How Healthy Are Our Hospitals:
An Analysis of Hospital Quality and Patient Volume

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Table of Contents

Abstract

This paper examines the relationship between a hospital's patient volume and performance on quality measures. I used data from the Centers for Medicare and Medicaid Services (CMS) Hospital Compare website and Medicare cost reports to determine the relationship between the hospital's number of patient days and their compliance with 39 quality measures, using regression analysis. This study also controls for four potentially confounding variables that may affect quality and patient volume: hospital location, hospital size, number of employees, and whether the hospital is a teaching hospital. I found that an increase in number of patient days had a positive relationship with a hospital's performance on the chosen quality measures. This relationship held even when including control variables. This conclusion supports the findings from the greater field of research that patient and physician volume improve patient outcomes and procedural efficiency in a hospital setting. Possible policy effects from this research could include Medicare-mandated volume thresholds on certain surgeries or procedures, or regionalization of high-risk procedures to only high-volume hospitals.

Introduction

With the 2010 Affordable Care Act extending health insurance coverage to 7 million individuals, the number of individuals seeking health care services will surely increase. But how will this increase in patient volume affect hospitals and their quality performance? In this research project I will seek to determine the relationship between a hospital's patient volume and their performance on a number of quality measures.

The predominant theory on patient volume and quality is that a hospital gets more procedural practice with a high patient volume, thus causing them to become more proficient, more effective, and to even have better patient outcomes[i]. For example, a 1999 study on regionalizing major surgery for Medicare patients to high-volume hospitals recognized that "large population-based studies have consistently demonstrated better outcomes for cardiovascular surgery, major cancer resection, and other high-risk procedures at high-volume centers."[ii] Another found that "one study of pancreaticoduodenectomy (also known as the Whipple Procedure) [saw] surgical mortality was fourfold higher at very-low-volume hospitals than at high-volume centers (16% vs. 4%)." [iii] Yet another study in 1998 found that "when procedures such as pancreatectomy and esophagectomy are attempted, there is strong evidence that these can be performed more safely in high-volume referral centers."[iv]

This paper will not look at patient volume and its correlation with *patient outcomes* such as mortality rates; rather, I will examine patient volume and its correlation with *process of care measures*. This is because I want to examine the

quality of the healthcare services provided, and outcome measures are not always good indicators of quality. For instance, a physician could perform all of their processes correctly and still lose a patient due to many varying factors; there are too many unknown variables to accurately measure quality at this level using outcome measures. However, process of care quality measures "are used to gauge how well an entity provides care to its patients,"[v] and are also called "timely and effective care measures."[vi] An example of a process of care measure would be the percentage of acute myocardial infarction (AMI) patients who received a beta blocker medication within 24 hours after hospital arrival. Process of care quality measures are useful in showing the full picture of a hospital's quality performance because, according to CMS, they show "the percentage of hospital patients who receive treatments known to get the best results for certain common, serious medical conditions or surgical procedures" as well as "how quickly hospitals treat patients who come to the hospital with certain medical emergencies."[vii]

By examining the effect of a hospital's patient volume on its quality, we will gain further insight into potential policy decisions. If there is a clear positive relationship between high patient volumes and high performance on quality measures, policy makers may consider implementing certain "volume thresholds" in order for a hospital to perform a certain procedure on a federal program beneficiary.

An example of this is in 2012 when CMS set volume thresholds for both hospitals and physicians for transcatheter aortic valve replacement (TAVR), which is a procedure to fix a failing heart valve.[viii] In order to be reimbursed for a TAVR

procedure, a hospital must meet stringent volume thresholds "to both initiate a program and maintain competency."[ix] Only 341 cardiovascular programs meet those requirements based on 2010 data.[x] These volume thresholds will "significantly limit adoption of TAVR to high-volume hospitals with experienced multidisciplinary heart teams."[xi]

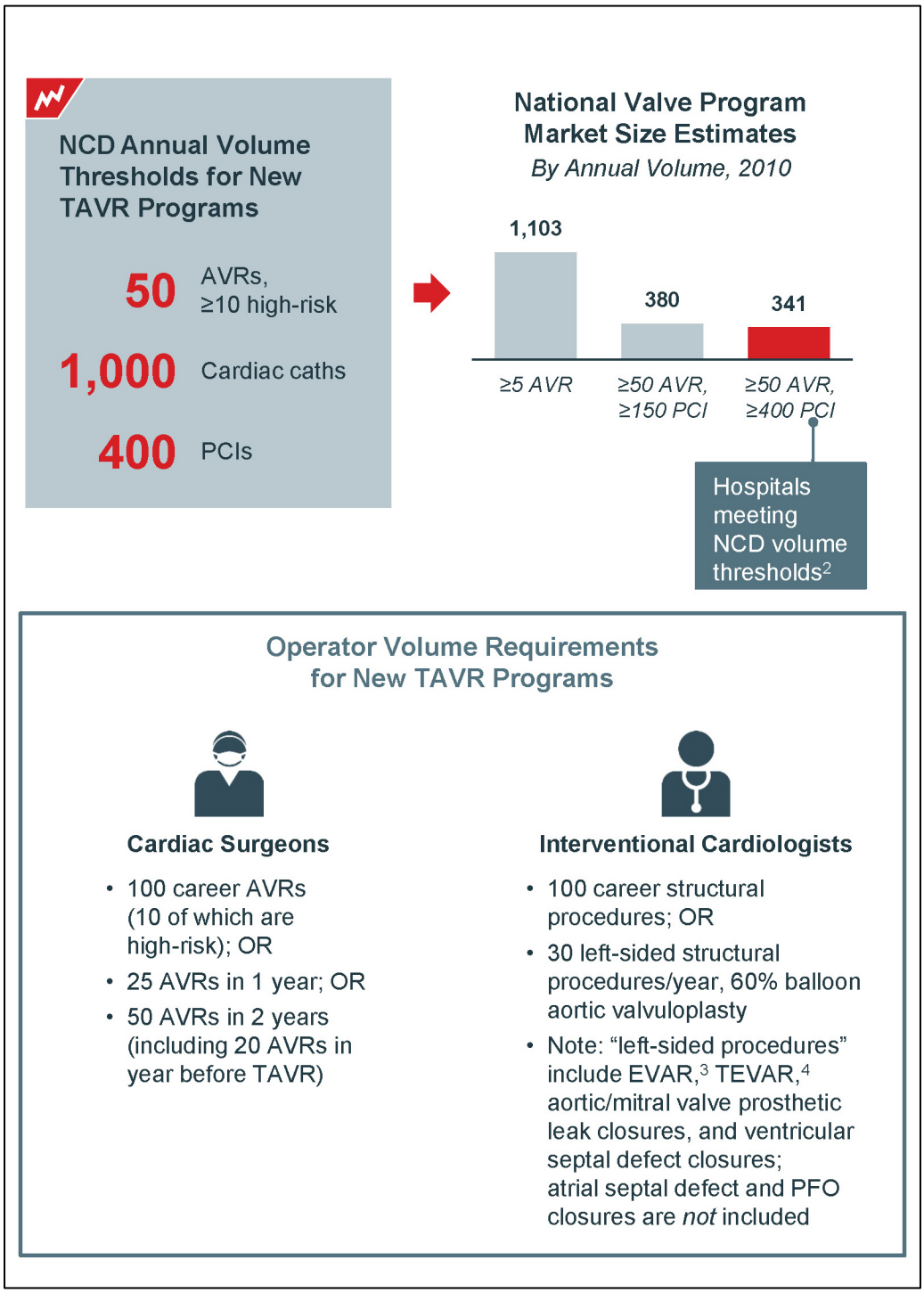

Figure 1- Volume Thresholds for TAVR Procedures (CMS, "Decision Memo for TAVR," available at: www.cms.gov, accessed September 28, 2012; Tommaso et al., Journal of Thoracic and CV Surgery, 2012, 143: 1254-1263; Cardiovascular Roundtable research and analysis.)

Prior Research

There is a significant amount of research dedicated to the study of patient or procedure volume and quality outcomes. As discussed above, a 1999 study entitled "estimated how many lives would be saved by regionalizing 10 surgical procedures for Medicare patients" to high-volume hospitals by "calculating the potential benefits of regionalization in terms of the number of lives saved."[xii] The study found that the " total number of lives saved by regionalization depends on assumptions about the mortality reductions likely to be achieved," which varied from a 5% to 25% reduction in mortality. They concluded that "regionalizing common, intermediate-risk procedures would save far more lives than regionalizing less-common, higher-risk operations."[xiii]

Another study in 1999 used Medicare claims data to "perform a national cohort study of 7,229 Medicare patients" to examine the relationship between hospital volume and mortality for the Whipple procedure.[xiv] They found that more than half of the patients studied had this procedure performed at a hospital that performed fewer than two Whipple procedures per year, and that the mortality rates at these low-volume hospitals were three to four times higher than at hospital that performed a higher volume of Whipple procedures.[xv] It concluded that "hospital experience is particularly important" with this specific procedure and that "Patients considering this procedure should be given the option of care at a high-volume referral center."[xvi]

Additionally, a 1979 study "examined mortality rates for 12 surgical procedures of varying complexity in 1,498 hospitals to determine whether there

[was] a relation between a hospital's surgical volume and its surgical mortality."[xvii] They found that "the mortality of open-heart surgery, vascular surgery, transurethral resection of the prostate, and coronary bypass decreased with increasing number of operations" and that "hospitals in which 200 or more of these operations were done annually had death rates, adjusted for case mix, 25 to 41 per cent lower than hospitals with lower volumes."[xviii] Their data supported the idea of regionalizing certain procedures to high-volume hospitals.[xix]

There is also a growing amount of study surrounding cancer care, supporting the hypothesis that "specialist cancer care significantly improves patient outcomes… using patient volume to represent specialization."[xx] A review of literature in 2000 that "search[ed] for evidence that hospital or physician volume or specialty affects the outcome of cancer care" found that the existing literature "supported a volume-outcome relationship… for cancers treated with technologically complex surgical procedures."[xxi]

Hypothesis

I expect to find a positive relationship between a hospital's patient volume and their performance on quality measures. I also expect this relationship to hold when controlled for hospital location (rural or urban), hospital size (number of beds), size of staff (number of full time employees) and for factors such as whether a hospital is a teaching hospital.

The reasoning for this hypothesis is that I believe that this study will have similar results to previous studies on hospital patient share and quality. It makes

logical sense that the more patients a hospital sees, the more practice they will get to become more efficient and more effective. Thus, a hospital with a high patient volume will have a high performance on quality indicators, while a hospital with low patient volume will have a low performance on quality indicators.

Data Set

The data used in this research project comes from two different sources. The hospital patient volume data will come from CMS Medicare cost reports. CMS requires that every "Medicare-certified institutional provider [must] submit an annual cost report" which "contains provider information such as facility characteristics, utilization data, cost and charges by cost center (in total and for Medicare), Medicare settlement data, and financial statement data."[xxii] The measure of patient volume that will be used is patient days.

The process of care quality measures and each hospital's individual performance will come from the CMS Hospital Compare website. Hospital Compare is a federal website that provides "information about the quality of care at… Medicare-certified hospitals across the country" for consumers.[xxiii] The data sources for timely and effective care measures are: data submitted by hospitals to the CMS Certification And Survey Provider Enhanced Reporting (CASPER) system; data submitted by hospitals to the QIO Clinical Data Warehouse through the CMS Abstraction and Reporting Tool (CART); and The Joint Commission.[xxiv]

The process of care measures are divided into categories. This study will use the following categories of data: Blood Clot Prevention and Treatment; Heart Attack;

Heart Failure; Pneumonia; SCIP (Surgical Care Improvement Project); and Stroke Care.

There are some limitations to this data set. First, there was no available data for individual procedure patient volumes at the time this research was completed. Therefore, total patient volume was substituted instead. Second, there is no simple overall process of care quality indicator, so we must look at the process of care indicators in the aggregate to draw conclusions.

Methods

The data analysis in this study will be done using the statistical software program STATA. I will first run linear regressions on each of the 39 quality measures, using patient days as the independent variable and the percent of hospitals that are in compliance with that quality measure as the dependent variable. I will then select the quality variables with the most variability, range, or most interesting outcome to graph visually and discuss the result. I will choose one variable from each category to discuss.

I will then run a linear regression on these chosen variables, now controlling for other dummy variables to see if the results change significantly. The variables that I will be controlling for are:

- Hospital location (measured as rural or urban)
- Hospital size (measured as number of beds),
- Size of staff (measured as number of full time employees)
- Whether a hospital is a teaching hospital (measured as yes or no)

Not all of the 4,677 hospitals with available Hospital Compare data have quality measure data available for every measure. The reason for this is that a hospital may have too small a sample size or may not have had any patients where that quality measure was relevant. For that reason, the number of available observations for each quality measure fluctuates.

Regression analysis was chosen as the method of analysis because I primarily wanted to find the correlation between the number of patient days and the performance on the quality measures. I also needed a way to control for factors that could be potentially confounding; for example, larger hospitals may have better quality and a higher patient volume, but the quality performance could be causally independent of patient volume because a larger hospital will attract better physicians to its staff.

Analysis and Results

This section will first discuss the general structure of the analysis, and then will break down each controlling variable to discuss results in more depth.

Effect of Patients Days on Quality Measures

This analysis includes 39 quality measures in six different categories, all of which are listed in entirety in Appendix A.

The first linear regression that I ran was to find the relationship between a hospital's number of patient days and its effect on each quality measure. This

regression was done on each of the 39 quality measures. I then selected one quality measure from each category and ran four more linear regressions, controlling for: urban/rural, number of beds, number of employees, and teaching hospital. My method for selecting the quality measure for further analysis was two-fold: the regression for the measure needed to be statistically significant (meaning it has a t-value greater than 2) and the measure needed to be something that I believed would have a direct correlation to a hospital's quality. Many of the measures selected for further analysis are measuring whether a drug or a treatment was given to a patient in a certain amount of time; that quality measure could then ostensibly be a good indicator of a hospital's efficiency and effectiveness. The coefficients for this analysis can be found in Table 1.

All but six of the quality measures had a positive correlation with patient days. This is illustrated with Figures 1-6 below, which show the positive correlations of the quality measures. The positive relationship between patient days and the compliance with quality measures means that the more patient days a hospital had, the better they did complying with the quality measures. This supports my hypothesis.

It is also important to note that the phrasing of the quality indicators has affected some of the graphical interpretations. For example, in Figure 3, the sixth quality measure, Measure F (shown in red), looks as if it does not follow the same positive correlation as the rest of the Blood Clot measures. However, this measure quantifies the percent of "Patients who developed a blood clot while in the hospital

who did not get treatment that could have prevented it," where a lower percentage is better. In the rest of the Blood Clot measures, a higher percentage is better.

Along those same lines, any quality measures which measure a time variable instead of a percentage of compliance have been removed from the graphs (average number of minutes, median time, etc.). These quality measures will be shown on separate graphs in Appendix 2.

The quality indicators selected for the next stage of analysis were chosen because I believed that each of these measures would have the highest correlation with a hospital's quality within their category. The measures are as follows:

- Stroke Care A- *Ischemic or hemorrhagic stroke patients who received treatment to keep blood clots from forming anywhere in the body within 2 days of arriving at the hospital*
- Blood Clot Prevention and Treatment B- *Patients who got treatment to prevent blood clots on the day of or day after being admitted to the intensive care unit (ICU)*
- Heart Attack H- *Heart attack patients given a prescription for a statin at discharge*
- Heart Failure A- *Percent of heart failure patients given an evaluation of left ventricular systolic (LVS) function*
- Pneumonia B- *Percent of pneumonia patients given the most appropriate initial antibiotic(s)*
- Surgical Care Improvement Project (SCIP) D- *Patients who got treatment at the right time (within 24 hours before or after their surgery) to help prevent blood clots*