Identifying the Surgical Profiles of U.S. Acute Care Hospitals: A Latent Class Analysis

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Surgical services are key strategic and operational activities that have important implications for a hospital's performance. Little is known, however, about whether and how the types of surgical services offered by hospitals vary at an organizational level. The purpose of this study was to identify different surgical profiles based on the type and volume of surgical services provided by hospitals. The study was an observational pooled, cross-sectional study. Latent class analysis (LCA) was used to identify different surgical profiles. Bivariate analyses were used to assess whether there were differences between the surgical profiles with respect to hospital and community characteristics. Our analysis revealed six surgical profiles among U.S hospitals: Specialist hospitals; No Focus hospitals; Cardiovascular Focus hospitals; Low Surgical Volume hospitals; High Surgical Volume hospitals; and Generalist hospitals. These profiles covaried systematically with organizational characteristics (ownership type, size, payer mix) and community characteristics including minority composition and level of education. These findings point to new ways of thinking about managing the portfolio of surgical services offered by hospitals.

Keywords: hospitals, surgery, management

INTRODUCTION

Surgical Services represent one of the key departments for most hospitals in the United States, for several reasons. First, surgical services generate a significant portion of a hospital's revenue (Plotzke & Courtemanche, 2009; Plotzke & Courtemanche, 2011). Second, the number of surgical services provided by hospitals has steadily grown over the years (American Hospital Association, 2000). Third, surgical services generate additional reimbursable activities, and thus revenue, for other departments such as tissue acquisition, select radiology services, and pharmaceuticals, to name a few. Given the importance of surgical services for most hospitals, it is imperative that hospital leaders think strategically about their surgical service offerings (Swinehart, Zimmerer, & Oswald, 1995).

Empirical and Theoretical Background

Despite the importance of surgical services, little empirical research has attempted to holistically assess whether a typology of hospitals can be derived based on the entire suite of surgical services. Instead, previous work has taken a very narrow view of surgical services. For example, one study attempted to group surgical services for ambulatory surgery centers (ASCs) based on urological procedures (Strope, Daignault, Hollingsworth, Wei, & Hollenbeck, 2008). Other research acknowledges the value of considering combinations of organizational activities such as surgical services. For example, MacDuffie (1995) argued that "bundles" of human resource practices may act synergistically to affect performance and found empirical support for this argument, with certain combinations of practices associated with better performance while other combinations could undermine performance.

The existence of profiles or configurations of practices or services have generally been observed within and across organizations (Bazzoli, Shortell, Dubbs, Chan, & Kralovec, 1999; Combs, Liu, Hall, & Ketchen, 2006; Shortell, Wu, Lewis, Colla, & Fisher, 2014; Subramony, 2009). Configuration theory addresses this observation by proposing that organizations may be categorized into different groupings based on their scope of operations or means of accomplishing competitive advantage (Ketchen, Thomas, & Snow, 1993). Further, the theory posits that distinctive organizational configurations may emerge as unique arrangements of strategy, structure, and the external environment converge and coalesce (Hambrick, 1980; Lunenburg, 2012; Miller, 1986, 1987, 1996). Configurations of surgical services may exist as the types and volume of surgical services offered by hospitals will vary as a function of organizational and environmental characteristics. For example, some research has shown clinical productivity to vary significantly for different types of hospitals (Abouleish et al., 2003). Likewise, surgical volume can be influenced both by reimbursement and management pressures (Wilson, Fisher, Welch, Siewers, & Lucas, 2007; Wilson, Schneller, Montgomery, & Bozic, 2008). Increases in reimbursement for certain types of procedures can lead organizations to emphasize those areas. Similarly, hospital leadership might emphasize a particular surgical service specialty (e.g. urology, ophthalmology) in reaction to the competitive environment (Capkun, Messner, & Rissbacher, 2012; Wilson et al., 2013).

Based on these considerations, the purpose of this study was to explore whether hospitals could be distinguished from each other based on the types and volume of surgical services, and if so, whether these profiles differed systematically as a function of different hospital and local community characteristics. Findings from the study may inform how leaders and policy makers think about access to surgical care, competition between hospitals for surgical services, and how hospital leaders position themselves vis-à-vis competitors. As the current study is exploratory in nature, a priori hypotheses with respect to the number and types of hospital surgical service profiles are not presented. However, consistent with the ideas presented above, we hypothesize that hospitals may adopt different combinations of surgical services.

METHODS

Data Sources

The study utilized data from four sources: the Health Care Utilization Project's (HCUP) State Inpatient Database (SID) and the Ambulatory Surgical Center Database (SASD) provided inpatient and outpatient surgical service data, respectively; the American Hospital Association (AHA) Annual Survey data set provided hospital characteristic data including ownership status, system affiliation, payer mix, and size; and the Area Resources File (ARF) provided sociodemographic data and market characteristic data relevant to this study. We chose to use the HCUP databases in this study because they are more comprehensive (e.g., all ages and insurance types) than other data sets (e.g., Medicare claims data), which we believe is important in an exploratory study such as this one. All data spanned the years 2009, 2010, and 2011. The study focused on hospitals from three states: California, Florida, and New York. These three states were chosen because each are geographically representative of major regions in the U.S. and contain diverse patient populations. The study sample was narrowed further to acute care general hospitals that provide surgical services. The first three data sets were linked using AHA identifiers unique to each hospital. The study protocol was designated as exempt by the authors' Institutional Review Board. The study's data use agreements with HCUP and AHA allowed linking these data sets at the hospital level. The ARF was merged at the county-level using the Federal Information Processing Standard (FIPS). The fully merged data set began with 2,376 hospital-year observations. Missing data needed for analysis resulted in the removal of 110. Data across the 2009-2011 period were then averaged for all applicable variables to create a pooled cross-sectional data set. The resulting data set included a single observation for 774 unique hospitals.

Analytic Strategy

The study was an observational pooled, cross-sectional study. The unit of analysis was the hospital. Latent class analysis (LCA) was used to identify different types of surgical profiles. LCA is a technique for grouping subjects (hospitals in our case) into subgroups based on similar characteristics (e.g., volume of services, types of services) (Rindskopf, 2009). It is especially useful in exploratory research where a priori knowledge about the solution (e.g., number of subgroups) is not available. Similar to the goals of cluster analysis, latent class analysis assigns subjects to subgroups in such a way that members of one subgroup are more similar to each other than they are to subjects in another subgroup. Unlike clustering techniques, however, LCA is a model-based technique that uses posterior membership probabilities (rather than dissimilarity measures) to assign subjects to a subgroup. Because it is based in a structural equation framework, LCA also provides more objective indicators of subgroup solutions than traditional clustering techniques (Jung & Wickrama, 2008; Wang & Wang, 2012). Specifically, we used the Akaike Information Criterion (AIC), the sample size adjusted Bayesian Information Criterion (ABIC), and the adjusted Lo-Mendell-Rubin likelihood ratio (ALMR LR) test, and entropy statistics to identify the number of latent classes. When using these indicators, lower AIC, ABIC, and ALMR LR as well as higher entropy indicate better fitting models when examining different class solutions. ALMR LR also looks at the relative goodness-of-fit of the current model to the previous model. A one-class solution would indicate that hospitals are not differentiated with respect to their surgical profiles.

Following the latent class analysis, we conducted bivariate analyses (chi-square and one-way analysis of variance) to assess whether there were differences between the surgical profiles with respect to hospital and community characteristics. All analyses were performed using Stata 14.0 and comparisons were considered significant at the 0.05 probability level after adjusting for multiple comparisons.

Variables

The operationalization of the surgical profile variable(s) began by collecting medical surgical diagnosis related grouping (MS-DRG) codes (inpatient surgical cases) and current procedural terminology clinical classifications software (CPTCCS) codes (outpatient surgical cases). Unique codes identified in this process were then categorized by a surgical nurse consultant with over 40 years of industry experience to predefined surgical specialty categories (e.g., general, urology, plastic), which in turn were used to create a crosswalk of DRG and CPTCCS codes to a surgical specialty category. The categories were mutually exclusive such that a single DRG or CPTCCS code was assigned to one category. Based on the primary DRG and/or CPTCCS code, patient level cases were assigned to one of these surgical specialty categories. Consequently, cases with a missing primary DRG or CPTCCS code were excluded from the analysis. The number of individual cases within each category was then summed to create hospital-level variables that reflected the number of cases per year for each surgical category.

Hospital-level sums for each surgical category were divided into quartiles that were then used to construct a dichotomous variable indicating high vs. low volume. Specifically, hospitals were assigned a value of "1" if they were in the 75th percentile or higher with respect to the number of surgeries for a surgical specialty and a value of "0" if they were less than the 75th percentile. This dichotomous variable was then utilized for the latent class analysis to identify unique surgical profiles. Dummy variables were created for each latent class to represent whether a hospital was a member of that class (i.e., profile).

We focused on hospital characteristics that reflect differential access and availability of resource access and allocation strategies for hospitals, including: 1) Ownership status (for-profit, not-for-profit, and government); 2) Size (measured as total number of beds set up and staffed for use); and 3) Payer mix (measured as the number of Medicaid and Medicare patient days as a percentage of total inpatient days, multiplied by 100). Similarly, we focused on sociodemographic, economic, and physical characteristics of local communities that reflect differential resource levels and the complexity of the patient population served by a hospital, including: 1) The percentage of minority residents (measured as the number of Blacks, Hispanics, Asians, and Others in a county divided by the total number of county residents, multiplied by 100); 2) Percentage of county residents below the federal poverty level; 3) Percentage of county residents with less than a high school education; and 4) The Medicare managed care penetration rate (measured as the percentage of county residents enrolled in a Medicare health maintenance organization). Finally, hospitals were assigned to one of four types of geographic locations on the United States' Census Bureau's Core Based Statistical Areas: 1) Metropolitan Division (single core with a population of at least 2.5 million); 2) Metropolitan Statistical Area (at least one urbanized area with a population of at least 50,000); 3) Micropolitan Statistical Area (at least one urban cluster with a population of at least 10,000 but less than 50,000); and 4) Rural.

RESULTS

Number of Surgical Profile Types

Various latent class structures were considered and the fit statistics suggested that a 6-class solution provided the best fit (Table 1). As shown in this table, the AIC and ABIC were smaller for larger classes and the entropy was high and the ALMR LR test for a 7-class solution was nonsignificant, suggesting that a 6-class solution was preferred.

TABLE 1
LATENT CLASS ANALYSIS FIT STATISTICS

Model	AIC	ABIC	ALMR LR	p-value	Entropy
1-class	13824.4	13854.0	N/A	N/A	N/A
2-class	10416.2	10476.8	3433.9	<.0001	.95
3-class	9774.79	9866.24	685.0	<.0001	.94
4-class	9555.83	9678.19	265.3	.07	.93
5-class	9402.12	9555.41	200.4	.09	.95
6-class	9309.14	9493.34	140.1	.002	.95
7-class	9250.39	9465.5	106.1	.17	.95

Each of the hospitals was then assigned to one mutually exclusive latent class based on their posterior class-membership probability given each hospital's response pattern on the observed categorical items (i.e., high-volume surgery for each surgery type). A 'heat map' (see Table 2) was created to assist in developing labels for each of the latent classes. To do so, six separate shades were applied to the class probabilities to visually rank each class for each of the surgical specialty categories. Each number in Table 2 refers to the percentage of hospitals within that latent class that were within the fourth quartile for surgical volume within that specialty. For example, the value for Orthopedics under Latent Class 5 is 1.000, which means that 100% of the hospitals assigned to latent class 5 were at or above the 75^{th} percentile in terms of the number of orthopedic surgeries.

TABLE 2
LATENT CLASS "HEAT MAP" AND LATENT CLASS TITLES

Surgical specialties	Latent Class 1	Latent Class 2	Latent Class 3	Latent Class 4	Latent Class 5	Latent Class 6
Orthopedics	0.700	0.429	0.341	0.003	1.000	0.248
Plastics	0.941	0.486	0.155	0.003	0.937	0.216
Podiatry	0.584	0.391	0.146	0.042	0.677	0.361
Thoracic	0.907	0.177	0.491	0.000	1.000	0.089
Transplant	0.136	0.066	0.030	0.005	0.553	0.065
Oral	0.299	0.362	0.055	0.043	0.760	0.340
Ophthalmology	0.397	0.419	0.130	0.040	0.786	0.327
Open Heart	0.640	0.026	0.583	0.003	1.000	0.114
Non-surgical	0.538	0.163	0.436	0.070	0.850	0.169
Neurosurgery	0.773	0.135	0.252	0.042	0.969	0.219
Maxillofacial	0.520	0.459	0.053	0.015	1.000	0.185
Hand	0.545	0.411	0.109	0.022	0.889	0.412
GYN	0.601	0.271	0.289	0.038	0.722	0.287
GI	0.581	0.000	0.048	0.005	1.000	1.000
General	0.463	0.000	0.000	0.000	1.000	0.899
ENT	0.724	0.585	0.104	0.015	0.916	0.202
Diagnostic	0.516	0.277	0.232	0.064	0.918	0.202
Cardiovascular	0.846	0.070	0.608	0.003	0.967	0.188
Cardiology	0.681	0.000	0.689	0.003	0.807	0.105
Bariatric	0.176	0.092	0.045	0.019	0.387	0.083
Urology	0.818	0.527	0.154	0.005	0.971	0.165
Ungrouped	0.890	0.219	0.404	0.010	1.000	0.230
Trauma	0.319	0.276	0.152	0.012	0.624	0.115
Latent Class Title	Specialists	No focus	Cardiovascular	Low surgical volume	High surgical volume	Generalist
Legend						
High	0.800-1.00					
Medium-High	0.600-0.799					
Medium	0.400-0.599					
Medium-Low	0.200-0.399					
Low	0.00-0.199					

When looking at the heat map, hospitals appear to vary along two dimensions: volume and surgical focus. For example, looking across the cells in the figure for thoracic surgery, the percentages range from 0 to 100 (variation in volume). Likewise, looking within the columns in the figure, some classes have no hospitals in the top quartile for any surgical specialty (no focus), while other classes have hospitals in the top quartile for only two specialties (focused). Based on these variations, the latent classes were assigned the following labels: Specialists, No Focus, Cardiovascular Focus, Low Surgical Volume, High Surgical volume, and Generalists. "Specialist" hospitals (latent class 1) were those hospitals that tended to be above the 75th percentile for many surgical specialty procedures (e.g., plastic surgery, thoracic surgery), but lower volume for more general procedures (e.g., GI, general surgery). "No Focus" hospitals (latent class 2) lacked focus on a specific surgical area and instead provided modest levels of surgeries across most types of all surgical services. "Cardiovascular" hospitals (latent class 3) focused on the cardiovascular specialties.

"Low Surgical Volume" (latent class 4) hospitals were those below the 75th percentile for all surgical procedures, while "High Surgical Volume" (latent class 5) hospitals were those that were above the 75th percentile for all surgical procedures. Finally, "Generalist" hospitals (latent class 6) provided high numbers of gastrointestinal, general, and oral surgeries while providing intermediate numbers of other types of surgeries. The Generalist class of hospitals was the largest class with 423 hospitals, or 55% of the entire sample. The other classes ranged from 40 hospitals (Specialist Hospitals) to 87 hospitals (High Surgical Volume Hospitals).

Hospital Characteristics by Surgical Profile

There were significant differences between the surgical profiles with respect to ownership ($\chi^2 = 73.6$, $p<.001$; Table 3). Hospitals in the Specialist class were exclusively private hospitals. Similarly, the Low Surgical Volume class were nearly exclusively (95.6%) not-for-profit hospitals (both private and public). The General Surgery class was the most "balanced", with just over one-half of the hospitals being private, not-for-profit, slightly less than one-third being public, not-for-profit, and the remaining hospitals being private, for-profit hospitals.

There also were significant differences between the surgical profiles in terms of hospital size ($F(5,733)=98.72$, $p<.001$). On average, hospitals in the Specialist class had the most beds ($\bar{x}=728.5$) while hospitals in the Generalist class had the fewest beds ($\bar{x}=134.1$). The average number of beds for hospitals in the Specialist class was significantly larger than the hospitals in each of the other five classes. Likewise, the average number of beds in the General Surgery class was significantly smaller than the hospitals in each of the other five classes.

The average Medicare inpatient days as a percentage of total inpatients days for the sample was 48%. There were significant differences, however, between the hospitals that belonged to the different surgical profiles with respect to their Medicare payer mix ($F(5,733)=8.56$, $p<.001$). Hospitals in the Cardiovascular class had the lowest percentage of Medicare patients (39.8%) while hospitals in the Low Surgical Volume class had the highest percentage (53.5%). In fact, hospitals in the Low Surgical Volume class had a significantly higher percentage of Medicare admissions than all other classes except the General Surgery class (48.1%). Similarly, there were significant differences between the hospitals in the different surgical profiles with respect to their Medicaid patient mix ($F(5,733)=4.27$, $p<.001$); however, the differences were limited to three classes. Specifically, hospitals in the Low Surgical Volume class had the lowest percentage of Medicaid patient days (17.5%), which was significantly lower than hospitals in the Cardiovascular Focus class (25.9%) and the High Surgical Volume class (27.3%).

Community Characteristics by Surgical Profile

The percentage of minorities in the surrounding market overall was 22%, on average, and there were significant differences between the hospitals in the surgical profiles ($F(5,733)=7.76$, $p<.001$). Hospitals in the General Surgery profile (13.6%) and the Cardiovascular profile were in communities with the lowest percentage of minorities, while hospitals in the Low Surgical Volume were in communities with the highest percentage of minorities (17.4%). The overall percentage of population in poverty was 17%, on average, and hospitals in all classes were operating in comparable communities with respect to poverty. The percentage of the population without a high school degree overall was 17%, on average. There was one significant difference between the surgical profiles with respect to education – hospitals in the Low Surgical Volume profile were in communities where residents had more education (18.5%), which differed significantly from hospitals in the Generalist profile (20.6%). Finally, the Medicare HMO penetration rate was 33.2%, on average, with significant differences between the different surgical profiles ($F(5,733)=3.18$, $p<.01$). Hospitals in the Low Surgical Volume profile were operating in areas with the lowest Medicare HMO penetration rate (29.1%), while hospitals in the Cardiovascular profile were operating in areas with the highest Medicare HMO penetration rate (35.2%).

TABLE 3
HOSPITAL AND COMMUNITY CHARACTERISTICS BY SURGICAL PROFILE

Organizational characteristics

	Ownership			Size/# of beds	Payer Mix	
	FP	NFP	Public		% Medicaid Days	% Medicare Days
Specialist (N=40)	7 (17.5%	33 (82.5%)	0 (0%)	728.5[2,3,4,5,6]	21.7	40.7[6]
No Focus (N=93)	18 (19.4%)	67 (72.0%)	8 (8.6%)	458.2[1,3,4,5,6]	20.3	46.1[4]
Cardiovascular (N=88)	18 (20.5%)	60 (68.2%)	10 (11.4%)	235.4[1,2,6]	25.9[4]	39.8[4,6]
Low Surgical Volume (N=65)	3 (4.6%)	34 (52.3%)	28 (43.1%)	293.9[1,2,6]	17.5[3]	53.5[1,2,3,5]
High Surgical Volume (N=95)	16 (16.8%)	71 (74.7%)	8 (8.4%)	257.4[1,2,6]	27.3	45.5[4]
Generalist (N=358)	57 (15.9%)	191 (53.4%)	110 (30.7%)	134.1[1,2,3,4,5]	23.3	48.1[1,3]
	χ^2 = 73.6, p<.001			F=98.72, p<.001	F=4.27, p<.001	F=8.56, p<.001

Community characteristics

	% Minority	% Below Poverty	% w/less than high school	Medicare HMO Penetration Rate	Geographic location			
					Metro Division	Metro	Micro	Rural
Specialist (N=40)	14.8	15.6	18.7	33.1	17 (42.5%)	23 (57.5%)	0 (0%)	0 (0%)
No Focus (N=93)	15.2[5]	15.3	18.9	33.8[4]	46 (49.5%)	45 (48.4%)	3 (2.1%	0 (0%)
Cardiovascular (N=88)	13.5[4]	15.7	20.3	35.2[4]	55 (63.2%)	29 (33.3%)	3 (3.5%)	0 (0%)
Low Surgical Volume (N=65)	17.4[3,5,6]	16.1	18.5[6]	29.1[2,3,6]	20 (31.3%)	42 (65.6%)	2 (3.1%)	0 (0%)
High Surgical Volume (N=95)	12.3[2,4]	15.1	19.4	33.6	36 (38.7%)	47 (50.5%)	10 (10.8%)	0 (0%)
Generalist (N=358)	13.6[5]	16.0	20.6[4]	33.2[4]	112 (32.3%)	151 (20.9%)	42 (12.1%)	42 (12.1%)
	F=7.76, p<.001	F=2.46, p<.05	F=3.58, p<.01	F=3.18, p<.01	χ^2 = 95.7, p<.001			

Note: Bonferroni adjustment for multiple comparisons.
[1] Significantly different than Specialist, [2] Significantly different than No Focus, [3] Significantly different than Cardiovascular, [4] Significantly different than Low Surgical Volume, [5] Significantly different than High Surgical Volume, [6] Significantly different than Generalist

Finally, there were significant differences among hospitals in the different profiles with respect to their geographic location ($\chi2=95.7$, $p<.001$). Most notably, hospitals in the Specialist profile were exclusively located in metropolitan areas (either metropolitan division or metropolitan statistical area), while hospitals in the Generalist category were more evenly distributed across geographic locations, including 12.1% of the hospitals in rural locations. This pattern may explain why Specialist hospitals had more beds than Generalist hospitals. Specialist hospitals tend to be urban medical centers that provide high volumes of surgical services in concentrated areas (e.g., thoracic surgery, cardiovascular) and more intermediate levels of all other types of surgical services. In contrast, Generalist hospitals are more likely to be located in less urban communities where they may be the sole community provider of surgical services, which may result in the provision of a broader range but more modest volume of surgical services.

DISCUSSION

This study found that hospitals can be distinguished based on the types and volume of surgical procedures they perform, indicating support for our general hypothesis that hospitals adopt different combinations of surgical services. In doing so, our findings extend previous studies that have focused on specific types of surgical services (e.g., urology) (Strope, Daignault, Hollingsworth, Wei, & Hollenback, 2008). Likewise, our research builds on previous research that developed similarity indices to identify competitor hospitals (Wachtel, Dexter, & Dexter, 2010; Wachtel, Dexter, Barry, & Applegeet, 2010). Specifically, our research complements this work by providing a different way of thinking about competition and market segmentation. For example, many analyses assume most, if not all, hospitals in the same market are direct competitors by constructing measures of competition based on size (number of beds) or percentage of revenues. However, our findings raise the possibility that hospitals that belong to different surgical profiles may only be indirect competitors and may even play complementary roles in a market. Such nuances can have important implications for how a hospital positions itself in a market and could serve as the basis for alternative modes of coordinating and delivering care (e.g., partnerships between hospitals with complementary profiles).

As for policy makers, differentiating between hospitals based on their surgical profiles may shed light on how the same policy may differentially affect hospitals. For instance, reimbursement changes may not have a uniform effect on hospitals due to differences in their surgical profiles. Similarly, closures of hospitals or reductions in services by hospitals with different surgical profiles may not have a uniform impact on access to care. For example, it is notable that 'low surgical volume' hospitals in our study were more likely to be located in communities with the highest percentage of minority residents. Extending this finding further, it is conceivable that community-level variations in access to hospitals with different surgical profiles may contribute to observed disparities in care (Fiscella, Franks, Doescher, & Saver, 2002; Fiscella, Franks, Gold, & Clancy, 2000; Nelson, Stith, & Smedley, 2002) and potentially highlight a need for new ways to think about and measure access to care. In sum, these findings are consistent with and reinforce other studies suggesting that 'one size fits all' policy approaches may have unintended consequences.

The findings of the study raise a number of questions that are worthy of future research, the answers to which are likely to be of interest to hospital leaders, regulators, and policy makers. Surgical profiles have not been established in previous research and more research is needed to understand these profiles. For example, are differences in profiles intentional/strategic or emergent over time? If intentional, what factors drive the decision to pursue one profile over another (e.g., competition in the market; population size)? What combinations of surgical profiles exist within markets? Is it the case that hospitals within a market tend to adopt the same profile, perhaps because of the supply of specific kinds of physicians within that market or patient demand for services, or do hospitals attempt to differentiate themselves and adopt complementary profiles? The investigation of such questions will also require more robust empirical analyses (e.g., multivariable regression) and potentially additional data sources (e.g., primary data) than we were able to incorporate in this initial exploratory study.

Another consideration is whether different surgical profiles have implications for performance? For example, recent studies have found that specialist hospitals are more efficient in their specialized areas than generalist hospitals (Eastaugh, 2011; Lee, Chun, & Lee, 2008). Similarly, a longstanding line of research has considered whether higher surgical volumes are related to better outcomes (Birkmeyer, Siewers, Finlayson et al., 2002; Birkmeyer, Stukel, Siewers, Goodney, Wennberg, & Lucas, 2003; Halm, Lee, & Chassin, 2002). Future research could extend work in this area by examining whether differences in quality (e.g., surgical site infections, readmissions, patient experience) exist between hospitals with different surgical profiles. Likewise, but more systemically, researchers may want to consider whether markets consisting of hospitals with more heterogenous/complementary profiles experience better or worse outcomes than markets made up of hospitals with more homogenous/competitive profiles.

There are several study limitations that should be considered when interpreting these findings. First, there is the potential of misclassification of surgical codes to a surgical specialty due to the use of only a single nurse to make this assignment. Although this nurse had extensive industry experience, the use of multiple raters could have provided greater assurance of correct classification. Similarly, our use of the HCUP data (SID and SASD) to identify surgical procedures means that our analysis could not account for other factors (e.g., surgical duration) that may affect surgical volume and consequently, the groupings that emerged from our analysis. Future research may want to consider replicating our analysis on other data sets (e.g., Medicare claims data) that can account for some of these factors. Second, the study was limited to three states (Florida, New York, and California), and thus, may have limited external validity. Third, the study adopted a pooled, cross-sectional analytic strategy and assumed stability over the three years included in the study. Hospitals, however, may change profiles over time and should be considered in future research. Similarly, future research can build on our study by replicating this analysis using more recent data to determine whether the different types of hospitals are stable over time.

CONCLUSION

Hospitals operate in turbulent and complex environments with limited resources. Consequently, administrators need to understand how to best use resources and improve a hospital's positioning in a market. Surgical services are key strategic and operational activities for hospitals and a better understanding of how this department can be modified to meet the needs of organizations is important. This study found that hospitals differ in the types and volumes of procedures in predictable ways. From a practitioner perspective, the findings of the study point to new ways of thinking about managing the portfolio of surgical services offered at the organization. From a policy standpoint the findings of this study suggest uniform approaches to treating hospitals with respect to surgical profiles and payment systems may be misguided.

REFERENCES

Abouleish, A.E., Prough, D.S., Barker, S.J., Whitten, C.W., Uchida, T., & Apfel baum, J.L. (2003). Organizational Factors Affect Comparisons of the Clinical Productivity of Academic Anesthesiology Departments. *Anesthesia & Analgesia*, *96*(3), 802-812.

American Hospital Association (2006, July). The Migration of Care to Non-Hospital Settings: Have Regulatory Structures Kept Pace with Changes in Care Delivery? *Trendwatch*.

Bazzoli, G.J., Shortell, S.M., Dubbs, N., Chan, C., & Kralovec, P. (1999). A taxonomy of health networks and systems: bringing order out of chaos. *Health Services Research*, *33*(6), 1683.

Birkmeyer, J.D., Siewers, A.E., Finlayson, E.V.A., Stukel, T.A., Lucas, F.L., Batista, I, . . . Wennberg, D.E. (2002). Hospital Volume and Surgical Mortality in the United States. *New England Journal of Medicine*, *349*(22), 2117-2127.

Birkmeyer, J.D., Stukel, T.A., Siewers, A.E., Goodney, P.P., Wennberg, D.E., & Lucas, F.L. (2003). Surgeon Volume and Operative Mortality in the United States. *New England Journal of Medicine*, *349*(22), 2117-2127

Capkun, V., Messner, M., & Rissbacher, C. (2012). Service Specialization and Operation Performance in Hospitals. *International Journal of Operations & Production Management*, *32*(4), 468-495.
Combs, J., Liu, Y., Hall, A., & Ketchen, D. (2006). How much do high-performance work practices matter? A meta-analysis of their effects on organizational performance *Personnel Psychology*, *59*(3), 501-528. doi:10.1111/j.1744-6570.2006.00045.x
Eastaugh, S.R. (2011). Hospital Specialization: Product-Line Planning During the Market Reformation. *Journal of Health Care Finance*, *38*(1), 71.
Fiscella, K., Franks, P., Doescher, M.P., & Saver, B.G. (2002). Disparities in Health Care by Race, Ethnicity, and Language Among the Insured: Findings From a National Sample. *Medical Care*, *40*(1), 52-59.
Fiscella, K., Franks, P., Gold, M.R., & Clancy, C.M. (2000). Inequality in Quality: Addressing Socioeconomic, Racial, and Ethnic Disparities in Health Care. *Journal of the American Medical Association*, *283*(19), 2579-2584.
Halm, E.A., Lee, C., & Chassin, M.R. (2002). Is Volume Related to Outcome in Health Care? A Systematic Review and Methodologic Critique of the Literature. *Annals of Internal Medicine*, *137*(6), 511-520.
Hambrick, D. C. (1980). Operationalizing the concept of business-level strategy in research. *Academy of Management Review*, *5*(4), 567-575.
Jung, T., & Wickrama, K. (2008). An Introduction to Latent Class Growth Analysis and Growth Mixture Modeling. *Social and Personality Psychology Compass*, *2*(1), 302-317.
Ketchen, D.J., Jr, Thomas, J.B., & Snow, C.S. (1993). Organizational Configurations and Performance: A Comparison of Theoretical Approaches. *Academy of Management Journal*, *36*(6), 1278-1313. doi:10.5465/256812
Lee, K., Chun, K., & Lee, J. (2008). Reforming the Hospital Service Structure to Improve Efficiency: Urban Hospital Specialization. *Health Policy*, *87*(1), 41-49.
Lunenburg, F.C. (2012). Organizational Structure: Mintzberg's Framework. *International Journal of Scholarly, Academic, Intellectual Diversity*, *14*(1).
MacDuffie, J.P. (1995). Human Resource Bundles and Manufacturing Performance: Organizational Logic and Flexible Production Systems in the World Auto Industry. *ILR Review*, *48*(2), 197-221.
Miller, D. (1986). Configurations of strategy and structure: Towards a synthesis. *Strategic Management Journal*, *7*(3), 233-249.
Miller, D. (1987). The genesis of configuration. *Academy of Management Review*, *12*(4), 686-701.
Miller, D. (1996). Configurations revisited. *Strategic Management Journal*, *17*(7), 505-512.
Nelson, A.R., Stith, A.Y., & Smedley, B.D. *Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care* (full printed version). National Academies Press.
Plotzke, M.R., & Courtemanche, C. (2009). Does Competition from Ambulatory Surgical Centers Affect Hospital Surgical Output and Hospital Profit? *Journal of Health Economics*, *29*(5), 765-773.
Plotzke, M.R., & Courtemanche, C. (2001). Does Procedure Profitability Impact Whether an Outpatient Surgery is Performed at an Ambulatory Surgery Center or Hospital? *Health Economics*, *20*(7), 817-830.
Rindskopf, D. (2009). Latent Class Analysis. *The SAGE Handbook of Quantitative Methods in Psychology*, pp. 199-218.
Shortell, S.M., Wu, F.M., Lewis, V.A., Colla, C.H., & Fisher, E.S. (2014). A taxonomy of accountable care organizations for policy and practice. *Health Services Research*, *49*(6), 1883-1899.
Strope, S.A., Daignault, S., Hollingsworth, J.M., Wei, J.T., & Hollenbeck, B.K. (2008). Medicare Reimbursement Changes for Ambulatory Surgery Centers and Remuneration to Urological Physician-Owners. *The Journal of Urology*, *180*(3), 1070-1074.
Swinehart, K., Zimmerer, T.W., & Oswald, S. (1995). Adapting a Strategic Management Model to Hospital Operating Strategies: A Model Development and Justification. *Journal of Management in Medicine*, *9*(2), 34-47.

Wachtel, R.E., Dexter, E.U., & Dexter, F. (2007). Application of a Similarity Index to State Discharge Abstract Data to Identify Opportunities for Growth of Surgical and Anesthesia Practices. *Anesthesia & Analgesia*, *104*(5), 1157-1170.

Wachtel, R.E., Dexter, F., Barry, B., & Applegeet, C. (2010). Use of State Discharge Abstract Data to Identify Hospital Performing Similar Types of Operative Procedures (*110*(4), 1146-1154).

Wang, J., & Wang, X. (2012). *Structural Equation Modeling: Applications Using Mplus*. John Wiley & Sons.

Wilson, C.T., Fisher, E.S., Welch, H.G., Siewers, A.E., & Lucas, F.L. (2007). US Trends in CABG Hospital Volume: The Effect of Adding Cardiac Surgery Programs. *Health Affairs*, *26*(1), 162-168.

Wilson, N.A., Schneller, E.S., Montgomery, K., & Bozic, K.J. (2008). Hip and Knee Implants: Current Trends and Policy Considerations. *Health Affairs*, *27*(6), 1587-1598.

Wilson, N.P., Wilson, F. P., Neuman, M., Epstein, A., Bell, R., Armstrong, K., & Murayama, K. (2013). Determinants of Surgical Decision Making: A National Survey. *The American Journal of Surgery*, *206*(6), 970-978.