	8.84 *	9.12 *
	Observations	169575	216209	144681	219297	8436	10149	9655	8945

\*=significantly different from bottom quartile at the 5% level, computed using standard errors clustered at the Health Service Area level. ZIP code characteristics reported for those with ZIP code information.

khat and zmiss stars

Table A2: American Travel Survey:  
 Characteristics of Visitors Across Cities, by Quartile of Spending Intensity

		All ages				Age >= 45			
Metropolitan Area Spending Intensity Quartile:		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
<b>Individual:</b>	White	0.904	0.883	0.811	0.893	0.938	0.902	0.880	0.922
	Black	0.069	0.060	0.087	0.062	0.044	0.037	0.072	0.049
	Other race	0.027	0.057	0.102	0.045	0.018	0.061	0.048	0.029
	Hispanic	0.047	0.052	0.090	0.046	0.027	0.042	0.039	0.042
	Age	37.8	38.2	38.0	39.5	57.0	57.4	58.4	57.1
	Age >= 65	0.079	0.086	0.110	0.096	0.205	0.210	0.277	0.215
	Male	0.529	0.543	0.540	0.538	0.552	0.555	0.552	0.552
	Married	0.578	0.580	0.555	0.583	0.780	0.773	0.747	0.803
Origin:	Midwest	0.156	0.139	0.126	0.149	0.167	0.135	0.097	0.164
	Northeast	0.195	0.265	0.205	0.232	0.196	0.261	0.212	0.233
	South	0.621	0.557	0.638	0.551	0.601	0.571	0.659	0.525
	West	0.028	0.040	0.031	0.068	0.036	0.033	0.032	0.078
Reason	Vacation	0.511	0.538	0.555	0.509	0.487	0.437	0.446	0.481
	Business	0.193	0.208	0.162	0.184	0.194	0.277	0.215	0.224
<b>Household:</b>	Size = 1	0.097	0.105	0.096	0.091	0.156	0.184	0.158	0.119
	Size = 2	0.359	0.287	0.310	0.307	0.505	0.433	0.506	0.481
	Size >2	0.543	0.608	0.594	0.602	0.338	0.383	0.337	0.401
	Income <30K	0.193	0.239	0.263	0.246	0.237	0.232	0.272	0.229
	Income >30K <50K	0.306	0.267	0.315	0.307	0.331	0.296	0.343	0.333
	Income >50K <75K	0.223	0.288	0.227	0.245	0.246	0.266	0.222	0.250
	Income >75K	0.277	0.206	0.196	0.202	0.186	0.207	0.162	0.188
	# of Vehicles	2.00	1.94	2.04	2.11	2.21	1.98	1.87	2.05
	Married w/ children	0.385	0.405	0.399	0.404	0.150	0.106	0.130	0.168
<b>Household:</b>	Less than HS	0.237	0.223	0.261	0.204	0.097	0.078	0.139	0.065
<b>Head Education:</b>	HS degree	0.193	0.206	0.189	0.203	0.280	0.254	0.266	0.256
	Some college	0.264	0.255	0.256	0.262	0.273	0.300	0.293	0.331
	College degree	0.184	0.186	0.199	0.221	0.209	0.185	0.208	0.196
	Graduate degree	0.123	0.131	0.096	0.110	0.141	0.183	0.094	0.151
Work:	Retired	0.083	0.078	0.095	0.099	0.213	0.189	0.235	0.220
	Full time	0.531	0.547	0.479	0.541	0.602	0.560	0.512	0.583
	Part time	0.047	0.075	0.090	0.061	0.064	0.109	0.130	0.062
	Homemaker	0.105	0.073	0.075	0.078	0.100	0.115	0.092	0.117
	Home owner	0.745	0.721	0.709	0.770	0.867	0.854	0.832	0.892
	Person-trip Obs (raw)	2650	4637	3484	6633	1108	1964	1483	2897
	Person-trip Obs (weighted)	4858947	8684969	6521168	12683341	1880772	3555479	2589725	5662312
	Number of Metro Areas	3	4	4	2	3	4	4	2

Data represent 13 metropolitan areas available in the 1995 American Travel Survey (ATS). Each cell represents a weighted average of the traveller's characteristic, using the person-trip weights provided in the ATS. To categorize these metropolitan areas, the quartiles are based on the end-of-life spending measure calculated at the metropolitan-area level. Q1 is Sarasota, Pensacola, and Fort Myers; Q2 is Tampa, Melbourne, West Palm Beach, and Tallahassee; Q3 is Daytona, Jacksonville, Fort Luderdale, and Lakeland; Q4 is Orlando and Miami.



**Table A3: Reduced-Form Estimates (Selected Covariates)**

Dependent Variable: Mortality		Coeff.	S.E.
Local Area	Local area: mean log(costs)   mortality	-0.028	(0.0082)
Age Indicators (60 years old excluded)	Age<=20	0.054	(0.033)
	Age>20 & Age<30	-0.013	(0.018)
	Age = 35	-0.036	(0.012)
	Age = 45	-0.004	(0.019)
	Age = 55	-0.027	(0.013)
	Age = 65	-0.013	(0.015)
	Age = 75	0.010	(0.019)
	Age = 85	0.039	(0.018)
	Age = 95	0.033	(0.044)
	Age >= 100	0.061	(0.087)
Race	African American	0.007	(0.008)
	White	0.011	(0.008)
Sex	Male	-0.003	(0.003)
Time of Year	1st quarter	-0.010	(0.003)
	2nd quarter	0.007	(0.004)
	3rd quarter	0.002	(0.005)
Day of Week (Monday excluded)	Friday	-0.005	(0.005)
	Saturday	-0.002	(0.005)
	Sunday	-0.000	(0.004)
Primary Payer (uninsured excluded)	Medicare fee for service	-0.015	(0.006)
	Medicare HMO	-0.010	(0.009)
	Medicaid	-0.013	(0.012)
	Commercial Insurance	-0.026	(0.004)
	Other insurance	-0.009	(0.011)
Comorbidities (no comorbidities excluded)	Prior AMI	0.008	(0.004)
	Congestive Heart Failure	0.073	(0.006)
	Chronic Obstructive Pulmonary Disease	0.006	(0.003)
	Diabetes	-0.001	(0.003)
	Other Comorbidities	0.026	(0.005)
Primary Diagnosis	AMI	0.040	(0.004)
	Cardiac dysrhythmias	-0.010	(0.003)
	Heart failure	0.000	(0.000)
ZIP Code of Residence Characteristics  (College omitted)	Median income<30,000 (compared to >80,000)	-0.005	(0.012)
	Fraction with Less than HS Degree	-0.006	(0.037)
	Fraction with HS Degree only	0.026	(0.044)
	Fraction with some college	0.029	(0.050)
	Fraction with post-college	0.003	(0.058)
	Fraction White	-0.007	(0.035)
	Fraction African American	-0.030	(0.032)
	Fraction Hispanic	-0.020	(0.029)
	Percent over the age of 65	-0.082	(0.025)
	Percent Rural	-0.007	(0.005)
	Median Rent	5.65e-07	1.48e-05
	Missing ZIP code information (includes missing state information)	-0.010	(0.007)
	Area Prices	Per Diem June	0.0003
Per Diem January		-0.0003	(0.0001)
Year	Year = 1997	-0.005	(0.005)
	Year = 1998	-0.010	(0.006)
	Year = 1999	-0.009	(0.005)
	Year = 2000	-0.002	(0.005)
	Year = 2001	-0.007	(0.005)
	Year = 2002	-0.005	(0.005)
	Year = 2003	-0.013	(0.006)
	Observations	37185	
	Mean of Dep. Variable	0.058	

The model is from Table 2B, Column (6). It is estimated by OLS and the standard errors are clustered at the Health Service Area level. Models include indicators for each age, day of the week, 5-year age indicators interacted with the white indicator, as well.

**Table A4: Heart-Related Emergency Results Across Patient Types**

**Dependent Variable: Mortality**

<b>A. Race &amp; Sex</b>	<b>Race</b>		<b>Sex</b>	
	African Amer. (1)	Hispanic (2)	Male (3)	Female (4)
Local area: mean log(costs)   mortality	-0.033 (0.028)	0.002 (0.028)	-0.030 (0.009)	-0.037 (0.014)
Observations	1487	1588	23136	14049
Mean of Dep. Var.	0.048	0.050	0.054	0.064

<b>B. Insurance Status</b>	Private (5)	Public (6)	Uninsured (7)
	Local area: mean log(costs)   mortality	-0.012 (0.008)	-0.033 (0.012)
Observations	10966	23979	2240
Mean of Dep. Var.	0.036	0.067	0.061

<b>C. Home Region</b>	<b>Census Region</b>				<b>Exclude Missing State/ZIP (12)</b>
	Northeast (8)	Midwest (9)	West (10)	South (11)	
local area: mean log(charges)   mortality	-0.043 (0.011)	-0.021 (0.015)	-0.035 (0.033)	-0.035 (0.011)	-0.035 (0.010)
Observations	11869	9278	1403	8380	31388
Mean of Dep. Var.	0.062	0.053	0.073	0.057	0.059

<b>D. Models with Destination Controls</b>	2000 Census County Controls (13)	1995 Amer. Travel Survey Controls (14)
	Local area: mean log(costs)   mortality	-0.031 (0.010)
Observations	37185	29184
Mean of Dep. Var.	0.058	0.058

Each cell represents a separate regression with full controls. The models are estimated by OLS and the standard errors are clustered at the Health Service Area level. Business destinations include the cities where the fraction of visitors whose reason for travel is business in the 1995 American Travel Survey is greater than the median city. Uninsured is defined as charity care, self pay, or less than 30% coverage.

Table A5: Results for Frequent Diagnoses & Across Illness Severity Levels

Dependent Variable: Mortality		Local area: mean			
	3-Digit ICD9-CM Diagnosis Codes	Mortality Rate	log(costs)   mortality Coeff.	S.E.	Obs.
<b>Top 10 Most Frequent Emergency Diagnoses</b>	410 Acute myocardial infarction	0.089	-0.033	(0.013)**	15069
	414 Other chronic ischemic heart disease	0.007	0.0020	(0.0029)	11970
	427 Cardiac dysrhythmias	0.030	-0.033	(0.011)***	9832
	428 Heart failure	0.042	-0.029	(0.011)**	12284
	434 Occlusion of cerebral arteries (stroke)	0.063	-0.029	(0.016)*	6409
	486 Pneumonia	0.040	-0.008	(0.011)	11207
	491 Chronic bronchitis	0.028	-0.005	(0.011)	6123
	780 General symptoms	0.003	0.0033	(0.0027)	9008
	786 Symptoms involving respiratory system and other chest symptoms	0.001	-0.001	(0.0014)	13792
	820 Fracture of neck of femur (hip fracture)	0.024	-0.012	(0.012)	5297
<b>Pooled Diagnoses</b>	All Emergency admissions	0.039	-0.010	(0.0049)**	272772

Each row represents a separate regression with full controls, as in column (6) of Table 2. The models are estimated by OLS and the standard errors are clustered at the Health Service Area level. Each sub-sample is restricted to patients from states with at least 5 observations. \*=10%; \*\*=5%; \*\*\*=1%.

**Table A6: (Selected) Visitor Characteristics: HSA Subsamples**

**A. Major League Baseball Spring Training Counties in First Quarter**

Variable		Low-Spending HSA		High-Spending HSA	
		Mean	Std Dev	Mean	Std Dev
<b>Local-area level:</b>					
Treatment	Mean log(costs)   mortality	8.96	0.11	9.30	0.15
Personal Characteristics	Male	0.64	0.48	0.63	0.48
	Age	72.8	10.4	71.9	11.4
Race	White	0.98	0.14	0.94	0.24
Comorbidities	No Comorbidities	0.40	0.49	0.41	0.49
Area Prices	Per-diem in January	115.00	12.20	115.89	9.21
	Observations	4293		4318	

**B. Excluding Top 30% Most Costly HSAs**

Variable		Low-Spending HSA		High-Spending HSA	
		Mean	Std Dev	Mean	Std Dev
<b>Local-area level:</b>					
Treatment	Mean log(costs)   mortality	8.95	0.11	9.23	0.08
Personal Characteristics	Male	0.62	0.49	0.62	0.49
	Age	71.9	11.7	71.5	12.1
Race	White	0.96	0.21	0.93	0.25
Comorbidities	No Comorbidities	0.38	0.49	0.40	0.49
Area Prices	Per-diem in January	103.76	17.77	113.55	16.27
	Observations	12862		13498	

High- and low-spending areas are defined by the median of the local-area treatment measure: mean log costs conditional on mortality for the HSA.

**Table A7: Robustness**

Dependent Variable: Mortality

	Probit (marginal effect) (1)	ZIP Code Fixed Effects (2)	Local Area measure quartiles (3)	Spending: Bottom 3 Quartiles (4)	Measure:		
					median log(costs)   mortality (5)	mean log(costs) unconditional (6)	heart-related emergencies: mean log (costs)   mortality (7)
Patient or Local-Area cost measure	-0.029 (0.009)	-0.022 (0.010)		-0.031 (0.013)	-0.033 (0.009)	-0.027 (0.014)	-0.022 (0.0092)
Mean log(costs)   mortality: 2nd quartile			-0.008 (0.007)				
Mean log(costs)   mortality: 3rd quartile			-0.017 (0.007)				
Mean log(costs)   mortality: Top quartile			-0.018 (0.007)				
Number of HSAs	97	97	97	83	97	97	97
Observations	36985	27356	37185	28240	37185	37185	37185
Mean of Dep. Var.	0.058	0.059	0.058	0.061	0.058	0.058	0.058

Each column represents a separate regression with full controls. Standard Errors are clustered at the Health Service Area level. All models are estimated using OLS, except column 1 that reports the estimated marginal effect on patient costs from a probit model. The number of observations is slightly smaller in the probit model due to the exclusion of cells with zero deaths. Column (5) uses the local-area measure calculated as the median of log(costs) for patients who died in the hospital, whereas column (6) uses the mean costs of all local emergency patients, whether or not they died in the hospital. Column (7) calculates the end-of-life cost measure for local patients with heart-related emergencies.

**Table A8: Robustness to Local Area Definitions**

<u>Local Area</u>	<u>Treatment Intensity Measure</u>	<u>(#)</u>	<u>(Std. Dev.)</u>	<u>Mortality model</u>	<u>Obs.</u>
Health Service Area & Dartmouth Atlas Measure	Inpatient hospitalization reimbursements (in thousands) per decedent: Last hospitalization	73	3.979 (1.23)	-0.006 (0.002)	34661
ATS Metropolitan Area	mean log(Costs)   mortality:	14	9.24 (0.200)	-0.036 (0.009)	37185
Hospital	mean log(Costs)   mortality:	189	9.20 (0.263)	-0.023 (0.008)	37185
	Teaching Hospital	189	0.073 (0.260)	-0.013 (0.006)	37185

Each row represents a separate regression with full controls. The models are estimated by OLS and the standard errors are clustered at the respective area

Table A9: Hospital Charge Categories

**A. Visitors**

	AMI Patients				Heart Patients			
	Coefficient on EOL Costs	S.E.	Obs.	Mean of Dep. Var.	Coefficient on EOL Costs	S.E.	Obs.	Mean of Dep. Var.
Room	303	(201)	15069	451	287	(194)	37185	510
ICU	1,046	(370)**	15069	1220	785	(275)**	37185	902
CCU	1,193	(414)**	15069	872	713	(239)**	37185	569
Pharmacy	1,714	(433)**	15069	2656	1,073	(215)**	37185	1691
Medical Devices	2,312	(1,010)*	15069	2496	1,521	(603)*	37185	1784
Laboratory	1,391	(283)**	15069	1999	1,047	(223)**	37185	1630
Radiology	264	(71)**	15069	339	194	(42)**	37185	287
Nuclear Medicine	51	(24)*	15069	106	92	(36)*	37185	152
CT Scan	98	(17)**	15069	154	88	(15)**	37185	158
Operating Room	400	(276)	15069	699	257	(143)	37185	390
Anesthesia	121	(84)	15069	141	70	(43)	37185	77
Respiratory Svcs.	1,001	(161)**	15069	504	633	(85)**	37185	345
Physical Therapy	48	(10)**	15069	40	30	(6)**	37185	37
Emergency Room	153	(46)**	15069	331	152	(44)**	37185	308
Cardiology	461	(823)	15069	3048	462	(412)	37185	1705
Recovery Room	77	(54)	15069	35	49	(28)	37185	29
Other	1,016	(193)**	15069	1308	624	(120)**	37185	945
log(Total)	0.608	(0.198)**	15069	9.287	0.553	(0.104)**	37185	8.862
log(ICU & CCU)	0.842	(0.249)**	13313	7.291	0.705	(0.194)**	27160	7.117
log(Diagnostic)	0.651	(0.145)**	15065	7.436	0.575	(0.128)**	37168	7.271
log(Surgical)	0.384	(0.327)	13441	7.641	0.415	(0.187)*	30096	7.051
log(other)	0.690	(0.199)**	15068	8.466	0.572	(0.111)**	37184	8.073

**B. Local Floridians**

	AMI Patients				Heart Patients			
	Coefficient on EOL Costs	S.E.	Obs.	Mean of Dep. Var.	Coefficient on EOL Costs	S.E.	Obs.	Mean of Dep. Var.
Room	220	(143)	238926	413	306	(166)	749762	508
ICU	1,246	(331)**	238926	1146	827	(249)**	749762	827
CCU	678	(265)*	238926	775	393	(158)*	749762	520
Pharmacy	1,305	(347)**	238926	2134	680	(168)**	749762	1345
Medical Devices	1,636	(679)*	238926	1885	1,051	(346)**	749762	1334
Laboratory	1,206	(250)**	238926	1872	842	(200)**	749762	1510
Radiology	136	(58)*	238926	312	103	(37)**	749762	270
Nuclear Medicine	47	(15)**	238926	97	59	(20)**	749762	124
CT Scan	106	(20)**	238926	163	97	(18)**	749762	157
Operating Room	202	(190)	238926	494	117	(82)	749762	263
Anesthesia	75	(48)	238926	97	41	(23)	749762	52
Respiratory Svcs.	771	(120)**	238926	414	476	(66)**	749762	305
Physical Therapy	42	(15)**	238926	51	27	(12)*	749762	49
Emergency Room	162	(47)**	238926	300	161	(44)**	749762	280
Cardiology	157	(967)	238926	2361	194	(381)	749762	1139
Recovery Room	30	(30)	238926	26	20	(14)	749762	24
Other	855	(183)**	238926	1167	546	(109)**	749762	834
log(Total)	0.579	(0.155)**	238926	9.184	0.540	(0.067)**	749762	8.773
log(ICU & CCU)	0.864	(0.152)**	209447	7.294	0.756	(0.117)**	534388	7.127
log(Diagnostic)	0.574	(0.116)**	238844	7.472	0.482	(0.107)**	749352	7.292
log(Surgical)	0.265	(0.361)	200591	7.420	0.283	(0.195)	524508	6.862
log(other)	0.673	(0.138)**	238925	8.346	0.586	(0.086)**	749754	7.988

All models include full controls and average at least \$20 in costs. Costs are measured by charges deflated by a cost-to-charge ratio at the hospital x year level and expressed in 2003 dollars.

**Table A10: Selection Models**

Dependent Variable: Mortality				
	Patient Group: Local Floridians		Visitors	
	(1)	(2)	(3)	(4)
County: mean log(costs)   mortality	-0.0062 (0.0058)	-0.012 (0.0071)	-0.025 (0.0090)	-0.027 (0.012)
Control function	No	Yes	No	Yes
Number of Counties	29		29	
Observations	704780		34958	
Mean of Dep. Var.	0.058		0.058	

Each column represents a separate regression, and all models include full patient controls. Standard Errors are clustered at the county level. The control function is a fourth-ordered polynomial in the number of heart-disease related deaths that occur outside of the hospital in any given county-year, as well as the county population from the 2000 census.



Figure A1: Estimated Admission Rate (per 10,000)

