The Relationship Between Patient Safety Outcomes and Hospital Characteristics

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To augment the discussion of the extent to which quality is universal, this study presents the results of an analysis of 13.5 million inpatient discharges from 1,640 general hospitals from 16 states. Factor analysis was performed on 588 general U.S. hospitals and 18 PSIs were reduced to seven factors. Hospital tiers were profiled utilizing demographic variables. Contrary to expectations the best quality hospitals tended to be smaller, non-teaching hospitals whereas larger, teaching hospitals tended to be poor quality performers. This analysis provided evidence patient safety quality rates may not be universal and organizational context may be an important influencing factor.

Keywords: Quality outcomes, Hospital quality, Organizational context

INTRODUCTION

The influential leaders of the early quality movement suggested that quality was universal, i.e., that the principles and practices that produced quality were the same for all organizations. For example, Juran (1986) presented quality management as three basic processes: quality planning, quality improvement, and quality control. Deming (1986) famously discussed 14 principles by which quality should be managed and recommended fundamental alteration of the culture of the organization. Crosby (1979) prescribed a 14-step program that emphasized quality improvement through a philosophy of zero-defects. This universalist quality impact approach assumes that quality management practices are universal and should be applied consistently to each organization without regard to the specific situation or context.

In direct contrast to the universal approach to quality management, contingency theory suggests different management approaches in response to different situations or contexts (Lawrence and Lorsch, 1967). According to contingency theory, the firm's organizational and environmental context should influence quality management practices, quality performance, and organizational performance. Therefore, a more comprehensive approach to quality is needed that takes the organizational context into consideration. This contingent approach to quality was first established in the 1990s. Benson et al. (1991) found that organizational quality context influenced managers' perceptions of ideal quality as well as actual quality. Dean and Bowen (1994), in contrasting management theory and quality approaches, suggested that a contingency approach should be used when designing customer-supplier relationships and employee involvement and empowerment initiatives. Sitkin et al. (1994) proposed a contingency approach to conceptualizing quality management in order to provide a basis for predicting the conditions in which different aspects of quality management would be effective, concluding that context was important to the success of these practices. Powell (1995) found that factors such as culture and commitment, rather than TQM tools and techniques, produced a competitive advantage for organizations, while Spencer (1994) recommended aligning or matching quality management implementation to organizational context in response to challenges to the "principles" approach to quality management. Watson and Korukonda (1995) examined the dichotomy between universal and contingent orientations towards quality management and concluded that empirical evidence that it is universally applicable to all organizational settings had not been presented.

According to this contingent model, quality outcomes should be influenced by other variables relative to the specific organization and to the environment in which the organization operates. These other variables can be described as the context in which the firm operates, both organizationally (internal) and environmentally (external). While the universalist approach may explain quality as it is presented in quality management theory, the reality seems to be that the organizational and environmental contexts will influence quality in a significant way.

The question concerning the universal versus contingent application of quality management practices has continued. Sila (2007) found more support for the universal model of quality management and concluded that a context-dependent model was not warranted for five contextual factors that were analyzed, but two recent studies provided support for the contingent model. Jayaram et al. (2010) found support for the effects of four contingencies (firm size, TQM duration, unionization, and industry type) on the implementation of TQM, while Zhang et al. (2012) found that the effectiveness of different QM practices depended on environmental uncertainty and on organizational structure.

This study provides additional information to assist in answering the question of universal versus contingent approaches to quality. The current research assesses the effect of organizational context on quality. Drawing from publicly available databases from several states, the impact of organizational-level variables on quality is examined. This study seeks to use the data and tools from a specific industry, hospitals, to test the contingency model. Controlling for industry, the extent to which quality outcomes might be influenced by organizational characteristics or context is tested.

This study also focuses on quality in a particular industry, U.S. hospitals. While the quality movement began with organizations in manufacturing industries, it eventually spread to the service sector, including U.S. hospitals. In the hospital industry, Berwick (1989) is commonly cited as the first to introduce quality management principles to that industry. Subsequently, a considerable amount of emphasis has been given in the literature as to how these quality management concepts, developed in manufacturing, can be applied to the hospital industry. The discussion of quality in the hospital literature follows the typical pattern for most industries. Early articles presented theoretical discussions of how organizations could benefit from adopting the new quality philosophy and methods (Bader, 1992; Berwick, 1989; Berwick et al. 1990; Gaucher and Coffey, 1990; Laffel and Blumenthal, 1989; McLaughlin and Kaluzny, 1990; Merry, 1990; Siler and Garland, 1991). These articles were followed by case studies illustrating how specific organizations were dealing with the quality management implementation process (Frist, 1992; Smith, 1992; Weber, 1991). Along with these articles showing the positive aspects of the quality movement for hospitals, contrary views could also be found expressing skepticism as to the appropriateness of applying quality management to hospitals (Atchison, 1992; Chorn, 1991; McConnell, 1992).

More recent research has examined the effect of quality management on various outcome variables. While outcomes such as financial performance are important and have been studied (Alexander et al., 2006), of particular importance is the effect on patient safety. A seminal report by the Institute of Medicine (IOM), To Err is Human: Building a Safer Health System, (Kohn et al., 1999) estimated that there were between 44,000 and 98,000 preventable deaths every year due to medical errors. Subsequent reports by the IOM (2001) reinforced this specter of unnecessary loss of human life due to preventable errors. Recent research has suggested that patient safety can be enhanced by reducing errors through attention to such factors as employee commitment and control (Gowen et al., 2006) and through transformational leadership (McFadden et al., 2009).

While the study of quality in hospitals is rather unique due to the direct effect on human life, whether it is loss of life or a reduction in the quality of life, another characteristic somewhat unique to hospitals is the existence of publicly available databases containing objective indices of quality. Quality in U.S. hospitals can be measured using both data bases and tools available from the government through the Agency for Healthcare Research and Quality (AHRQ). The AHRQ maintains multiple databases and tools to use these databases. One group of databases and tools forms the Healthcare Cost and Utilization Project (HCUP), which contains longitudinal U.S. hospital data, beginning in 1988. The HCUP is a federal partnership with state agencies and industry to collect data from organizations in participating states that maintain statewide data systems. Included among the HCUP databases are the State Inpatient Databases (SID), a set of databases containing the universe of inpatient discharge abstracts from the participating states. The SID put these data in a uniform format which allows analyses over a larger set of data from multiple states, and encompass approximately 97% of all annual discharges in the United States. (HCUP, 2013).

Along with databases, AHRQ provides tools and software to allow access for users to compute Quality Indicators (QI). Among these QIs are a set of indicators termed Patient Safety Indicators (PSI). PSIs provide information about complications and adverse events following surgeries, medical procedures, and childbirth in U.S. hospitals (HCUP, 2013). The PSIs were developed to identify potential in-patient safety problems for the purpose of quality improvement (Miller, 2001). The PSIs include such problems as complications with anesthesia, birth trauma, and accidental puncture or laceration. A complete listing and descriptions can be found on the AHRQ website qualityindicators.ahrq.gov/Modules/psi_resources.aspx.

While several studies from the healthcare literature have examined the PSIs in terms of different hospital characteristics (Romano et al., 2003; Rosen et al., 2006; Thornlow and Stukenborg, 2006; Vartak et al., 2008), this study is the first to use the PSIs to examine the impact of organizational context in terms of the business quality management literature.

METHODS

The 2004 State Inpatient Databases (SID) and the 2004 American Hospital Association Annual Survey (AHA) were employed in this study. The 2004 SID include information on 13,496,841 cases from 1,640 U.S. hospitals from 16 states, and 20 PSI were available for study based on these data. Not all of the possible cases or hospitals were used; hospitals without identifiers linking them to the AHA Annual Survey were eliminated, as were low volume hospitals [based upon a minimum number of PSI surgeries (500), a minimum number of deliveries (200), or the absence of all 20 PSI cases]. These eliminations resulted in a sample of 588 hospitals for this study. While twenty PSIs were calculated by the AHRQ software, 2 were eliminated from the analysis due to very low instance of occurrence: complications of anesthesia occurred in only 10 out of more than 2.4 million potential cases, while transfusion reaction happened in just 34 of more than 7.7 million possible cases.

The PSIs were calculated as incidence rates, or number of occurrences of the adverse event or complication divided by the total possible number of occurrences, using AHRQ PSI software, Version 3.1, March 2007 (AHRQ, 2007). For illustration, using complications of anesthesia as an example, there were 2,474,816 cases from the 588 hospitals that involved the use of anesthesia and in 10 of these cases, complications occurred. The calculated PSI is therefore 0.000040. This is an example of an unadjusted PSI; most of the PSIs were risk-adjusted based upon age, gender, age-gender interactions, and other factors. Four of the PSIs were not available in risk-adjusted form. Three factor analyses were performed to reduce the 18 PSIs into a smaller number of more easily interpretable factors for the purpose of distinguishing between high and low performing hospitals. The factor analyses were based on indicators from 3 distinct categories of PSIs: Medical/Surgical (7 PSIs), Surgical (7 PSIs), and Obstetric (4 PSIs).

The 588 hospitals were then ranked on the resulting factors and were divided into 5 approximately equal-in-size groups based on performance on these factors. Finally, discriminant analysis was used to identify contextual factors common to either the low or high performing hospitals. The six hospital contextual factors were derived from the 2004 American Hospital Association (AHA) Annual Survey. They included hospital size, measured by number of beds; teaching status, measured by whether the hospital was affiliated with a medical school, had a residency program, or was a member of the Council of Teaching Hospitals; patient mix, measured by the percentage of patients on Medicaid, the percentage of patients on Medicare, and the combined Medicare and Medicaid percentages; rural center status; JCAHO accreditation status; and type of ownership (government, church, other not-for-profit, or for-profit).

RESULTS

Table 1 shows the 20 PSIs and how the observed incidence rates were calculated overall for the 588 hospitals in the study. The numerator is the number of cases in which an adverse event or complication occurred. The denominator is the total number of possible cases, as specified by the PSI software. Two of the PSIs, complications of anesthesia (OPPS01) and transfusion reactions (OPPS16), had very low occurrences and were dropped from the analyses. It is interesting to note that each PSI has very specifically constructed denominators from which the instances are derived and the rates can vary from those that are fairly low to as high as over 12.6% for Failure to Rescue and 18.8% for Obstetric Trauma - Vaginal with Instrument.

TABLE 1
SUMMARY OF PSIS (AGGREGATED)

PSI	Description	Numerator	Denominator	PSI Rate
OPPS01	Complications of Anesthesia	10	2,474,816	.000040
OPPS02	Death in Low Mortality DRGs	1,513	2,675,378	.005655
OPPS03	Decubitus Ulcer	49,964	2,071,009	.024125
OPPS04	Failure to Rescue	34,019	268,826	.126547
OPPS05	Foreign Body Left in During Procedure	645	7,779,106	.000829
OPPS06	Iatrogenic Pneumothorax	3,896	6,212,916	.006271
OPPS07	Infection Due to Medical Care	11,736	5,122,263	.022912
OPPS08	Postoperative Hip Fracture	435	1,389,807	.003130
OPPS09	Postoperative Hemorrhage or Hematoma	5,858	2,114,729	.027701
OPPS10	Postoperative Physiologic and Metabolic Derangement	1,319	1,165,584	011316
OPPS11	Postoperative Respiratory Failure	9,838	951,952	.010335
OPPS12	Postoperative Pulmonary Embolism/DVT	22,380	2,103,838	.010638
OPPS13	Postoperative Sepsis	2,886	265,610	.010866
OPPS14	Postoperative Wound Dehiscence	943	416,284	.022653
OPPS15	Accidental Puncture or Laceration	25,273	6,594,788	.038323
OPPS16	Transfusion Reaction	34	7,779,271	.000044
OPPS17	Birth Trauma - Injury to Neonate	3,224	1,057,723	.030481
OPPS18	Ob Trauma - Vaginal with Instrument	12,194	64,752	.188319
OPPS19	Ob Trauma - Vaginal Without Instrument	29,146	668,518	.043598
OPPS20	Ob Trauma - Cesarean-Section	1,491	312,567	.047702
	Total PSI Events	216,804		

Table 2 summarizes the same data based on PSI rates by hospital, providing the PSI rate means, minimum (Min), maximum (Max), and standard deviation (Std Dev) among the 588 hospitals. Again, as we saw with the previous overall table the average rates by hospital for each of the PSIs can vary considerably. In looking at the minimum ranges, it should be noted that with all the PSIs, there are hospitals with no instances of a PSI, with the exception of Decubitus Ulcers where the minimum for a hospital is only 0.23%. On the other hand, maximum levels for some of the PSIs can be quite high at almost 26% for Failure to Rescue and 50% for Obstetric Trauma - Vaginal with Instrument.

TABLE 2
SUMMARY OF OBSERVED (OBS) PSIS (BY HOSPITAL)

PSI	Description	Mean (obs)	Min (obs)	Max (obs)	Std Dev (obs)
OPPS01	Complications of Anesthesia	0.000005	0	0.000994	0.000057
OPPS02	Death in Low Mortality DRGs	0.000547	0	0.004738	0.000561
OPPS03	Decubitus Ulcer	0.023099	0.002436	0.106610	0.012376
OPPS04	Failure to Rescue	0.123118	0	0.257143	0.039107
OPPS05	Foreign Body Left in During Procedure	0.000077	0	0.000883	0.000106
OPPS06	Iatrogenic Pneumothorax	0.000558	0	0.002291	0.000406
OPPS07	Infection Due to Medical Care	0.001985	0	0.009819	0.001399
OPPS08	Postoperative Hip Fracture	0.000298	0	0.006944	0.000563
OPPS09	Postoperative Hemorrhage or Hematoma	0.002702	0	0.012915	0.001535
OPPS10	Postoperative Physiologic and Metabolic Derangement	0.000977	0	0.019231	0.001515
OPPS11	Postoperative Respiratory Failure	0.010252	0	0.075000	0.008792
OPPS12	Postoperative Pulmonary Embolism/DVT	0.008971	0	0.037784	0.005067
OPPS13	Postoperative Sepsis	0.011116	0	0.100000	0.011356
OPPS14	Postoperative Wound Dehiscence	0.002408	0	0.023077	0.002660
OPPS15	Accidental Puncture or Laceration	0.003603	0	0.020536	0.002781
OPPS16	Transfusion Reaction	0.000003	0	0.000156	0.000018
OPPS17	Birth Trauma - Injury to Neonate	0.002706	0	0.056029	0.003931
OPPS18	Ob Trauma - Vaginal with Instrument	0.184880	0	0.500000	0.089117
OPPS19	Ob Trauma - Vaginal Without Instrument	0.041413	0	0.138158	0.020267
OPPS20	Ob Trauma - Cesarean-Section	0.004134	0	0.045977	0.005216

Tables 3 provide summaries of three factor analyses that were performed for each of the PSI categories--Medical/Surgical, Surgical, and Obstetrics--whereby the 18 PSIs are reduced to 7 factors, using a factor loading of 0.4 as a cutoff for determination of significance. The seven Medical/Surgical PSIs were reduced to two factors; these factors matched the factors found in a previous study which used the PSI software with data from Veteran's Administration (VA) Hospitals (Rosen et al., 2005). Using the same naming convention as in Rosen's (2005) study, the first Medical/Surgical factor, Procedure Complications (f1med), included four PSIs (in order of factor loading): Foreign Body Left in During Procedure, Iatrogenic Pneumothorax, Infection Due to Medical Care, and Accidental Puncture/Laceration. The second Medical/Surgical factor was Mortality and Disability (f2med) and included 3 PSIs: Death in Low Mortality DRGS, Decubitus Ulcer, and Failure to Rescue.

In contrast to the previous study, the seven Surgical PSIs did not load on a single factor, but instead produced three factors. The first Surgical factor, labeled Postoperative Care (f1surg), included four PSIs: Postoperative Physiologic Metabolic Derangement, Postoperative Respiratory Failure, Postoperative Pulmonary Embolism or Deep Vein Thrombosis, and Postoperative Sepsis. The second Surgical factor was labeled Surgical Complications (f2surg) and included two PSIs: Postoperative Hemorrhage or Hematoma, and Postoperative Wound Dehiscence. The third Surgical factor was labeled Postoperative Falls (f3surg) and contained one PSI, Postoperative Hip Fracture.

Four Obstetric PSIs were not included in Rosen's (2005) VA hospital study; in the current study, these PSIs were reduced to two factors. The first Obstetric factor was labeled Vaginal Delivery (f1ob) and included two Obstetric Trauma - Vaginal Delivery PSIs (trauma with and without instruments). The remaining two Obstetric PSIs (Birth Trauma-Injury to Neonate, and Cesarean Section) loaded together; this factor was labeled Birth Trauma/Cesarean Section (f2ob).

TABLE 3
PSI FACTOR ANALYSIS: MEDICAL/SURGICAL, SURGICAL, AND OBSTETRIC

	Med/Surg PSI Factor Loadings	Procedure Complications	Mortality & Disability
OPPS05	Foreign Body Left in During Procedure	*0.540	-0.258
RPPS06	Iatrogenic Pneumothorax	*0.591	0.090
RPPS07	Infection Due to Medical Care	*0.645	0.423
RPPS15	Accidental Puncture/Laceration	*0.666	-0.268
OPPS02	Death In Low Mortality DRGS	-0.069	*0.459
RPPS03	Decubitus Ulcer	0.170	*0.624
RPPS04	Failure to Rescue	-0.229	*0.656

*Factor loadings of 0.4 or higher considered significant.

	Surgical PSI Factor Loadings	Postop Care	Surgical Complications	Postop Falls
RPPS10	Postoperative Physiologic Metabolic Derangement	*0.566	-0.022	-0.017
RPPS11	Postoperative Respiratory Failure	*0.554	0.109	0.392
RPPS12	Postoperative Pulmonary Embolism or Deep Vein Thrombosis	*0.635	-0.120	0.018
RPPS13	Postoperative Sepsis	*0.607	0.124	-0.220
RPPS09	Postoperative Hemorrhage or Hematoma	0.004	*0.673	0.015
RPPS14	Postoperative Wound Dehiscence	-0.006	*0.781	-07
RPPS08	Postoperative Hip Fracture	-0.092	-0.010	*0.911

*Factor loadings of 0.4 or higher considered significant.

	Obstetric PSI Factor Loadings	Vaginal Delivery	Birth Trauma/ C-Section
RPPS18	Obstetric Trauma-Vaginal Delivery with Instrument	*0.820	0.051
RPPS19	Obstetric Trauma-Vaginal Delivery Without Instrument	*0.812	0.045
RPPS17	Birth Trauma-Injury to Neonate	-0.087	*0.803
OPPS20	Obstetric Trauma-Cesarean Delivery	0.180	*0.690

*Factor loadings of 0.4 or higher considered significant.

In order to examine the effect of the contextual factors on hospital quality performance, the seven factors were used to divide the 588 hospitals into deciles based on factor scores for each of the seven factors. Each hospital was then assigned a number from 1 to 10 for each of the seven PSI factor deciles. The seven decile values were then summed for each hospital, with a minimum possible sum of 7 (if a hospital was in the first decile for each of the factors) and a maximum possible sum of 70 (if a hospital was in the tenth decile for each of the factors). The decile sum for the best performing hospital was 13; the worst performing hospital had a decile sum of 65. The hospitals were then divided into five performance groups that were approximately equal in size based on the decile sums. The smallest group contained 106 hospitals and the largest contained 127 hospitals. The sums of the hospitals in Group 1 (the best performing group) sums ranged from 13 to 30, Group 2 from 31 to 36, Group 3 from 37 to 41, Group 4 from 42 to 47, and Group 5 (the worst performing group) from 48 to 65. Table 4 summarizes the five hospital performance groups in terms of the decile sum variable and the seven PSI factor scores. As can be seen based on the methodology employed, Group 1 consistently shows lower PSI factor score means (meaning lower rates of instances) and these consistently increase (having more instances) for each group across all PSI factors.

TABLE 4
FIVE HOSPITAL GROUPS FACTOR SCORE SUMMARIES

decsum descriptives

decgroup	Mean	N	Std. Deviation	Minimum	Maximum	Range
1	25.3898	118	4.03411	13	30	17
2	33.6378	127	1.72594	31	36	5
3	38.7833	120	1.46203	37	41	4
4	44.2137	117	1.72621	42	47	5
5	52.3113	106	4.09498	48	65	17
Total	38.5034	588	9.40957	13	65	52

factor score means

decgroup	m1 proccomp	m2 mortdisab	s1 popcare	s2 surgcomp	s3 popfalls	o1 obtrvag	o2 brthcsec
1	-.710	-.526	-.749	-.453	-.338	-.461	-.511
2	-.249	-.259	-.287	-.244	-.099	-.115	-.263
3	-.117	.070	.010	.012	.107	-.060	.003
4	.234	.233	.358	.225	.075	.268	.208
5	.964	.560	.770	.535	.292	.423	.651
Total	0	0	0	0	0	0	0

decgroup = decile-based ranked groups (1 = best performing 5 = worst performing hospitals)

Tables 5, 6, 7, and 8 show the distribution of the hospitals in each performance group over the categories for each of the contextual factors. In analyzing these tables, it is important to note whether any patterns can be discerned with regard to the number of hospitals which are distributed across the 5 groups for each of the contextual categories of hospitals. A higher or lower number of a certain kind of hospital in Group 1 or Group 5 might be an indication that those kinds of hospitals might tend to be better or worse performing hospitals in terms of our overall PSI measure. Table 5 summarizes the hospitals based on their Bedsize Category. In looking at the smaller Bedsize Categories, 25-49 and 40-99, there tends to be a higher number of these hospitals in the Group 1, the best performing group, with 5 of 9 (55.5%) and 21 of 51 (41.1%) hospitals, respectively. On the other hand very few of these smaller hospitals fall into Group 5, the worst performing group [0 of 9 (0%) and 4 of 52 (7.7%), respectively]. On the other hand, considering the largest Bedsize Categories, 400-499 and over 500, there is a small representation of these hospitals in the best performing group, 2 of 50 (4%) and 2 of 82 (2.4%), respectively, and much greater numbers in the worst performing group, 18 of 50 (36%) and 41 of 52 (50%), respectively. Based on these findings, there seems to be relatively strong evidence that hospital size contributes to quality performance with regard to the PSIs.

TABLE 5
FIVE HOSPITAL GROUPS PROFILE: BEDSIZE CATEGORIES

Bedsize Category		decgroup					Total
		1	2	3	4	5	
BSC	under 25	0	0	0	0	0	0
	25-49	5	3	0	1	0	9
	50-99	21	11	13	3	4	52
	100-199	47	48	35	33	8	171
	200-299	26	32	30	27	18	133
	300-399	15	15	21	23	17	91
	400-499	2	7	11	12	18	50
	over 500	2	11	10	18	41	82
Total		118	127	120	117	106	588

decgroup = decile-based ranked groups (1 = best performing 5 = worst performing hospitals)

Table 6 summarizes the number of hospitals in each performance group using 3 different measures of teaching status. Across all three measures of teaching status, there seems to be a smaller percentage of teaching hospitals in the best performing group with 21 of 221 (9.5%) for medical schools, 12 of 185 (6.5%) for hospitals with residency programs, and 2 of 86 (2.3%) for council of teaching hospitals, respectively. At the same time the reverse seems to be true with a larger number of teaching hospitals in the worst performing group, with 66 of 221 (29.9%) for medical schools, 64 of 185 (34.6%) for hospitals with residency programs, and 44 of 86 (51.1%) for council of teaching hospitals, respectively, in this group. Again, as with Bedsize Category, it seems that there is evidence that teaching hospitals may tend to perform worse in term of the quality performance indicator.

TABLE 6
FIVE HOSPITAL GROUPS PROFILE: TEACHING STATUS

Medical School		decgroup					Total
		1	2	3	4	5	
MAPP5	Yes	21	42	41	51	66	221
	No	97	85	79	66	40	367
Total		118	127	120	117	106	588

Residency Program		decgroup					Total
		1	2	3	4	5	
MAPP3	Yes	12	34	32	43	64	185
	No	106	93	88	74	42	403
Total		118	127	120	117	106	588

Council of Teaching Hosp		decgroup					Total
		1	2	3	4	5	
MAPP8	Yes	2	9	9	22	44	86
	No	116	118	111	95	62	502
Total		118	127	120	117	106	588

decgroup = decile-based ranked groups (1 = best performing 5 = worst performing hospitals)

In order to develop the Patient Mix context measure for Table 7, claims were summarized according to primary payer and all hospitals were classified into groups based on patient type into high, medium and low categories for both Medicare and Medicaid patients. The Medicare and Medicaid Percentage was derived by adding both type of claims together and then placing the hospitals into three categories, with a consistent number of hospitals across the 3 categories. When observing the number of hospitals in each cell in the table, it would be expected if patient mix had no bearing on quality performance, there would be an even division of the hospitals for the 3 categories (33.3% in each category) within each of the five hospital quality performance groups. As observed, this is not the case. In general, the best performing hospitals (those in Group 1) tended to have higher proportions of Medicare patients and higher proportions of combined Medicare/Medicaid patients, and the worst performing hospitals (Group 5) tended to have lower proportions of these two measures of patient mix: 57 (48.3%) and 52 (44.1%), respectively, of the 118 best performing hospitals had high proportions, while 68 (64.2%) and 54 (50.9%) of the 106 worst performing hospitals had low proportions of Medicare and combined Medicare/Medicaid patients.

TABLE 7
FIVE HOSPITAL GROUPS PROFILE: PATIENT MIX

Medicaid Percentage		decgroup					Total
		1	2	3	4	5	
mcdgp	Low	41	42	35	48	30	196
	Medium	38	42	51	36	29	196
	High	39	43	34	33	47	196
Total		118	127	120	117	106	588

Medicare Percentage		decgroup					Total
		1	2	3	4	5	
mcrgp	Low	23	38	26	41	68	196
	Medium	38	48	49	40	21	196
	High	57	41	45	36	17	196
Total		118	127	120	117	106	588

Medicaid and Medicare Percentage		decgroup					Total
		1	2	3	4	5	
mcdrgp	Low	26	42	29	45	54	196
	Medium	40	39	44	39	35	197
	High	52	46	47	33	17	195
Total		118	127	120	117	106	588

Table 8 summarizes hospitals within the 5 performance groups for the remaining four contextual measures. With regard to rural status, it appears that rural hospitals may perform better, since 26 of 68 (38%) rural hospitals were in the best performing group, while only 5 of 68 (7.3%) were in the worst performing group. Only 15 of the hospitals in the study did not have JCAHO accreditation, so no patterns could be ascertained for this variable. Regarding hospital ownership and comparing for-profit and not-for-profit hospitals, the only discernable pattern might be that there are fewer for-profit hospitals in the worst performing group (5 of 60, or 8.3%).

TABLE 8
FIVE HOSPITAL GROUPS PROFILE: OTHER CATEGORIES

Rural Center		decgroup					Total
		1	2	3	4	5	
RRCTR	No	92	110	110	107	101	520
	Yes	26	17	10	10	5	68
Total		118	127	120	117	106	588

JCAHO Accreditation		decgroup					Total
		1	2	3	4	5	
MAPP1	Yes	114	122	118	116	103	573
	No	4	5	2	1	3	15
Total		118	127	120	117	106	588

Ownership		decgroup					Total
		1	2	3	4	5	
CNTL	government	9	14	13	6	17	59
	church	19	14	18	23	14	88
	other nfp	75	83	75	78	70	381
	for profit	15	16	14	10	5	60
Total		118	127	120	117	106	588

decgroup = decile-based ranked groups (1 = best performing 5 = worst performing hospitals)

In order to determine whether specific context variables could predict hospital quality performance, a polar extreme discriminant analysis approach (Hair, et al., 1998) was employed to determine if there were significant differences between the highest and lowest performing groups on any of the contextual factors. The polar extreme approach was used because there were small differences between the end points for the five performance groups based on the decile sums, so it would not be meaningful to analyze the differences between each of the groups. Table 9 provides structure matrix discriminant analysis loadings for all ten of the context variables on an individual basis. The results indicate that 7 of the 10 context variables are significant predictors of hospital quality performance grouping with loadings of 0.3 or higher. The size context variable as well as all of the teaching context variables (residency program, medical school, and council of teaching), and one of the patient mix variables (Medicare percentage) were loaded positively, meaning that these context variables represented hospitals with higher PSI rates (or worse quality performance). On the other hand, both patient type measures that included Medicare percentage loaded negatively, which indicates that hospitals with a higher percentage of Medicare patients have lower PSI rates (or better-quality performance). Accreditation status, hospital location (rural/urban), and ownership status were not significant predictors of hospital performance.

TABLE 9
STRUCTURE MATRIX DISCRIMINANT ANALYSIS (POLAR EXTREMES)

*Loadings (> 0.30 = sig)

	Function
	1
Total Beds	*.798
Residency Program	*.762
Medical School	*.664
Medicare Percentage	*-.637
Council of Teaching	*.597
Medicaid Percentage	*.342
Medicaid Medicare Percentage	*-.309
JCAHO Accredited	.139
Rural Center	-.109
For Profit	-.025

Functions at Group Centroids

hilogroup	Function
	1
1	-.773
2	.861

hilogroup = decile-based ranked groups (1 = best performing 2 = worst performing hospitals)

Table 10 shows the results of including the ten context variables in a stepwise discriminant analysis model. The model that shows the best predictive capability, explaining over 40% of the variation, included two measures which are positively correlated, hospital size (measured in total beds) and teaching status (residency program), and one which is negatively correlated, patient type (Medicare percentage). This indicates that larger hospitals with residency programs and a lower percentage of Medicare patients tended to perform worse (i.e., have high PSI rates).

TABLE 10
STEPWISE MODEL DISCRIMINANT ANALYSIS (POLAR EXTREMES)

Step	Entered	Min. D Squared					
			Between Groups	Exact F			
		Statistic		Statistic	df1	df2	Sig.
1	Total Beds	1.699	1 and 2	94.870	1	222	.000
2	Medicare Percentage	2.331	1 and 2	64.782	2	221	.000
3	Residency Program	2.669	1 and 2	49.232	3	220	.000

Summary of Canonical Discriminant Functions

Eigenvalues

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation	Variation Explained
1	.671	100.0	100.0	.634	.4020

Standardized Canonical Discriminant Function Coefficients

	Function
	1
Total Beds	.546
Medicare Percentage	-.400
Residency Program	.406

hilogroup = decile-based ranked groups (1 = best performing 2 = worst performing hospitals)

DISCUSSION

The purpose of this study was to use the data and tools from the U.S. hospital industry to test the contingency model of quality. We examined several contextual factors to assess their effects on hospital performance in regard to quality outcomes. We employed factor analysis and a decile ranking methodology to sort hospitals into low and high performers on several indicators of quality in order to determine if there were contextual characteristics common to either high or low performing hospitals. We also employed an AHRQ data base in our analyses. This database is available to researchers interested in studying quality issues in the U.S. hospital industry.

Our results support the contention that quality is contingent, rather than universal. We found that contextual factors had an effect on the quality performance of hospitals. The results of discriminant analysis indicated that there were significant differences between the best performing hospitals and the poorest performing hospitals in regard to characteristics of the best and worst performing groups. The context variables size, teaching status, and patient mix were all significant. Hospitals in the best performing group with the significantly lower PSI rates tended to include more hospitals that were small, non-teaching, hospitals with a higher percentage of Medicare patients and a lower percentage of Medicaid patients, while hospitals in the lowest performing group tended to include more large, teaching hospitals with a lower percentage of Medicare and higher percentage of Medicaid patients. On the other hand, the context variables accreditation status, rural center status, and ownership (for profit) status were not significant. It is interesting to note that some of these findings, while consistent with those from other studies (Miller, 1994; Romano et al., 2003; Slonim, et al., 2007; Vartak, 2008), are contrary to conventional wisdom which holds that the best care is provided by large teaching hospitals.

This study suggests several directions which might be taken for future research. From a methodological standpoint, it is important to evaluate the stability of the underlying PSI factors. The factor analyses from this study only partially agree with previous factor analytic results (Rosen et al., 2005) from a sample of a different population of hospitals (VA hospitals), so further studies involving factor analyses could clarify the structure of these factors. It would be beneficial to determine the extent to which the PSIs that contribute to these factors are stable over time and with regard to different hospitals. If the PSI factors are shown to be stable, this would be impact not only for the methodologies employed in future studies, but could have implications for hospitals in their management of eliminating or reducing instances of these PSIs. In other words, if the same PSIs load on a single factor, then it might be beneficial to seek to manage them with a common approach or to look for a common source for the cause of these problems. On the other hand should the PSI factors prove to be unstable, the implications would be that each should be treated individually, both from a methodological standpoint and in terms of managing or decreasing the number of instances of each PSI.

Another area for future study would be to assess these measures over a longer period than just one year in order to determine the extent to which the findings of this study, which suggests that the contingent model of quality management is more appropriate than universal model, are supported. If it turns out that certain PSIs or PSI factor rates are consistently higher or lower for hospitals with specific organizational characteristics, it would be beneficial to turn to organizational theory to explain how those characteristics might lead to consistent patterns of PSI rates.

Since this study uses publicly available databases from some but not all states from a single year, the results of this study may not be applicable to either all U.S. hospital or for extended periods of time. Again, this is support for future studies which evaluate the stability of these findings over time and for different populations of hospitals. The study also uses publicly available software which is limited to only 22 PSIs. The findings from this study may not be applicable to all hospital quality outcomes. Future studies might concentrate on additional quality factors which may give support for the extent to which certain types of hospitals may perform better or worse in terms of quality.

This study also looked at only one industry, U.S. hospitals. Future studies taking a similar approach involving firms across a range of industries would add validity to the finding of this study which supports the contingent rather that the universal model of quality management.

CONCLUSION

This study used publicly available databases and software tools to test the validity of the universal approach versus the contingent approach to quality management models across an entire industry, general hospitals in the United States. It reduced individual patient safety indicators (PSIs) to several interpretable PSI factors, used these factors to group hospitals according to quality performance, and then used hospital characteristics to profile extreme best-performing and worst-performing groups. The results indicated that contextual variables have an effect on quality performance, providing support for the conclusion that quality is contingent, rather than universal. There were significant differences between high and low performing hospitals in regard to several contextual factors. Hospital size, teaching status, and patient mix all had an effect on quality, according to discriminant analysis. Additionally, this study should inspire further research in health care as well as other industries to take advantage of publicly available databases to test business models across industries.

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