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The Effects of Physician Characteristics on Patients' Hospital Discharge Destination and Length of Stay

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Abstract

We study the effects of physician, hospital, and market characteristics on length of stay and discharge destinations for cardiac inpatients in Florida hospitals in 2004, while controlling for patient characteristics. Using a competing risks hazard model, we analyze the determinants of whether patients are discharged home, to a skilled nursing facility, home under the supervision of a home health agency, or die within the hospital. Our study is unique in that we estimate a competing risks hazard model to identify the impact of physician education and training on hospital length-of-stay and post-hospital discharge destination. We find that physician characteristics are significantly related to transition rates to home discharge and that hospital and county characteristics impact the hazard rates for discharge to home health agencies and skilled nursing facilities.

Keywords: physician training, patients' length of stay, patients' discharge destination

1. Introduction

As national health care expenditures use an increasingly large share of national resources, government and private insurers have tried to control costs by pressuring hospitals and physicians to be more responsible for their treatment decisions. A predominant response to these pressures has been to shorten the time that inpatients remain in the hospital. According to the American Hospital Association the average length of stay in U.S. community hospitals has steadily decreased from 6.5 days in 1995 to 5.6 days in 2004 and 5.5 days in 2016.

Many empirical studies have shown that patients' length of stay depends primarily on patient's health, but also on hospital characteristics such as staffing ratios, total beds in the hospital, financial incentives and communication and coordination across health care workers (Waring, Marshall and Bishop 2015; Burke et al. 2015; Brusco et al. 2012; Needleman, Buerhaus, Mattke, Stewart and Zelevinsky 2002; Chen and Naylor 1994; Lichtig, Knauf and Milholland 1999; Burns and Wholey 1991; and Anderson et al. 2002). Although hospital characteristics may play a role in determining patients' length of stay, it is physicians who direct the majority of health care decisions and thus determine the majority of costs. Variations in physician characteristics such as quality of care could have important impacts on patients' outcomes and efficient use of resources within a hospital. To explore this possibility, we analyze the impact of physician characteristics on cardiac inpatients' length of stay and discharge destinations, where in-hospital mortality is a possible destination.

Physicians may impact a patient's ability to recover within the hospital by determining the choice and quality of procedures performed on the patient, and by the physician's competency when monitoring a patient's post-operative care. The effects of physician characteristics on patients' lengths of stay are difficult to predict, a priori. Higher quality physicians may reduce complications and thereby achieve a successful discharge home or to an institution with a shorter length of stay. On the other hand, higher quality physicians might obtain better outcomes by saving the frailest patients, thus lowering mortality rates but increasing lengths of stay through further interventions and care.

There has been an upsurge of interest in the effect of physician quality on health care outcomes, as demonstrated by several states, including New York and Pennsylvania, who have issued report cards on physicians which include information such as volume of patients treated or physician-specific risk adjusted mortality rates and several studies of the impact of physicians on treatments and outcomes (Einav, Finkelstein and Mahoney 2018; Eliason, Grieco, McDevitt and Roberts 2018; Clemens and Gottlieb 2014; Howard and Kaplan 2006; Jha and Epstein 2006; Mukamel, Mushlin, Weimer, Zwanziger, Parker and Indridason 2000; and Mukamel, Weimer, Zwanziger and Mushlin 2002).

Our study is unique in that we estimate a competing risks hazard model to identify the impact of physician quality on hospital length-of-stay and post-hospital discharge destination including in hospital mortality. Specifically, our study measures the effects of physician, hospital, and market characteristics on length of stay and discharge destinations for cardiac inpatients in Florida hospitals in 2004, while controlling for patient characteristics. Using a competing risks hazard model, we analyze the determinants of whether patients are discharged

home, to a skilled nursing facility, home under the supervision of a home health agency, or die within the hospital. To approximate physician quality, we include physicians' board certification, an indicator for whether the physician graduated from one of the top 30 medical schools, and the number of cardiac patients the physician treated in Florida in the prior three years (2001–2003).

2. Methodology

Patients' lengths of stay in a hospital and discharge destination are commonly used measures of health quality for hospitals but not for physicians. Shorter length of stay and discharge home, with or without home care, are generally associated not just with better quality of life for patients but also with reduced resource use (Han, Kim, Storfiell and Kim 2013). We are interested in examining the effect of physician quality on these parameters for cardiac patients, whose length of stay varies considerably (Akkerman and Knip 2004). Prior studies incorporating measures of physician quality have typically focused on risk adjusted mortality rates for physicians. However, if shorter stays and discharges home are desirable outcomes, risk adjusted mortality rates may not capture all the dimensions of health care quality that are of concern to patients. As stated earlier, it may not be possible to predict how a 'good' physician would impact length of stay independent of mortality or discharge destination. For instance, a good physician may be able to reduce mortality but with a longer hospital stay. It seems appropriate therefore to consider the joint outcomes of length of stay and discharge destination including in-hospital mortality.

A common method for analyzing patients' mortality and length of stay within a hospital has been to estimate two separate equations on these two "outcomes"; a regression method for length of stay with patient and hospital characteristics as covariates, and separately, a probit or logit model to estimate a patient's mortality, with length of stay as an independent variable (Gaughan, Gravelle, Santos and Siciliani 2017; Hamilton and Ho 1998; Phillips, Luef and Ritchie 1995; Burns and Wholey 1991). Likewise, models of the patient's discharge destination from the hospital are frequently estimated using a multinomial logit model that allows for an unordered categorical variable (Reineck et al. 2015; Mkanta et al. 2017; Howrey, Kuo and Goodwin 2011). These models do not account for the duration dependence of the discharge destination on the length of time a patient has spent in the hospital. As described further in Picone, Mark, and Shin-Yi (2003), length-of-stay is an outcome described by the probability of discharge from a hospital at each point in time, conditional upon not already being discharged. These conditional probabilities vary by discharge destination.

We use a competing risks hazard model to address the complication that both the length-of-stay and the post-hospital discharge destination are jointly determined by the physician's decision to release the patient from the hospital to a specific destination. To our knowledge Picone, Mark, and Shin-Yi (2003) is the only other study to analyze the length-of-stay and hospital destination decision using a hazard model with multiple destinations. Their study did not include physician characteristics, but focused on how changes in Medicare payments for home health agencies and for skilled nursing facilities influenced length-of-stay and discharge

destinations for Medicare patients.

Our goal is to determine whether physician, hospital, and market characteristics influence a patient's length of stay at a hospital and/or the probability that a patient is discharged to a given destination, after controlling for patient characteristics. The unit of analysis is patient *i* seen by physician *p* at hospital *h*. A patient exits to one of four mutually exclusive destinations; either death within the hospital (*d*), discharge home (*m*), discharge to a skilled nursing facility (*snf*), or discharge home under the care of a home health agency (*hha*). Once a patient has exited to one of these destinations the patient is no longer at risk for another destination. The empirical model is constructed so that a patient enters at *time 0* and exits such that *exit time* = length of stay.

Below is the failure-specific hazard rate at time *t* for a patient's risk of being discharged to destination *j*:

$$\lambda_j(t,x) = \lim_{dt\to 0} \frac{\Pr\{t \le T < t+dt, J = j \mid T \ge t, x\}}{dt}$$

and the overall hazard rate for all destinations is

$$\lambda(t,x) = \sum_{j=1}^{m} \lambda_j(t,x)$$

see Rodriguez (2005) and Kalbfleisch and Prentice (2002). The partial likelihood function for the Cox regression is

$$L = \prod_{j=1}^{m} \prod_{i=1}^{k_j} \frac{e^{x'_{ji(j)}\beta_j}}{\sum_{k\in R(t_{ji})} e^{x'_{jk}\beta_j}}$$

where *m* is the total number of destinations and *k* is the total number of persons in group *j*.

We estimate the Cox competing risks regression stratified by type of failure, which again allows the baseline hazard function to be different for each destination. We also assume that the effects of the covariates differ across the four possible destinations. The time to failure of each destination type is the minimum of the failure times associated with these risks.

3. Data

We match 2004 Florida inpatient hospital records to data on physician and hospital characteristics. Patient and hospital data are from the Florida Agency for Health Care Administration. We analyze all patients who received a particularly costly procedure in the U.S., percutaneous transluminal coronary angioplasty (PTCA). Using one procedure such as

the PTCA has many advantages. First, it allows for comparison to many studies that have analyzed PTCA patients. Second, we can focus on physician skills that are required for one procedure, rather than analyzing different diagnoses that may be treated differently by different physicians. Third, according to the Agency for Healthcare Research and Quality (AHRQ), the PTCA is a relatively common procedure, but it does require "proficiency with the use of complex equipment, and technical errors may lead to clinically significant complications" (AHRQ 2007), implying that physician quality is likely to have an impact on patients' outcomes.

3.1 Physician Characteristics

Quality of care is measured by the quality of the operating physician who treats the patient, or if the patient does not have an operating physician, the quality of the attending physician. One measure of quality is whether the medical school attended by the physician is in the top 30 medical school rankings, as determined by the U.S. News & World Report (U.S. News and World Report 2006). We also use board certification to distinguish physicians by creating an indicator for physicians who have one or more of the following certifications: cardiac, another surgical specialty, internal medicine, or a non-surgical specialty. Data on physicians are provided by the Medical Quality Assurance division of the Florida Department of Health.

For cardiac-related procedures, several studies have shown that higher volumes of coronary artery bypass graft surgeries by hospitals and physicians are associated with lower mortality rates (Wen, Tang, Lin, Tsai, Chen and Li 2006; AHRQ 2004). We calculated the total number of times each physician performed a coronary artery bypass surgery, percutaneous transluminal coronary angioplasty, or abdominal aortic aneurysm repair from 2001-2003, using the primary and secondary procedure codes of the physicians' patients. We expect doctors who have treated a higher volume of patients to provide higher quality to cardiac patients.

Figure 1 contains plots of the smoothed hazard estimates for discharge to each of the four destinations in our data. Clearly, the majority of patients are discharged home, and the hazard of being released to one of the other three destinations increases with the length of the patient's stay in the hospital.

Table 1 shows the fraction of patients discharged to each destination, based on the characteristic of the treating physician. These raw statistics indicate that the mean in-hospital mortality rate is higher, and the fraction of patients discharged home is lower, for patients treated by less experienced physicians or physicians who are from lower-ranked medical schools. However, mortality rates change by less than one percentage point between any two physician characteristics; in fact, the range in mean mortality rates across all categories of physician characteristics is quite small, from 1.0% to 1.7%. Overall, we were surprised by the very small differences in the proportion of patients discharged to each destination, across physician characteristics.

In Table 2 we created simple means for patients' length of stay and three measures of patients' health. ICISS is a key measure of survival probability (explained further below), and we also created indicators for patients who experienced an acute myocardial infarction (AMI), or heart attack, in the hospital, and whether the patient received a coronary artery stent implant or a

drug-eluting stent (Stent). An AMI is an outcome that may be beyond the physician's control, but "timely and effective treatments" are "essential" for patient survival (AHRQ 2007). In contrast, providing a stent is a specific procedure decided upon by the physician. Using stents significantly reduces restenosis rates by approximately 20% (Applegate 2004).

Table 1. Proportion of Patients Discharged to Each Destination by Characteristics of Treating Physician, 2004

	Discharge Destination			
Physician Characteristics	Home *(n = 28,033)*	Home Health Agency *(n = 1,497)*	Skilled Nursing Facility *(n = 654)*	In-Hospital Mortality *(n = 366)*
*Volume Quartiles, PTCA patients**				
DOCVOL ≤ 257	0.904	0.059	0.024	0.013
258 ≤ DOCVOL ≤ 396	0.926	0.045	0.017	0.011
397 ≤ DOCVOL ≤ 609	0.917	0.049	0.022	0.011
DOCVOL ≥ 610	0.926	0.045	0.019	0.010
*Medical School Ranking***				
Top 30 Medical School	0.922	0.045	0.021	0.011
Not Top 30 Medical School	0.916	0.050	0.022	0.012
Board Certification				
Cardiology	0.924	0.050	0.016	0.010
Surgical Field	0.903	0.065	0.022	0.010
Internal Medicine	0.903	0.049	0.031	0.017
Non-Surgical Field	0.925	0.042	0.020	0.012
Not Board Certified	0.910	0.058	0.021	0.011

*DOCVOL is the number of times each physician performed a coronary artery bypass surgery, percutaneous transluminal coronary angioplasty, or abdominal aortic aneurysm repair from 2000-2003.
** School rankings are from the U.S News and World Report (USNWR 2006).

The results in Table 2 show that the patients' mean length of stay is slightly lower for patients treated by physicians who performed more than 396 procedures in the prior 3 years. Based on a rank significance test there is no significant difference in the average survival probability of patients across any of the physician characteristics. The fraction of patients given a stent is higher for patients treated by more experienced physicians or those certified in cardiology. In contrast, physicians who are not from the top 30 medical schools perform more stents, on average. The significance test indicates that there is a statistically significant difference between the underlying distributions of the fraction of patients given a stent amongst all patients treated by a physician from a to p30 medical school, and the fraction of patients given a stent amongst all patients *not* treated by a physician from a top 30 medical school.

3.2 Patient Characteristics

Table 2. Length of Stay and Patients' Case Mix across Physician Characteristics

	Average of Patient Means			
Physician Characteristics	Patients Mean Length of Stay	ICISS (Survival Probability)	Fraction of Patients had AMI[a]	Fraction of Patients given Stent[b]
Volume Quartiles, PTCA patients				
DOCVOL ≤ 257	3.5	0.82	0.29	0.81
258 ≤ DOCVOL ≤ 396	3.0	0.84	0.25	0.83
397 ≤ DOCVOL ≤ 609	2.9	0.83	0.27	0.85
DOCVOL ≥ 610	2.9	0.83	0.25	0.86
Significance test (*P* value)*	0.000	0.110	0.000	0.000
Medical School Ranking				
Top 30 Medical School	3.1	0.83	0.29	0.80
Not Top 30 Medical School	3.1	0.83	0.26	0.84
Significance test (*P* value)	0.024	0.108	0.000	0.000
Board Certification				
Cardiology	3.02	0.83	0.25	0.87
Surgical Field	3.05	0.83	0.25	0.84
Internal Medicine	3.49	0.82	0.27	0.82
Non-Surgical Field	2.90	0.83	0.27	0.84
Not Board Certified	3.34	0.82	0.27	0.82
Significance test (*P* value)**	0.073	0.936	0.264	0.002

a AMI – Acute Myocardial Infarction

b Stent could be a Drug-Eluding or Non-Drug Eluding Stent

* *P* value is from a rank test of the null hypothesis that the quantity for the top quartile (DOCVOL ≥ 610) is significantly different from those of the three lower quartiles combined.

** *P* value is from a rank test of the null hypothesis that the quantity for the cardiology certification is significantly different from those of the three lower quartiles combined

Following categorizations by AHRQ, we identify recipients of a PTCA as patients discharged with ICD-9 codes of 0066, 3601, 3602, or 3605 in any procedure field. As frequently discussed in the literature, there is a strong likelihood that the researcher does not observe all indicators of patient health that are perceived by hospital staff and used in treatment decisions. Unobserved health differences that influence physicians' choice of destination for patients can bias estimated results on coefficients. In addition to patient demographic information such as age, gender, and race, we control for 11 secondary diagnoses which would indicate the health status of the patient at the time of admission, following Baker et al. Baker, Sudano, Albert, Borawski and Dor (2001). All patient characteristics are shown in Table A1 in the Appendix.

We also include an indicator equal to one if the patient was admitted during the week and equal to zero if admitted on the weekend, since previous research has shown that the physicians that are more highly regarded are able to avoid weekend work more frequently.

We also construct a measure of survival risk, the ICD-9 Injury Severity Score (ICISS). For each of the patient's ICD-9 diagnoses (one primary and up to nine secondary), survival risk ratios (SRRs) are derived by dividing the number of survivors in each ICD-9 code by the total number of patients with the same ICD-9 code. ICISS is calculated as the simple product of the SRRs for each of the patient's diagnoses. The ICISS has been shown to outperform other standard measures of patient severity in recent empirical work (Osler, Rutledge, Deis and Bedrick 1996; Rutledge, Turner, Emery and Kromhout-Schire 1998; Huynh, Guy and Rutledge 1998). We use the entire population of 2,512,406 inpatients to construct the ICISS.

We further limit our sample by excluding patients who were transferred to a hospice or to an Intermediate Care Facility (ICFs). In Florida ICFs are predominantly for the treatment of the mentally retarded. We group patients into four insurance categories: Medicare, Medicaid, privately insured, and uninsured/charity and exclude patients who have *other* state and local government insurance such as County Public Health Programs, or who have Workers' Compensation or VA, since these patients represent less than three percent of the sample and payment incentives which are unclear, a priori. These restrictions yielded a sample size of 30,557 admissions for the four destinations.

3.3 Hospital Characteristics

Hospital characteristics are shown in Table 3. Hospitals' profit margins, defined as operating revenues minus operating expenses as a percent of operating expenses, are included as covariates because they may affect its purchasing, staffing, and treatment decisions – all of which may impact in-hospital mortality and length of stay. For hospitals which are members of the Council of Teaching Hospitals (COTH) of the Association of Medical Colleges, a selective group of hospitals with residency programs, we created the indicator COTH = 1, and 0 otherwise.

Ownership type of the hospital, where types are privately owned, not-for-profit, government owned, and teaching hospitals, are also included. Teaching hospitals are not included in the other three ownership categories because amongst both providers and patients, there is a perception that teaching hospitals a) have the highest quality physicians; and b) have a greater percentage of uninsured patients than (non-teaching) not-for-profit and for-profit hospitals. In our sample the range of physician quality was smaller in teaching hospitals than in non-teaching hospitals, and the average quality much higher when measured by school ranking.

An indicator for the presence of a Coronary Care Unit is included because these units provide continuous intensive care for cardiac patients. We also include nurses per bed since nurses have a role in properly providing pre- and post-operative care to patients, and thus influence patients' length of stay in the hospital.

3.4 County Characteristics

A Herfindahl index (HHI) is created based on inpatient admissions, where higher values represent reduced competition in the market. Personal income per capita and population density, measured as population per square mile, are included to capture market demand conditions for health care services. The number of approved home health agencies (HHAs) per 100,000 people in the county and the number of beds in skilled nursing facilities for every 1,000 people in the county describe local supply of these services.

4. Results

Results in Table 3 show the coefficients for each covariate and discharge destination. Our results indicate the patients' health is the dominant determinant of the discharge destination, particularly when patients die within the hospital. As expected, the estimates indicate that patients who have an AMI in addition to a PTCA are in more frail condition: they have a lower hazard of going home with no post-hospital care, and a significantly greater tendency to be released to a home health agency or skilled nursing home. Patients who receive a stent, on the other hand, have a greater tendency to go home immediately and are approximately 23% less likely to die within the hospital after controlling for physician, hospital, and all other patient characteristics.

Table 3 also shows that younger patients (under the age of 80), males, and those who have higher survival probabilities upon diagnosis, have decreased probabilities of dying within the hospital, all other variables held constant. Results of hazard ratios for patients' secondary diagnoses are not shown (they are available from the authors upon request), but patients with dementia or a vascular disease, or who had a stroke, had a greater probability of dying within the hospital.

A patient's insurance status also appears to significantly impact his/her discharge destination, as Medicaid and privately insurance patients, relative to Medicare patients, are significantly less likely to be discharged to a HHA. Previous studies have found that relative to uninsured patients, Medicaid and Medicare patients are significantly more likely to be discharged to a skilled nursing facility or to home health care (Schwarzkopf, Ho, Quinn, Snir and Mukamel 2016).

Patients of physicians who graduated from a top medical school, physicians with a higher volume of patients, and/or board certified physicians are all more likely to be sent home. Neither physician's prior patient volume nor graduation from a top 30 medical school significantly influences patients' risk of in-hospital mortality.

Table 3. Competing Risks Hazard Model for PTCA Patients (ALL Insurance Categories)

n = 122,200	Home	Home Health Agency	Skilled Nursing Facility	In-Hospital Mortality
Patient Characteristics:[a]				
Uninsured	0.017	-1.420***	-0.966	0.631***
Medicaid	-0.058*	-0.443***	-0.425*	0.057
Private Insurance	0.059***	-0.291***	-0.192	-0.077
Survival Probability	4.747***	2.595***	1.523***	-6.248***
Acute Myocardial Infarction	-0.073***	0.192***	0.608***	0.005
Use of Stent	0.334***	-0.107**	0.123	-0.243*
Female	-0.142***	0.164***	0.432***	0.382***
Black	-0.157***	-0.096	-0.074	-0.604**
Hispanic	-0.080***	0.101	-0.195	0.146
Age 0 – 39	0.179***	-0.525*	-4.662	-2.144**
Age 40 – 49	0.206***	-0.864***	-1.781***	-1.375***
Age 50 – 59	0.212***	-0.596***	-1.849***	-1.107***
Age 60 – 69	0.229***	-0.475***	-1.116***	-0.803***
Age 70 – 79	0.205***	-0.177***	-0.522***	-0.441***
Weekday	0.215***	0.208***	0.394***	0.081
Physician Characteristics:				
Volume of Cardiac Patients	0.001***	0.001	0.000	0.003
Top 30 Medical School	0.031**	-0.042	-0.036	-0.003
Board Certifications:				
Cardiology Specialty	0.086***	0.134	0.145	0.495
Surgical Specialty	-0.002	0.097	0.145	0.307
Internal Medicine	-0.024	-0.301**	0.220	0.407**
Non-Surgical Specialty	0.043***	-0.152**	0.224***	0.476***
Hospital Characteristics:				
Number of Beds	-0.001***	-0.005***	-0.002**	0.000
Profit Margin	0.010	-0.534***	-0.618***	0.112
For-Profit Ownership	0.003	0.242***	0.099	-0.126
Government Owned	-0.021	0.184*	0.035	-0.887
Teaching Hospital	-0.220***	-0.209	-0.397	0.029
Coronary Unit	0.092***	0.112*	-0.096	0.051
Nurses per Bed	0.001	0.037**	0.028	0.016
COTH	0.258***	0.311**	0.148	0.088
County Characteristics:				
Herfindahl Index based on hospital admissions	0.189***	-0.275**	0.025	0.165
Number of approved HHAs per 100,000	0.000	0.017***	-0.027***	-0.010
Number of skilled nursing homes per 1,000 population	0.016***	-0.021	0.054*	0.026
Per Capita Income	-0.001	0.002	-0.013	-0.009
Population per square mile	0.009	0.077	0.037	0.058

[a] Results for other patient variables are available from the authors upon request.
*** Indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

The effect of volume of cardiac patients treated by a physician is significant, but quite small. Physicians with board certifications have the largest statistical impact on the hazard rate of discharge home, as patients treated by certified physicians are approximately 9% more likely to exit home than patients treated by non-certified physicians. We also estimated the empirical model using only the Medicare patients. Age is an important component in health outcomes, and the production function for mortality may differ for those over age 65 compared to younger generations. We completed an estimation separately for Medicare patients because there is little overlap between the age distribution of Medicare patients and that of Medicaid and uninsured patients. The coefficients results were extremely similar in size and significance when only the Medicare sample was used. These results are available from the authors upon request.

Among hospital characteristics, greater profit margins are associated with lower rates of discharge to HHAs and skilled nursing facilities. Perhaps hospitals who keep patients within the hospital for recovery experience a greater increase in revenues than in costs towards the end of the patients' stay. The presence of a coronary care unit within a hospital increases the likelihood a patient is discharged home or to a home health agency, suggesting these units aid may provide superior care. Teaching hospitals have a lesser propensity to discharge patients home, relative to non-profit hospitals, and for-profit hospitals are more likely to discharge patients to HHAs than non-profits, but there are no other significant associations between hospital ownership and hazard ratios for the discharge destinations. The probability of dying within a hospital is not significantly associated with any of the hospital characteristics once patient, physician, and county characteristics are included in the model. Hospitals with more beds are less likely to discharge patients to a skilled nursing facility or HHA, consistent with previous research (Howrey, Kuo and Goodwin 2011).

County characteristics also influenced a patient's risk of exiting home. Higher concentrations of hospital admissions significantly increase hospitals' propensity to discharge patients home and reduces the propensity to discharge to a HHA. Greater numbers of approved home health agencies (HHAs) per 100,000 people in the county increases the likelihood patients are discharged to a HHA and reduces the likelihood patients are discharged home or to a skilled nursing facility. This is consistent with other results and the theory that greater availability of HHAs will help hospitals dismiss more patients home when home care supervision is available (Picone, Mark, and Shin-Yi 2003).

If an independent variable has significantly positive (negative) coefficients for exiting home, to a home-health agency, *and* to a skilled nursing facility, then the independent variable is associated with a decrease (increase) hospital length-of-stay. Based on the results in Table 3, we find that Medicaid and black patients, and patients in hospitals with a larger number of beds, tend to have decreased hazards of being released to home, HHA, and SNF destinations and therefore tend to have longer hospital length-of-stays. In contrast, shorter hospitals stays are associated with higher survival probabilities, doctors who have treated higher volumes of former cardiac patients, board certified cardiologists, and hospitals with more nurses per bed and/or who are members of the COTH association of medical colleges.

5. Discussion

Our study is the first to investigate the length-of-stay/discharge destination decision employing a competing risks hazards model with multiple destinations and including physician characteristics. Our estimates indicate that a patient's health, demographic information, hospital and physician characteristics, and market conditions influence the discharge destination decision.

The likelihood of being discharged home is higher for patients who are treated by doctors from a top 30 medical school, with a board certification in cardiology, or who have treated greater numbers of cardiac patients in the previous three years. However, the sizes of these impacts are quite small; all are under a 10% change. None of the indicators for higher physician quality have a significant impact on patients' risk for in-hospital mortality.

Hospitals' who have a coronary unit or who are members of COTH, a prestigious association of medical colleges, are more likely to discharge patients home or to a home health agency. Hospitals with higher profits margins are less likely to discharge patients to a home health agency or to a skilled nursing facility. However, once patient and physician characteristics are controlled for, hospital characteristics have no impact on the hazards of patients dying within the hospital.

Based on data for PTCA patients treated in Florida hospitals in 2004, patients are *not* less likely to die within the hospital when treated by board certified cardiologists, physicians from top medical schools, or by physicians with higher volumes of prior patients (after accounting for patient and hospital characteristics). These results are in contrast to prior studies that have found that certification in cardiology or higher volumes of prior patients are associated with lower mortality rates. We attribute this contrast to the fact that prior studies have estimated the mortality and length-of-stay determinants separately. When these decisions are jointly determined the results are different. Our study suggests that the effect of physician quality may not be large enough to affect mortality but can alter the course and length of treatment and the quality of outcomes for patients short of mortality.

These findings are an important step in understanding the relationship between physician characteristics and discharge destination. Physicians play a key role in determining a patient's discharge destination. As the U.S. population continues to grow older and demand greater care, physicians' decisions regarding their patients' discharge destinations will have important implications for private and public health care spending, and for patients' outcomes. Future work should also consider 30-day outcomes, as this study did not have access to such data.

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Appendix

Appendix 1. Characteristics of PTCA Patients within Each Discharge Destination

As a percentage of all those exiting to each destination:	Home *(n = 28,033)*	Home Health Agency *(n = 1,497)*	Skilled Nursing Facility *(n = 654)*	In-Hospital Mortality *(n = 366)*
Uninsured	3.7%	1.4%	1.0%	6.8%
Medicaid	3.1	3.2	2.7	3.8
Private Insurance	32.2	12.1	6.5	14.1
Medicare	56.4	82.3	89.6	75.0
Survival Probability	85.1	69.3	60.6	28.0
Acute Myocardial	25.4	37.9	44.5	36.4
Stent	86.0	59.7	56.2	29.3
Female	31.9	47.5	57.2	47.8
Black	6.3	8.4	7.5	4.1
Hispanic	8.5	12.2	6.6	10.3
Age 0 – 39	1.5	0.7	0.0	0.3
Age 40 – 49	9.5	2.9	1.5	3.5
Age 50 – 59	21.2	9.4	3.5	9.5
Age 60 – 69	28.8	18.7	13.6	19.8
Age 70 – 79	28.0	38.0	38.4	34.0
Over Age 79	11.1	30.4	43.0	32.9
Weekday	72.8	68.8	70.1	63.9
Secondary Diagnoses:				
Diabetes	20.4	13.9	9.3	6.8
Cancer	1.1	1.4	1.5	0.8
Dementia	0.3	1.0	1.1	0.8
Heart Failure	8.2	29.7	37.3	33.4
Hypertension	49.3	25.8	18.9	6.3
Stroke	1.3	2.2	4.3	4.1
Vascular Disease	4.5	3.5	4.0	2.4
Pulmonary Disease	11.3	19.5	20.1	13.9
Respiratory Disease	1.3	8.9	12.5	36.9
Renal Disease	1.4	5.8	9.6	20.0
Previous Myocardial	7.1	2.3	1.2	0.0
Obese	16.1	14.3	9.5	12.0
Other Heart Disease	18.9	27.8	27.4	41.3

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