

Returns to Local-Area Healthcare Spending:
Evidence from Health Shocks to Patients Far From Home
Joseph J. Doyle Jr.

Web 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	8.91	9.13 *	9.32 *	9.57 *	8.91	9.13 *	9.31 *	9.56 *
Outcome	Mortality	0.058	0.062	0.050 *	0.055	0.07	0.063	0.049 *	0.049 *
Personal	P(Mortality X)					0.063	0.061	0.053 *	0.055 *
Characteristics	Male	0.524	0.517	0.524	0.511	0.625	0.603	0.627	0.636
	Age	73.2	72.5	71.1	70.4 *	71.9	71.5	70.2	66.9 *
Race	White	0.903	0.797	0.837 *	0.535 *	0.956	0.924	0.943	0.743 *
	African American	0.067	0.087	0.113 *	0.184 *	0.024	0.029	0.027	0.087 *
	Hispanic	0.018	0.096	0.033	0.255 *	0.009	0.024 *	0.017	0.123 *
ZIP Code of	Median Household Income	36757	38153	39838	38125	47254	50163	51239	48371
Residence	Percent White	0.854	0.817	0.801 *	0.682 *	0.865	0.840	0.852	0.780 *
Characteristics	Percent African American	0.063	0.086	0.111 *	0.180 *	0.076	0.086	0.079	0.123 *
	Percent Hispanic	0.021	0.098	0.034	0.260 *	0.041	0.058 *	0.052	0.093 *
	Percent >65 years old	0.264	0.223	0.194 *	0.151 *	0.146	0.140	0.142	0.137
	Percent No HS Degree	0.197	0.208	0.196	0.259	0.168	0.164	0.156	0.183
	Percent HS Degree	0.328	0.298 *	0.298 *	0.261 *	0.316	0.298	0.293 *	0.285 *
	Percent Some College	0.290	0.286	0.290	0.265	0.266	0.261	0.262	0.252 *
	Percent College Degree	0.120	0.134	0.140 *	0.134	0.155	0.170	0.177	0.170
	Percent Post College	0.066	0.075	0.077	0.081 *	0.094	0.107	0.112	0.111
	Median Rent	527	559	556	599	514	567	568	580
	Percent Rural	0.144	0.079	0.154	0.027 *	0.320	0.235	0.228 *	0.191 *
	Missing ZIP Code Information	0.042	0.020 *	0.040	0.010 *	0.127	0.163 *	0.143	0.300 *
Payer	Medicare	0.655	0.598	0.593	0.438 *	0.669	0.618	0.607	0.436 *
Categories	Medicare HMO	0.118	0.128	0.115	0.187 *	0.048	0.046	0.045	0.045
	Medicaid	0.027	0.039	0.045 *	0.070 *	0.007	0.012 *	0.009	0.024 *
	Private Insurance	0.150	0.183 *	0.184	0.227 *	0.220	0.269 *	0.296 *	0.348 *
	Other insurance	0.018	0.020	0.018	0.011 *	0.011	0.013	0.008	0.018
	Uninsured	0.032	0.033	0.044 *	0.067 *	0.046	0.042	0.034	0.128 *
Comorbidities	No Comorbidities	0.314	0.319	0.330	0.354 *	0.384	0.384	0.413	0.439 *
	AMI	0.131	0.114	0.113	0.094 *	0.143	0.129	0.135	0.100 *
	Congestive Heart Failure	0.171	0.161	0.149 *	0.141 *	0.168	0.162	0.149 *	0.164
	C.O.P.D.	0.286	0.290	0.282	0.246 *	0.211	0.218	0.201	0.176 *
	Diabetes	0.238	0.245	0.245	0.263	0.202	0.210	0.198	0.210
	Other Comorbidities	0.088	0.089	0.089	0.086	0.075	0.085	0.073	0.070
Timing	1st Quarter	0.284	0.277	0.273 *	0.267 *	0.495	0.475	0.498	0.397 *
	2nd Quarter	0.236	0.236	0.241	0.244 *	0.201	0.210	0.209	0.220
	3rd Quarter	0.221	0.225	0.224	0.235 *	0.108	0.116	0.101	0.159 *
	4th Quarter	0.258	0.261	0.263	0.254	0.196	0.199	0.192	0.223 *
	Weekend	0.281	0.275	0.274 *	0.266 *	0.285	0.285	0.282	0.294
Area	Per-diem in January	103	110	107	114	104	109	113	115
Prices	Per-diem in June	93	101 *	96	110 *	93	100 *	97	110 *
Patient-level	Hospital costs	8039	8918	9353 *	11648 *	9255	9135	10157	14568 *
treatment	log(Hospital costs)	8.62	8.75 *	8.79 *	8.92 *	8.73	8.77	8.84	9.11 *
	Observations	183245	217902	129318	219297	9487	8917	9470	8926

*=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 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
Individual:	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
Household:	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
Household:	Less than HS	0.237	0.223	0.261	0.204	0.097	0.078	0.139	0.065
Head	HS degree	0.193	0.206	0.189	0.203	0.280	0.254	0.266	0.256
Education:	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	-0.031	(0.0089)
Age Indicators (60 years old excluded)	Age<=20	0.061	(0.034)
	Age>20 & Age<30	-0.009	(0.018)
	Age = 35	-0.032	(0.011)
	Age = 45	-0.001	(0.018)
	Age = 55	-0.021	(0.012)
	Age = 65	-0.010	(0.014)
	Age = 75	0.015	(0.018)
	Age = 85	0.044	(0.017)
	Age = 95	0.040	(0.044)
	Age >= 100	0.067	(0.087)
Race	African American	0.006	(0.008)
	White	0.011	(0.008)
Sex	Male	-0.003	(0.003)
Time of Year	1st quarter	-0.010	(0.004)
	2nd quarter	0.007	(0.004)
	3rd quarter	0.002	(0.005)
Day of Week (Monday excluded)	Friday	-0.006	(0.005)
	Saturday	-0.002	(0.005)
	Sunday	-0.001	(0.004)
Primary Payer (uninsured excluded)	Medicare fee for service	-0.003	(0.010)
	Medicare HMO	0.003	(0.010)
	Medicaid	-0.003	(0.014)
	Commercial Insurance	-0.015	(0.009)
	Uninsured	0.011	(0.010)
Comorbidities (no comorbidities excluded)	Prior AMI	0.008	(0.003)
	Congestive Heart Failure	0.072	(0.006)
	Chronic Obstructive Pulmonary Disease	0.006	(0.003)
	Diabetes	-0.001	(0.003)
	Other Comorbidities	0.027	(0.005)
Primary Diagnosis	AMI	0.041	(0.004)
	Cardiac dysrhythmias	-0.010	(0.003)
	Heart failure	-	-
ZIP Code of Residence Characteristics (College omitted)	Median income<30,000 (compared to >80,000)	-0.002	(0.012)
	Fraction with Less than HS Degree	-0.016	(0.037)
	Fraction with HS Degree only	0.036	(0.050)
	Fraction with some college	0.045	(0.050)
	Fraction with post-college	0.010	(0.065)
	Fraction White	-0.006	(0.034)
	Fraction African American	-0.031	(0.033)
	Fraction Hispanic	-0.018	(0.029)
	Percent over the age of 65	-0.091	(0.024)
	Percent Rural	-0.007	(0.005)
	Median Rent	3.85e-06	1.13e-05
	Missing ZIP code information (includes missing state information)	-0.007	(0.007)
	Area Prices	Per Diem June	0.0004
Per Diem January		-0.0004	(0.0002)
Year	Year = 1997	-0.005	(0.005)
	Year = 1998	-0.009	(0.006)
	Year = 1999	-0.010	(0.006)
	Year = 2000	-0.002	(0.005)
	Year = 2001	-0.006	(0.005)
	Year = 2002	-0.004	(0.005)
	Year = 2003	-0.013	(0.006)
	Observations	36800	
	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

A. Race & Sex	Race		Sex	
	African Amer. (1)	Hispanic (2)	Male (3)	Female (4)
Local area: mean log(costs) mortality	-0.030 (0.028)	0.0013 (0.030)	-0.029 (0.0089)	-0.034 (0.014)
Observations	1515	1558	22920	13880
Mean of Dep. Var.	0.046	0.051	0.054	0.064

B. Insurance Status	Private (5)	Public (6)	Uninsured (7)
	Local area: mean log(costs) mortality	-0.016 (0.0082)	-0.036 (0.012)
Observations	10401	24124	2275
Mean of Dep. Var.	0.035	0.067	0.061

C. Home Region	Census Region				Exclude Missing State/ZIP (12)
	Northeast (8)	Midwest (9)	West (10)	South (11)	
local area: mean log(charges) mortality	-0.039 (0.015)	-0.021 (0.013)	-0.084 (0.043)	-0.046 (0.012)	-0.036 (0.010)
Observations	11858	9265	1402	8356	30118
Mean of Dep. Var.	0.062	0.052	0.073	0.057	0.058

D. Models with Destination Controls	2000 Census County Controls (13)	1995 Amer. Travel Survey Controls (14)
	Local area: mean log(costs) mortality	-0.029 (0.010)
Observations	36800	28889
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

	3-Digit ICD9-CM Diagnosis Codes	Mortality Rate	Local area: mean log(costs) mortality		Obs.
			Coeff.	S.E.	
Top 10 Most Frequent Emergency Diagnoses	410 Acute myocardial infarction	0.089	-0.033	(0.013)*	14887
	414 Other chronic ischemic heart disease	0.007	0.002	(0.003)	12014
	427 Cardiac dysrhythmias	0.030	-0.032	(0.011)**	9720
	428 Heart failure	0.042	-0.027	(0.011)*	12193
	434 Occlusion of cerebral arteries (stroke)	0.062	-0.031	(0.016)*	6416
	486 Pneumonia	0.039	-0.010	(0.011)	11296
	491 Chronic bronchitis	0.028	-0.005	(0.011)	6209
	780 General symptoms	0.003	0.004	(0.003)	9160
	786 Symptoms involving respiratory system and other chest symptoms	0.001	-0.001	(0.001)	14058
	820 Fracture of neck of femur (hip fracture)	0.024	-0.013	(0.012)	5308
Pooled Diagnoses	All Emergency admissions	0.038	-0.011	(0.005)*	277260

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. *=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
Local-area level:					
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	10.3	71.9	11.5
Race	White	0.98	0.14	0.94	0.24
Comorbidities	No Comorbidities	0.40	0.49	0.40	0.49
Area Prices	Per-diem in January	120	18	130	18
	Observations	4228		4243	

B. Excluding Top 30% Most Costly HSAs

Variable		Low-Spending HSA		High-Spending HSA	
		Mean	Std Dev	Mean	Std Dev
Local-area level:					
Treatment	Mean log(costs) mortality	8.95	0.11	9.23	0.078
Personal Characteristics	Male	0.62	0.49	0.62	0.49
	Age	71.8	11.7	71.4	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	108	22	125	23
	Observations	12997		13036	

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)	Local Area measure quartiles (2)	Spending Dist'n: Exclude Top Quartile (3)	Measure:		
				median log(costs) mortality (4)	mean log(costs) unconditional (5)	heart-related emergencies: mean log (costs) mortality (6)
Patient or Local-Area cost measure	-0.026 (0.0076)		-0.031 (0.013)	-0.040 (0.0097)	-0.027 (0.014)	-0.024 (0.0098)
Mean log(costs) mortality: 2nd quartile		-0.0074 (0.0062)				
Mean log(costs) mortality: 3rd quartile		-0.014 (0.0058)				
Mean log(costs) mortality: Top quartile		-0.019 (0.0067)				
Number of HSAs	97	97	83	97	97	97
Observations	36597	36800	27874	36800	36800	36800
Mean of Dep. Var.	0.058	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 (4) uses the local-area measure calculated as the median of log(costs) for patients who died in the hospital, whereas column (5) uses the mean costs of all local emergency patients, whether or not they died in the hospital. Column (6) 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	3.98 (1.23)	-0.0061 (0.0021)	34128
ATS Metropolitan Area	mean log(Costs) mortality:	14	9.17 (0.148)	-0.049 (0.014)	36800
Hospital	mean log(Costs) mortality:	194	9.20 (0.266)	-0.023 (0.0077)	36800
	Teaching Hospital	194	0.073 (0.260)	-0.014 (0.0064)	36800

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	357	(244)	14887	451	341	(232)	36800	509
ICU	1097	(451)*	14887	1224	842	(327)*	36800	903
CCU	1080	(447)*	14887	873	543	(271)*	36800	570
Pharmacy	2261	(514)**	14887	2661	1343	(271)**	36800	1692
Medical Devices	2528	(997)*	14887	2498	1606	(595)**	36800	1782
Laboratory	1624	(290)**	14887	2001	1161	(227)**	36800	1631
Radiology	254	(78)**	14887	340	188	(48)**	36800	287
Nuclear Medicine	28	(25)	14887	105	72	(36)	36800	151
CT Scan	103	(19)**	14887	153	93	(19)**	36800	158
Operating Room	382	(352)	14887	700	263	(171)	36800	390
Anesthesia	147	(93)	14887	141	85	(47)	36800	77
Respiratory Svcs.	1048	(216)**	14887	504	635	(101)**	36800	345
Physical Therapy	39	(9)**	14887	40	27	(6)**	36800	37
Emergency Room	163	(49)**	14887	331	153	(42)**	36800	308
Cardiology	470	-1069	14887	3049	469	(514)	36800	1702
Recovery Room	73	(51)	14887	35	51	(27)	36800	29
Other	1096	(275)**	14887	1309	636	(154)**	36800	946
log(Total)	0.710	(0.209)**	14887	9.369	0.603	(0.098)**	36800	8.938
log(ICU & CCU)	0.932	(0.258)**	13157	7.374	0.771	(0.205)**	26876	7.195
log(Diagnostic)	0.777	(0.156)**	14883	7.518	0.650	(0.134)**	36783	7.349
log(Surgical)	0.500	(0.360)	13268	7.723	0.473	(0.197)*	29729	7.127
log(other)	0.820	(0.200)**	14886	8.548	0.645	(0.103)**	36799	8.150

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	261	(171)	238926	448	343	(197)	749762	548
ICU	1480	(355)**	238926	1227	977	(263)**	749762	882
CCU	533	(294)	238926	835	271	(183)	749762	557
Pharmacy	1519	(392)**	238926	2304	780	(193)**	749762	1446
Medical Devices	1822	(730)*	238926	2019	1140	(370)**	749762	1426
Laboratory	1371	(262)**	238926	2011	961	(205)**	749762	1617
Radiology	153	(64)*	238926	335	117	(40)**	749762	290
Nuclear Medicine	37	(17)*	238926	105	46	(21)*	749762	132
CT Scan	117	(21)**	238926	172	106	(20)**	749762	166
Operating Room	152	(220)	238926	527	99	(94)	749762	280
Anesthesia	83	(52)	238926	103	45	(24)	749762	56
Respiratory Svcs.	835	(130)**	238926	445	518	(78)**	749762	327
Physical Therapy	44	(16)**	238926	54	29	(13)*	749762	52
Emergency Room	165	(56)**	238926	320	166	(51)**	749762	298
Cardiology	136	-1081	238926	2525	188	(427)	749762	1216
Recovery Room	26	(29)	238926	28	21	(14)	749762	26
Other	938	(198)**	238926	1242	604	(106)**	749762	889
log(Total)	0.608	(0.153)**	238926	9.260	0.560	(0.060)**	749762	8.846
log(ICU & CCU)	0.884	(0.139)**	209447	7.370	0.759	(0.112)**	534388	7.199
log(Diagnostic)	0.617	(0.108)**	238844	7.549	0.522	(0.100)**	749352	7.365
log(Surgical)	0.329	(0.353)	200591	7.495	0.320	(0.185)	524508	6.934
log(other)	0.714	(0.133)**	238925	8.422	0.612	(0.077)**	749754	8.062

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:		Visitors	
	Local Floridians			
	(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.