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Nurse Reports on Resource Adequacy in Hospitals that Care for Acutely Ill Children

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Abstract

Despite the estimated 1.8 million children admitted to hospitals annually, little is known about the quality of care and the adequacy of resources in hospitals that care for acutely ill infants and children. Using survey data from 3,819 pediatric nurses working in 498 hospitals, we found that nursing resources vary significantly across different types of hospitals that care for children. Nurses working in a children's hospital within a hospital, and on a pediatric unit in a general hospital were more likely than nurses in freestanding children's hospitals to report inadequate nursing resources. We also found that inadequate nursing resources were associated with surveillance left undone and missed changes in patients' condition. These findings have implications for the quality and safety of pediatric care.

Keywords

nursing; patient safety; pediatrics

Few reports address the quality of healthcare delivered to children despite the estimated 1.8 million who are admitted to hospitals annually (Owens, Thompson, Elixhauser, & Ryan, 2003). Hospitalized children are particularly vulnerable to medical errors and preventable adverse outcomes (Miller, Elixhauser, & Zhan, 2003; Miller & Zhan, 2004). Yet little systematic investigation has been undertaken to determine if features of hospitals that care for children are associated with poor outcomes in ways that might be modified to reduce risks.

The Institute of Medicine (Institute of Medicine, 2004) has reported that nurses are the largest contingent of healthcare workers and that the nurse work environment significantly affects patient safety. This has been corroborated by a decade of research, which has provided evidence that nurses and the environment in which they work are associated with both nurse and patient outcomes (Aiken, Clarke, Cheung, Sloane, & Silber, 2003; Aiken, Clarke, Sloane, Sochalski, & Silber, 2002; Aiken et al., 2010). Although a few reports have linked nurse staffing to adverse outcomes in children (Archibald, Manning, Bell, Banerjee, & Jarvis, 1997; Mark, Harless, & Berman, 2007), none have examined additional nursing resource factors such as the educational attainment of nurses (Aiken et al., 2003) or the quality of the nurse practice environment, that have been linked to the quality of care in adult populations (Aiken, Clarke, Sloane, Lake, & Cheney, 2008). Although it has been reported that nursing resources and patient outcomes are better on specialized units (Aiken, Sloane, Lake, Sochalski, & Weber, 1999) and in specialized facilities such as designated cancer centers (Friese, Lake, Aiken, Silber, & Sochalski, 2008), there is very little evidence related to acute care facilities that specialize in the care of children, and no studies that compare reports of nursing resources and the quality of care provided to children in general acute care hospitals and children's hospitals. In this paper, we examine 498 hospitals in four states and reports from almost 4,000 pediatric nurses providing care to acutely ill infants and children in these same hospitals. We find that available nursing resources vary significantly

across different types of hospitals that care for children and that the nursing resources known to be associated with higher quality care may be more readily available in a freestanding children's hospital than in other hospitals.

Study Data and Methods

Our study involves an analysis of data from 498 acute care hospitals in four states—California ($n = 231$), Florida ($n = 104$), New Jersey ($n = 57$), and Pennsylvania ($n = 106$). Although these states were chosen partly on the basis of available funding, they are among the largest in the nation and account for more than 20% of annual admissions. Hospitals were classified into three types, based on licensure information received from state agencies, as follows: (1) general adult acute care hospital with a pediatric unit, (2) a children's hospital within a larger adult acute care hospital, and (3) free-standing children's hospitals—those dedicated exclusively to caring for children.

The units of analysis in this paper are 498 hospitals and the units of observation are the pediatric registered nurses employed in these same hospitals. The response rate at the hospital level was 90% of all acute care hospitals that provide care to acutely ill infants and children in the four states. Hospitals not appearing in the analysis are typically small community hospitals that do not provide pediatric services or where we did not have pediatric nurses who responded to our survey.

Survey data were available from 3,819 pediatric nurses working in these acute care hospitals. These nurses were a subsample from a larger study of registered nurses who were surveyed from licensure lists in each state from 2006 to 2008, some of whom were working in hospitals, others of whom were working in nonhospital settings and still others who were not working at all. The mail survey procedure, which has been described in detail elsewhere (Aiken et al., 2011), was executed using a modified Dillman method (Dillman, Smyth, & Christian, 2009). The survey response rate for the overall sample was 39%. To assess response bias, we used a double sample method and resampled 1,300 nonresponding nurses to the initial survey and found no significant differences between nurses who responded to the initial survey and those who did not (Smith, 2008). The study was approved by the institutional review boards of the University of Pennsylvania, Rutgers University, and University of Florida.

Measures

Hospitals

Structural characteristics of hospitals that were used as controls in our study were obtained from the American Hospital Association (AHA) Annual Survey and included bed size, teaching status, and technology. Bed size was defined as the total number of available beds in the hospital. Teaching status was defined by the number of medical residents and fellows, with non-teaching hospitals being those without any residents/fellows, minor teaching hospitals were those with 1:4 or smaller resident to bed ratios, and major teaching hospitals were hospitals with ratios higher than 1:4. Hospitals were designated as high technology if they had facilities for either open heart surgery, major organ transplants, or both.

Nurses

Data on nurse characteristics and workloads were obtained from the nurse survey. Two dimensions of nurse workload were measured at the hospital level as mean number of patients cared for by registered nurses on their last shift. Educational attainment and other nurse characteristics reported by individual nurses enabled us to estimate, for the different types of hospitals, the percent of nurses with a bachelor's degree or higher, the percent that

were female, and the mean age and experience of the nurses in terms of their years in nursing, in their current hospital, and on their current unit.

Staffing and Resource Adequacy

Aspects of the nurse work environment were computed from the Practice Environment Scale of the Nursing Work Index (PES-NWI). The PES-NWI is an extensively validated measure (Aiken et al., 2008; Aiken & Patrician, 2000; Lake, 2002; Lake & Friese, 2006) that has been endorsed by the National Quality Forum (National Quality Forum, 2004) as a “nursing sensitive” measure of hospital care quality. Nurses rate each item on a scale of 1–4, where 1 is *strongly disagree* and 4 is *strongly agree* to indicate whether a feature is present in their current job. For this study we examined one subscale, staffing, and resource adequacy, as it best assessed our outcomes of interest. The staffing and resource adequacy subscale is highly reliable with a reported Cronbach's alpha of .80 at the individual level and an average interitem correlation of .91 at the hospital level. The hospital-level intraclass correlation coefficient for this subscale has been reported at .96. Based on previous work (Lake & Friese, 2006), high staffing and resource adequacy was computed by contrasting hospitals with a mean subscale score greater than 2.5 with hospitals scoring below that level.

Incomplete Surveillance and Missed Changes in Patient Conditions

Two single items were used to assess our outcomes of interest. Nurses were asked if on their last shift surveillance was left undone because they lacked time to complete it, and if their workload caused them to miss important changes in their patients' conditions. Both were computed as binary response items.

Analysis

We used analysis of variance (ANOVA) procedures to examine differences in outcomes that were measured as continuous (or interval ratio) and used the Bonferroni method to adjust for multiple comparisons. Logistic regression models were used to estimate the effect of staffing and resource adequacy on bivariate outcomes of interest, before and after controlling for state, and nurse and hospital characteristics. To account for the clustering of nurses within hospitals, all models were estimated using Huber–White procedures. STATA 11.0 (STATA Corp, College Station, TX) was used for all computations and significance was set at 0.05.

Study Findings

Characteristics of Hospitals

Children's hospitals within adult hospitals had, on average, roughly twice as many total (adult and pediatric) hospital beds ($n = 615$ beds) as freestanding ($n = 306$) and general ($n = 331$) hospitals with a pediatric unit (Table 1). A significantly larger proportion of freestanding children's hospitals (83%) were teaching hospitals and a significantly larger proportion of children's hospitals within a hospital (83%) were high technology facilities based on adult and pediatric procedures. Nurses' workloads were significantly lower in freestanding children's hospitals; the mean patient-to-nurse ratios were 3:1 for freestanding children's hospitals, 4:1 for children's hospitals within a hospital, and 5:1 for pediatric units within general hospitals.

Characteristics of Nurses

As noted in Table 2, nurses working in freestanding children's hospitals were, on average, significantly younger (39 years), had fewer average years of experience as a nurse (13 years), fewer years working in the hospital (10 years), and fewer years on their specific unit (8 years). A significantly higher percent of nurses (61%) working in freestanding children's

hospitals were educated at the baccalaureate level or higher when compared to nurses working in both children's hospitals within a hospital (50%) and general (41%) hospitals, and were more likely to be male although men are still underrepresented in nursing.

Staffing and Resource Adequacy

Odds ratios estimating the differences between freestanding, children's hospital within a hospital and general hospitals on the likelihood of being below average on the staffing and resource adequacy items are shown in Table 3. When compared to nurses working in freestanding hospitals, nurses in children's hospitals within a hospital and general hospitals were more likely, by factors of 1.43 and 1.15 (or by 43% and 15%), to report not having enough staff to get the work done. Although neither of these differences are significant at the .05 level the first is very nearly so, and both are sizable enough to warrant further examination with larger samples of hospitals. Similar differences were found when nurses were asked about whether there were enough nurses to provide quality care; nurses working in children's hospitals within a hospital and general hospitals were more likely than nurses in free-standing hospitals, by factors of 1.31 and 1.20 (or by 31% and 20%), respectively, to report that there were not enough registered nurses to provide quality care. Working in children's hospital within a hospital and general hospitals also increased the likelihood that nurses reported inadequate support services to allow time with patients by factors of 1.47 and 1.36 (or by 47% and 36%), respectively, and both of these differences are highly significant. Not having enough time and opportunities to discuss patient care problems with other nurses was more likely to be reported by nurses working in children's hospitals within a hospital (OR = 1.49) and by nurses working in general hospitals (OR = 1.14) than by nurses in freestanding hospitals, though the difference between general and freestanding hospitals was not significant.

Incomplete Surveillance and Missed Changes in Patient Conditions

Table 4 shows the results of using bivariate and multivariate logistic regression models to estimate the differences between the three hospital types and the effect of staffing and resource adequacy on the likelihood of nurses reporting that (1) patient surveillance was left undone on their last shift and (2) they had missed changes in patients' condition. The results from bivariate models show that nurses working in children's hospitals within a hospital and general hospitals were significantly more likely than nurses in freestanding hospitals to report that they had left patient surveillance undone on their last shift, by factors of 1.68 and 1.59, respectively (or by 68% and 59%). Nurses in the children's hospitals within a hospital and general hospitals were also more likely than nurses in freestanding hospitals to report having missed changes in patients' conditions, by factors of 1.64 and 1.41, respectively (or by 64% and 41%). Nurses in hospitals that were high on staffing and resource adequacy were less likely than nurses in hospitals that were low on that dimension to report having left surveillance tasks undone and missed changes in patient conditions, by factors of 0.40 and 0.42 (or 60% and 58%).

When we estimated a multivariate model the effects of hospital type and staffing and resource adequacy simultaneously, without controlling for other hospital characteristics, we found that when differences in staffing and resource adequacy were taken into account, the differences in both outcomes across the three types of hospitals were greatly attenuated and rendered insignificant. Ultimately, in the final model that controlled for hospital characteristics as well as the highly significant effect of high staffing and resource adequacy, the difference between nurses' reports of both outcomes in children's hospital within a hospital and freestanding hospitals was rendered insignificant, as was the difference between general and freestanding hospitals on the likelihood of reporting having missed changes in patient conditions.

Discussion

In this paper, we examined nurse staffing and resource adequacy in three types of hospitals that provide care to acutely ill infants and children. Our findings that pediatric nurses employed in children's hospitals within a hospital and general acute care hospitals were in all cases more likely, and in some cases significantly more likely, to report inadequate staffing and resource adequacy than nurses in freestanding children's hospitals has not been previously reported. We also found that hospitals with better staffing and more adequate resources had lower odds of incomplete surveillance and of having missed changes in patient conditions. And finally, we found that without controlling for these differences across hospitals in staffing and resource adequacy the nurses employed in children's hospitals within a hospital and general acute care hospitals appeared to be significantly more likely to report incomplete surveillance and having missed changes in patients' conditions during their last shift than nurses in freestanding children's hospitals. Importantly, we found that these differences were largely attributable to differences in staffing and resource adequacy in the different types of hospitals. That is, when we controlled for differences in staffing and resource adequacy and its effect on incomplete surveillance and missed changes in patients' conditions in multivariate models, the differences across types of hospitals in these outcomes were rendered insignificant.

Specialty-service lines in pediatric acute care can represent a hospital within a hospital, or a floor or unit within a hospital, and there is some work to suggest that these hospitals often do not have designated administration, cost centers, or even a business plan (Berenson, Bodenheimer, & Pham, 2006). How the operation of pediatric service lines translates into the distribution of staff and nursing resources and performance has yet to be explored.

This is not the first report to show that nurse staffing and resources are associated with the quality of care in hospitalized infants and children. Nurse-to-patient ratios have been linked to unplanned extubation in critically ill children (Marcin et al., 2005) and increasing resource-adjusted nurse hours has been linked to a decrease in postoperative complications, postoperative pneumonia, and postoperative sepsis in children (Mark et al., 2007). Both the spread of infections and drug-resistant organisms has been linked to overcrowding and understaffing in neonatal intensive care (Andersen et al., 2002; Cimiotti, Haas, Saiman, & Larson, 2006; Haley & Bregman, 1982; Harbarth, Sudre, Dharan, Cadenas, & Pittet, 1999; Saiman et al., 2003) and pediatric (Archibald et al., 1997; Stegenga, Bell, & Matlow, 2002) general and intensive care units. However, none of these studies examine outcomes of care based on the specialty-specific type of hospitals that provide pediatric acute care.

It has been reported that 70% of extremely ill children will be admitted to a children's hospital (Odetola, Gebremariam, & Freed, 2007). Children admitted to children's hospitals have more complex medical conditions, are more severely ill (Burns et al., 2010; Donoghue, Nadkarni, Elliott, Durbin, & American Heart Association National Registry of Cardiopulmonary Resuscitation, 2006), and are at significant risk for in-hospital mortality (Donoghue et al., 2006; Odetola, Gebremariam, & Davis, 2010) and greater use of hospital resources (Odetola et al., 2010; Silber, Gleeson, & Zhao, 1999). Critically ill children are physically and physiologically immature when compared to adults and as such care must be adjusted accordingly (Hazinski, 1997). This includes continued assessment, which is often nonverbal in nature. Our finding that surveillance may be inadequate and that changes are missed in patients' conditions is alarming because both of these outcomes have implications for adverse events including death. Inadequate surveillance has been associated with reports of healthcare-associated infection, patient falls with injury, and the overall quality of hospital care being rated as fair or poor (Kutney-Lee, Lake, & Aiken, 2009). Being able to quickly identify changes in patients' conditions is essential to enabling hospitals to "rescue"

patients from what are often preventable deaths (Silber et al., 2007; Silber, Rosenbaum, & Ross, 1995; Silber, Williams, Krakauer, & Schwartz, 1992).

We note that this is a preliminary study of differences between types of children's inpatient services. We are estimating the adequacy of staffing and possible risks to children using nurses' assessments. Likewise nurses' reports of quality of care have been validated in hospital outcomes research on adults (Aiken et al., 2002), but having actual patient outcomes for children in the hospitals studied would be helpful. Our method of categorizing children's inpatient services is simple, and we were not able to control for case mix. Additionally, some of our control variables such as number of beds, medical residents, and high technology cannot distinguish between adult and pediatric patients in a children's hospital within a hospital and general hospitals. Our data are cross-sectional and we cannot be certain about causality. There are, moreover, unmeasured variables that might be associated with our results.

Conclusion

Our findings suggest that there may be differences in nursing resources and pediatric outcomes between freestanding children's hospitals, children's hospitals within larger institutions, and pediatric units within general hospitals, and that differences in the adequacy of resources may be largely responsible for differences in outcomes. Reports from nurses working in these different types of organizations suggest that these differences in nursing resources may have implications for quality of inpatient pediatric care. Further research is warranted to determine whether organizational sponsorship and financial models of children's inpatient services are associated with differences in quality of care and patient care outcomes, and if so the extent to which differences in investments in nursing are responsible.

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References

- Aiken LH, Cimiotti JP, Sloane DM, Smith HL, Flynn L, Neff DF. Effects of nurse staffing and nurse education on patient deaths in hospitals with different work environments. *Medical Care*. 2011; 49:1047–1053. [PubMed: 21945978]
- Aiken LH, Clarke SP, Cheung RB, Sloane DM, Silber JH. Educational levels of hospital nurses and surgical patient mortality. *Journal of the American Medical Association*. 2003; 290:1617–1623. [PubMed: 14506121]
- Aiken LH, Clarke SP, Sloane DM, Lake ET, Cheney T. Effects of hospital care environment on patient mortality and nurse outcomes. *Journal of Nursing Administration*. 2008; 38:223–229. [PubMed: 18469615]
- Aiken LH, Clarke SP, Sloane DM, Sochalski J, Silber JH. Hospital nurse staffing and patient mortality, nurse burnout, and job dissatisfaction. *Journal of the American Medical Association*. 2002; 288:1987–1993. [PubMed: 12387650]
- Aiken LH, Patrician PA. Measuring organizational traits of hospitals: The revised nursing work index. *Nursing Research*. 2000; 49:146–153. [PubMed: 10882319]
- Aiken LH, Sloane DM, Cimiotti JP, Clarke SP, Flynn L, Seago JA, et al. Implications of the California nurse staffing mandate for other states. *Health Services Research*. 2010; 45:904–921. [PubMed: 20403061]
- Aiken LH, Sloane DM, Lake ET, Sochalski J, Weber AL. Organization and outcomes of in-patient AIDS care. *Medical Care*. 1999; 37:760–772. [PubMed: 10448719]
- Andersen BM, Lindemann R, Bergh K, Nesheim BI, Syversen G, Solheim N, et al. Spread of methicillin-resistant *Staphylococcus aureus* in a neonatal intensive unit associated with understaffing, overcrowding and mixing of patients. *Journal of Hospital Infection*. 2002; 50:18–24. [PubMed: 11825047]
- Archibald LK, Manning ML, Bell LM, Banerjee S, Jarvis WR. Patient density, nurse-to-patient ratio and nosocomial infection risk in a pediatric cardiac intensive care unit. *Pediatric Infectious Disease Journal*. 1997; 16:1045–1048. [PubMed: 9384337]
- Berenson RA, Bodenheimer T, Pham HH. Specialty-service lines: Salvos in the new medical arms race. *Health Affairs*. 2006; 25:w337–w343. [PubMed: 16868008]
- Burns KH, Casey PH, Lyle RE, Bird TM, Fussell JJ, Robbins JM. Increasing prevalence of medically complex children in US hospitals. *Pediatrics*. 2010; 126:638–646. [PubMed: 20855383]
- Cimiotti JP, Haas J, Saiman L, Larson EL. Impact of staffing on bloodstream infections in the neonatal intensive care unit. *Archives of Pediatrics & Adolescent Medicine*. 2006; 160:832–836. [PubMed: 16894083]
- Dillman, DA.; Smyth, JD.; Christian, LM. Internet, mail, and mixed-mode surveys: The tailored design method. kindle edition. John Wiley & Sons, Inc.; Hoboken, NJ: 2009. ASIN: B00387FOGM
- Donoghue AJ, Nadkarni VM, Elliott M, Durbin D, American Heart Association National Registry of Cardiopulmonary Resuscitation Investigators. Effect of hospital characteristics on outcomes from pediatric cardiopulmonary resuscitation: A report from the national registry of cardiopulmonary resuscitation. *Pediatrics*. 2006; 118:995–1001. [PubMed: 16950990]
- Friese CR, Lake ET, Aiken LH, Silber JH, Sochalski J. Hospital nurse practice environments and outcomes for surgical oncology patients. *Health Services Research*. 2008; 43:1145–1163. [PubMed: 18248404]
- Haley RW, Bregman DA. The role of understaffing and overcrowding in recurrent outbreaks of staphylococcal infection in a neonatal special-care unit. *Journal of Infectious Diseases*. 1982; 145:875–885. [PubMed: 7086199]

- Harbarth S, Sudre P, Dharan S, Cadenas M, Pittet D. Outbreak of enterobacter cloacae related to understaffing, overcrowding, and poor hygiene practices. *Infection Control & Hospital Epidemiology*. 1999; 20:598–603. [PubMed: 10501256]
- Hazinski, MF. Anatomic and physiologic differences between children and adults. In: Levin, DL.; Morriss, FC., editors. *Essentials of pediatric intensive care*. 2nd ed.. Churchill Livingstone; New York: 1997. p. 1112-1126.
- Institute of Medicine. *Keeping patients safe: Transforming the work environment of nurses*. National Academies Press; Washington, DC: 2004.
- Kutney-Lee A, Lake ET, Aiken LH. Development of the hospital nurse surveillance capacity profile. *Research in Nursing & Health*. 2009; 32:217–228. [PubMed: 19161172]
- Lake ET. Development of the practice environment scale of the nursing work index. *Research in Nursing & Health*. 2002; 25:176–188. [PubMed: 12015780]
- Lake ET, Friese CR. Variations in nursing practice environments: Relation to staffing and hospital characteristics. *Nursing Research*. 2006; 55:1–9. [PubMed: 16439923]
- Marcin JP, Rutan E, Rapetti PM, Brown JP, Rahnamayi R, Pretzlaff RK. Nurse staffing and unplanned extubation in the pediatric intensive care unit. *Pediatric Critical Care Medicine*. 2005; 6:254–257. [PubMed: 15857520]
- Mark BA, Harless DW, Berman WF. Nurse staffing and adverse events in hospitalized children. *Policy, Politics, & Nursing Practice*. 2007; 8:83–92.
- Miller MR, Elixhauser A, Zhan C. Patient safety events during pediatric hospitalizations. *Pediatrics*. 2003; 111:1358–1366. [PubMed: 12777553]
- Miller MR, Zhan C. Pediatric patient safety in hospitals: A national picture in 2000. *Pediatrics*. 2004; 113:1741–1746. [PubMed: 15173500]
- National Quality Forum. *National voluntary consensus standards for nursing-sensitive care: An initial performance measure set*. Author; Washington, DC: 2004.
- Odetola FO, Gebremariam A, Davis MM. Comorbid illnesses among critically ill hospitalized children: Impact on hospital resource use and mortality, 1997-2006. *Pediatric Critical Care Medicine*. 2010; 11:457–463. [PubMed: 20595822]
- Odetola FO, Gebremariam A, Freed GL. Patient and hospital correlates of clinical outcomes and resource utilization in severe pediatric sepsis. *Pediatrics*. 2007; 119:487–494. [PubMed: 17332201]
- Owens, P.; Thompson, J.; Elixhauser, A.; Ryan, K. *Care of children and adolescents in U.S. hospitals*. Agency for Healthcare Research and Quality; Rockville, MD: 2003. Vol. HCUP Fact Book No. 4, AHRQ Publication No. 04-0004
- Saiman L, Cronquist A, Wu F, Zhou J, Rubenstein D, Eisner W, et al. An outbreak of methicillin-resistant *Staphylococcus aureus* in a neonatal intensive care unit. *Infection Control & Hospital Epidemiology*. 2003; 24:317–321. [PubMed: 12785403]
- Silber JH, Gleeson SP, Zhao H. The influence of chronic disease on resource utilization in common acute pediatric conditions. Financial concerns for children's hospitals. *Archives of Pediatrics and Adolescent Medicine*. 1999; 153:169–179. [PubMed: 9988247]
- Silber JH, Romano PS, Rosen AK, Wang Y, Even-Shoshan O, Volpp KG. Failure-to-rescue: Comparing definitions to measure quality of care. *Medical Care*. 2007; 45:918–925. [PubMed: 17890988]
- Silber JH, Rosenbaum PR, Ross RN. Comparing the contributions of groups of predictors: Which outcomes vary with hospital rather than patient characteristics. *Journal of the American Statistical Association*. 1995; 90:7–18.
- Silber JH, Williams SV, Krakauer H, Schwartz JS. Hospital and patient characteristics associated with death after surgery. A study of adverse occurrence and failure to rescue. *Medical Care*. 1992; 30:615–629. [PubMed: 1614231]
- Smith, HL. A double sample to minimize bias due to non-response in a mail survey. In: Ruiz-Gazen, PGA.; Haziza, D.; Tillé, Y., editors. *Survey methods: Applications to longitudinal studies, to health, to electoral studies and to studies in developing countries*. Dunod; Paris: 2008. p. 334-339.

Stegenga J, Bell E, Matlow A. The role of nurse understaffing in nosocomial viral gastrointestinal infections on a general pediatrics ward. *Infection Control & Hospital Epidemiology*. 2002; 23:133–136. [PubMed: 11918117]

Table 1Characteristics of Study Hospitals ($n = 498$)

	Freestanding children's hospital ($n = 12$)	Children's hospital within a hospital ($n = 30$)	General hospital ($n =$ 456)	p -Value
Hospital characteristics				
Total bed size, mean	306	615 ^{ab}	331	.000
Teaching hospital (%)	83 ^a	70 ^{ab}	47 ^b	.004
High technology (%)	66 ^a	83 ^{ab}	42 ^b	.000
Nurse workload, mean	3 ^a	4 ^{ab}	5 ^b	.000

Note.

^a $p < .05$ vs. general;^b $p < .05$ vs. freestanding.

Table 2Characteristics of Pediatric Nurse Survey Respondents ($n = 3,819$)

	Freestanding children's hospital ($n = 12$)	Children's hospital within a hospital ($n = 30$)	General hospital ($n = 456$)	<i>p</i> -Value
Nurse characteristics				
Male (%)	3 ^a	2 ^{ab}	1 ^b	.001
Age, mean	39 ^a	42 ^{ab}	46 ^b	.000
BSN (%)	61 ^a	50 ^{ab}	41 ^b	.000
Years RN, mean	13 ^a	16 ^{ab}	19 ^b	.000
Years in hospital, mean	10 ^a	11	12 ^b	.000
Years on unit, mean	8 ^a	9	10 ^b	.002

Note.

BSN, Bachelor of Science in Nursing; RN, registered nurse.

^a $p < .05$ vs. general;^b $p < .05$ vs. freestanding;

Table 3

Odds Ratios Estimating the Associations Between Hospital Type and the Staffing and Resource Adequacy Items

	Children's hospital within a hospital	<i>p</i> -Value	General hospital	<i>p</i> -Value
Staffing and resource adequacy items				
Not enough staff to get the work done	1.43	.057	1.15	.340
Not enough registered nurses to provide quality care	1.31	.163	1.20	.224
Inadequate support services to allow time with my patients	1.47	.036	1.36	.034
Not enough time and opportunities to discuss patient care problems with other nurses	1.49	.041	1.14	.386

Note. Freestanding children's hospitals are the referent category.

Table 4

Odds Ratios Estimating the Associations of High Staffing and Resource Adequacy with Surveillance and Missed Changes in Patient Condition

	<u>Bivariate models</u>		<u>Multivariate models</u>			
	Odds ratio	<i>p</i> -Value	<u>Without hospital controls</u>		<u>With hospital controls</u>	
			Odds ratio	<i>p</i> -Value	Odds ratio	<i>p</i> -Value
Incomplete surveillance						
Children's hospital within a hospital	1.68	.005	1.25	.214	1.17	.381
General hospital	1.59	.004	1.28	.131	1.18	.320
Staffing and resource adequacy	0.40	.000	0.41	.000	0.42	.000
Missed changes in patient condition						
Children's hospital within a hospital	1.64	.001	1.28	.071	1.05	.767
General hospital	1.41	.001	1.18	.076	1.10	.569
Staffing and resource adequacy	0.42	.000	0.43	.000	0.44	.000

Note. Freestanding children's hospitals are the referent category. The hospital controls in the multivariate model, in addition to staffing and resource adequacy, are size, teaching status, and technology.