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Outcomes Of A Pediatric Acute Care Nurse Practitioner Driven Front-Line Care Delivery Model In An Academic Pediatric Intensive Care Unit

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OUTCOMES OF A PEDIATRIC ACUTE CARE NURSE PRACTITIONER DRIVEN FRONT-LINE CARE DELIVERY MODEL IN AN ACADEMIC PEDIATRIC INTENSIVE CARE UNIT

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Abstract

Background: Determining the conditions that promote high performing advanced nursing practice is important because hospitals are increasingly dependent on the use of nurse practitioners (NPs) to deliver front-line care to acute and critically ill patients.

Objective: To describe the outcomes of a front-line care model that uses certified pediatric acute care NPs, limits work hours and night time and weekend patient-to-provider ratio, on the outcomes of patients cared for in an academic Pediatric Intensive Care Unit (PICU).

Methods: A retrospective quasi-experimental design was used to describe the outcomes of an NP Team model compared to a physician-only, Traditional Medical Team model that existed simultaneously in the same PICU.

Results: Patients cared for by the NP Team had lower mean acuity, experienced equivalent mortality, shorter length of stay (LOS), and with the exception of Catheter Related Urinary Tract Infections (CAUTI), slightly lower device associated hospital acquire infection rates compared to those cared for by a Traditional Medical Team.

Conclusions: In an academic PICU, a front-line care delivery model that used certified pediatric acute care NPs who were intermittently supplemented by pediatric hospitalist pediatricians and residents, and that limits work hours and night time and weekend patient-to-provider ratio, resulted in outcomes that are at least equivalent to those of traditional medical teams.

Introduction

Determining the conditions that promote high performing advanced nursing practice is important because hospitals are increasingly dependent on the use of nurse practitioners (NPs) to deliver front-line care to acute and critically ill patients. A trend of early retirement among intensive care physicians (intensivists), coupled with fewer than 1% of medical school graduates entering critical care, creates a significant risk of future shortages of intensivists (Auerbach, 2012; Riley, Poss, & Wheeler, 2013). In 2004, in response to impending intensivist shortages, the American College of Critical Care Medicine published Intensive Care Unit (ICU) staffing guidelines that support the delegation of patient care by intensivists to NPs. In 2006, the Leapfrog group further endorsed NPs as a solution for the mandate that providers with specialized training collaborate with intensivists to ensure the immediate availability of time-sensitive interventions to critically ill patients at all times (Angus et al., 2006). NPs are also frequently cited as the solution for academic workforce shortages that are caused by the Accreditation Council for Graduate Medical Education's (ACGME) restrictions on physician trainees' work hours (Aiken, Cheung & Olds, 2009; Aleshire, Wheeler & Prevost, 2012; Kleinpell & Goolsby, 2012; Ulmer, Wolman & Johns 2008). As a result, there is an ever increasing number of NPs working in ICUs. Evidence-based models for using NPs in the care of critically ill patients, however, are not well described in the literature (Angus et al., 2006; Brown, Besunder, & Bachmann, 2008; Keough, et al., 2011; Reuter-Rice, 2012; Riley, Poss, & Wheeler, 2013; Squiers, et al., 2013; Verger, Keefe-Marcoux, Madden, Bojko, & Barnsteiner 2005).

Seminal investigations, primarily led by Dr. Linda Aiken and her research teams from the University of Pennsylvania, demonstrate that a low patient-to-nurse ratio, work hour limitations, and a baccalaureate educated and specialty certified registered nurse (RN) workforce are associated with positive patient outcomes including lower rates of hospital acquired infection and mortality (Aiken, et al, 2011; Aiken, Clarke, Cheung, Sloane, & Silber, 2003; Aiken, Clarke, Sloane, Lake, & Cheney, 2009; Aiken, Clarke & Aiken, 2008; Clarke, Sloane, Sochalski, & Silber, 2002; Kendall-Gallagher, Aiken, Sloane, & Cimiotti, 2011; Stimpfel, Lake, Barton, Gorman, & Aiken, 2013; Stimpfel, Sloane & Aiken, 2012). It can be hypothesized that similar associations exist for advanced nursing practice and can be used to guide the design of high performing front-line provider care delivery models for ICUs. Although there is evidence that NPs provide high quality critical care, few studies describe the work hours, workload or education and specialty certification of NPs working in ICUs. Furthermore, there are few studies investigating the impact of the NP role in critical care that have included pediatric patients (Edkins, Cairns & Hultman, 2014; Fry, 2011; Newhouse et al., 2011).

Review of the Literature

The results of three published systematic reviews of the literature suggest that NPs deliver high quality intensive care. There is evidence that care provided by NPs is associated with shorter length of ICU stay, reduced patient complications, and faster weaning from mechanical ventilation (Edkins, Cairns & Hultman, 2014; Fry et al., 2011; Newhouse, et al., 2011). Russell et al. (2002) reported that post implementation of NP managed care, adult neurosurgical ICU patients experienced shorter total length of stay ($p = 0.03$), shorter ICU stay ($p < 0.001$), and fewer occurrences of urinary tract infection and skin breakdown ($p < 0.05$). In a comparison of NP to resident practice conducted by Morris et al. (2012), a higher rate of deep vein thrombosis (DVT) was found in a group of trauma ICU patients cared for by NPs ($p = 0.05$); however the authors concluded that the increased rate was due to better adherence by the NPs to a DVT screening protocol. In a study of critically ill neonates conducted by Luyts et al.

(2002), patients managed by neonatal NPs (NNPs) experienced faster weaning from mechanical ventilators ($p = 0.0458$). Similarly, Burns et al. (2003) correlated a median decline in ventilator days with the implementation of care management by NPs in an adult medical-surgical ICU ($p = .0001$). These authors also associated care management by NPs with decreased ICU length of stay ($p = .0008$) and a decrease in mortality rate ($p = .02$). Care by NPs has also been shown to decrease re-intubation rates after weaning from mechanical ventilation (Hoffman et al., 2005).

Comparisons of intensive care delivered by NPs and physician trainees have consistently shown no difference in patient mortality, or as indicated in the study by Burns et al. (2003), lower mortality when NPs participated in the care of patients (Fry, 2011; Gershengorn et al., 2011; Hoffman et al., 2005; Rudy et al., 1998). Using a quasi-experimental design, Gracias and colleagues (2008) found that mortality rates were lower after the addition of NPs to traditional teaching teams in an adult surgical ICU. In the same study of 1,380 admissions over 12 months, the authors reported improvement in adherence to clinical practice guidelines for DVT prophylaxis ($p < 0.0001$), stress ulcer bleeding prophylaxis ($p < 0\ .0001$), and anemia management ($p = 0.02$) after the addition of NPs to the teaching teams (Gracias et al., 2008).

Although the systematic reviews have led to the conclusion that NPs provide high quality intensive care, they also highlight the lack of pediatric studies. Multiple descriptions of successful roles for pediatric critical care NPs have been published (Brown, Besunder, & Bachmann, 2008; Molitor-Kirsch, Thompson, & Milonovich, 2005; Verger, Keefe-Marcoux, Madden, Bojko, & Barnsteiner, 2005; Verger, Trimarchi, & Barnsteiner, 2002), but only one article by Derengowski et al. (2000) addresses the outcomes of critically ill children cared for by pediatric NPs. Derenogowski et al. identified a favorable Pediatric Risk of Mortality (PRISM)-based Standardized Mortality Ratio (a ration of actual deaths compared to predicted deaths) of

0.14 for a sample of 10 critically ill children cared for over 6 months by pediatric NPs. However, the strength of the study is limited because it examined a small sample of patients for a limited period of time, and it did not include a comparison group.

In addition to a dearth of research investigating the effects of intensive care delivered by pediatric NPs, most studies comparing the performance of ICU teams that use NPs to the performance of physician-only teams, have a pre and post implementation design or used a different ICU or national benchmarks as the comparison group. Furthermore, few studies have compared the performance of different care models within the same ICU during the same period of time and described differences in care models in terms of provider mix, work hours and workload (Edkins, Cairns & Hultman, 2014; Fry et al., 2011; Newhouse et al., 2011).

Study Objectives

At the time of the study, the Children's Hospital of Philadelphia (CHOP) PICU was a 55-bed unit that was divided into 3 care delivery teams each comprising 17 to 18 critically ill children per day. Beginning in July 2012, in response to increased volume of critically ill children and a decrease in resident service hours, the leadership of the PICU at CHOP implemented a NP team that was separate from the unit's two traditional medical teams (Traditional Medical Teams). The NP Team was made up of pediatric NPs whose role was occasionally supplemented by pediatric hospitalist physicians (care by the hospitalists contributed less than 10% of all service hours for the NP Team) and a monthly rotating third or second year pediatric resident. The front-line providers on the Traditional Medical Teams were all third or second year pediatric residents who were supervised by pediatric critical care medicine fellows. A pediatric anesthesia fellow was assigned monthly to rotate and assist the NP Team with care and supervision of the rotating resident, but the fellow did not play a supervisory role for the NPs or the hospitalists on the team. The NPs worked 12 hour day shifts and 16 hour night shifts every day of the week; the residents and fellows worked weekdays and were on call for 24 hours every fourth weeknight and on the weekends. The residents worked up to their cap of 80 hours per week, the non-resident providers on the NP team were scheduled for approximately 80 hours every two weeks with typically no more than 60 hours in one week. The NP Team and the Traditional Medical Team cared for the same number of patients during the day, but a lower patient-to-provider ratio at night and on the weekends was assigned to the NPs. All NPs on the team were prepared with a master's degree and held national certification as pediatric NPs. All but one NP on the team were graduates of a pediatric acute care nurse practitioner program of study, and that one NP completed a post-masters certificate in pediatric acute care in 2014. The hospitalist pediatricians who supplemented the NP Team were recent graduates of pediatric residencies and board eligible or board certified pediatricians. The clinical practice of both the NP Team and the Traditional Medical Teams were directed by the same group of board-certified, pediatric intensive care attending physicians, and both teams used the same critical care nursing staff. Table 1 shows the characteristics of the two CHOP PICU front-line care models. Three and one half years after its inception, we investigated the performance of the pediatric acute care NP-driven front line care model retrospectively to assure that the outcomes of care delivered by NPs were at least equivalent to the outcomes of traditional medical models.

Methods

Study Design

A retrospective quasi-experimental design was used to examine the outcomes.

Participants

Patients admitted to the PICU between 7/1/2012 and 12/31/2015 were included in the study. During the study period there were one NP and two Traditional Medical Teams. The study included 4,047 patients admitted to the NP Team, 7,005 patients admitted to the two Traditional Medical Teams, for a total of 11,052 participants.

Inclusion and Exclusion Criteria. All patients of any age admitted to the PICU at CHOP between 7/1/2012 and 12/31/2015 were eligible for inclusion. Patients who were cared for by the PICU's "Yellow Team", that existed only intermittently during times of high census and included primarily low acuity, short stay, surgical-subspecialty patients, were excluded because the care model for the team did not fit that of either the NP or the traditional teaching team models that were being evaluated. Patients on the "Yellow Team", however, were covered by the NP Team at night and did contribute to the NP Team's workload. We also excluded 50 patients in the initial data set for whom a care team could not be identified.

Study Procedures

A retrospective review was conducted of existing data in CHOP's Virtual PICU Systems (VPS) database. These data had been collected by staff of CHOP's Critical Care Center for Evidence and Outcomes (CCCEO). The CCCEO staff collects patient-level data on all patients cared for in the PICU and submits the data to the national VPS registry. The VPS is a clinical registry of patients cared for in over 100 PICUs across North America that is used by participating units for comparative analysis research and for internal performance monitoring (Bennett et al., 2014). Cases included in the study were identified by querying the CHOP VPS database for all children admitted to the PICU during the study period. Both demographic and patient outcomes data were obtained from the CHOP VPS database.

Measures

Demographic and outcome measures were collected retrospectively and analyzed for the three CHOP PICU teams that existed during the study period. Because assignment to each of the teams was not entirely random (for example, the admitting attending physician sometimes assigned specific patients to the traditional medical teams staffed by critical care fellows for teaching purposes), an analysis of the equivalence in the age, gender, race, and acuity of patients and comparison of case mix based on the top ten most frequent admission diagnosis between the teams was conducted. The Pediatric Index of Mortality 2 (PIM 2) score and The Pediatric Risk of Mortality 3 (PRISM 3) score, internationally validated models for rating acuity and predicting the risk of death of pediatric patients admitted to ICUs (Visser et al., 2013), were used to compare acuity across the teams and to calculate risk adjusted mortality. These scoring systems were developed using regression analyses of large data sets of admission diagnosis, physiologic variables, and outcomes of children cared for in ICUs across the world. The PIM 2 score indicates the risk of a patient dying based on physiologic variables collected at the time of a patient's admission to an ICU, and the PRISM 3 score is an acuity score that indicates the risk of a patient dying based on physiological variables collected during the first 24 hours after admission to an ICU (Pollack, Patel, & Ruttimann, 1996; Shann, Pearson & Slater, 1997; Slater, Shann & Pearson, 2003; Visser et al., 2013).

After comparing age, gender, case mix, and acuity using PIM 2 and PRISM 3 scores to determine the degree of similarity between the care models, the outcomes of patients cared for by the two front-line care models were analyzed. Only patient clinical outcomes that occurred up to

12/31/2015 were analyzed and no long-term outcomes or follow-up data were collected. Individually identifiable information about the clinicians staffing each team was not accessed by the investigators and the investigators did not study outcomes based on who worked on each team.

Demographic Measures: The following demographic and clinical measures were collected: Total number of admissions, number of total patient days, mean patient age, gender, race/ethnicity, PIM 2 Score, PRISM 3 Score, and the top 5 most frequent primary diagnoses on admission.

Outcome Measures. The following outcome measures were collected: Mean ICU LOS, average delay in discharge time, mortality rate, Standardized Mortality Ratio (SMR) based on PIM 2 Risk of Mortality (ROM), Standardized Mortality Ratio (SMR) based on PRISM 3 Probability of Death (POD), Central Line Associated Blood Stream Infection (CLABSI) Rate Per 1,000 line days, Catheter Associated Urinary Tract Infection (CAUTI) Rate Per 100 catheter days, and Ventilator Associated Pneumonia (VAP) rate per 1,000 ventilator Days

Measures to Avoid Bias

To minimize bias, data were abstracted using strict pre-defined criteria and terminology created by the CCCEO and the study team. The CCCEO staff consists of a limited number of pediatric critical care nurses who have specialized training to collect patient data with quarterly monitoring to ensure greater than 92% inter-rater reliability. Device-associated hospital acquired infections were entered into the VPS database by the CCCEP nurses after identification by CHOP's infection control and prevention professionals according to definitions and diagnostic criteria of the Centers for Disease Control and Preventions National Healthcare Safety Network.

Analyses

We applied unpaired t-tests to the means across the 3.5 years of the continuous variables that were compared between patients cared for in the NP model and patients cared for in traditional teaching model. Alpha was set at $p < 0.05$ for differences between care model and patient outcome (Ajetunmobi, 2002). We were unable to determine statistical significance for mortality, SMRs, or infection rates between the team models because these data were calculated as single results rather than as continuous variables and the occurrence of these outcomes was very infrequent.

Results

Demographic Results

During the study period, 4,047 patients were admitted to the NP Team and 7,005 patients were admitted to the Traditional Medical Teams. There were no clinically relevant differences in the age, gender, or racial distribution of patients across the teams (Table 2); however, the Traditional Medical Teams cared for patients with higher mean acuity scores than the NP Team (Table 3). The mean PIM 2 score was -4.85 (range -8.41 to 5.07) for the NP Team and -4.73 (range -8.41 to 5.61) for the Traditional Medical Teams was ($p < 0.001$). The mean PRISM 3 score was 2.81 (range 0 to 42) for the NP Team and 3.45 (range 0 to 56) for the Traditional Medical Teams ($p < 0.001$). Thus, these results suggest a statistically significant difference in acuity between the two team models. Similarly, the predicted rate of mortality was lower for the NP team. The predicted rate of mortality based on PIM 2 scores was 2.03% for the NP team and 2.53% for the Traditional Medical Teams. The predicted rate of mortality based on PRISM 3 scores was 1.84% for the NP team and 2.51% for the Traditional Medical Teams. Despite a statistically significant difference in acuity score, the similarity in the ranges of acuity across the two models indicated that all teams cared for both low and high acuity patients. Table 4 presents the top ten diagnoses for each team model. A comparison of the top ten primary diagnoses on admission was the same for the NP team and the Traditional Medical Teams. For all teams, the top ten most frequent primary admission diagnoses accounted for fewer than one-half of all admission diagnoses indicating that a wide variety of patient populations were cared for by both team models.

Operational Results

Patients cared for by the NP Team experienced shorter LOS than patients cared for by the Traditional Medical Teams (Table 5). The mean LOS for the NP team was 4.99 days and the mean patient LOS for the Traditional Medical Teams was 5.74 days ($p = 0.011$). In addition to length of stay, we evaluated the discharge delay, defined as the time from medical clearance for discharge to the time of physical discharge from the unit as indicated by the patient no longer occupying a PICU bed space (Table 5). Patients cared for by the NP team experienced a slightly, but not statistically significant shorter discharge delay. The mean discharge delay was 4.53 hours for the NP Team and 4.71 hours for the Traditional Medical Teams ($p = 0.20$), suggesting no difference in the operational efficiency of the discharge process between the teams.

Clinical Results

Mortality. The unadjusted mortality rate was lower for patients cared for by the NP team (Table 6). The mortality rate for the NP team was 1.45% (59 deaths out of the 4,047 admissions) and the mortality rate for the Traditional Medical Teams was 1.99% (140 deaths out of 7,005 admissions). To adjust mortality for the higher acuity of the Traditional Medical Teams, we calculated the Standardized Mortality Ratio (SMR) as the actual mortality rate divided by the mortality rate predicted by the PIM 2 and PRISM 3 scores. The PIM based SMR was lower for the NP team, but the PRISM based SMR was the same for both teams. The PIM 2 based SMR was 0.71 for the NP Team and 0.79 for the Traditional Medical Teams. The PRISM 3 based SMR for was 0.79 for both the NP Team and the Traditional Medical Teams.

Device Associated Hospital Acquired Infection Rates. Patients cared for by the NP team experienced a slightly higher rate of CAUTI, but lower rates of CLABSI and VAP (Table 7). To account for the risk of CLABSI, CAUTI, and VAP, infection rates were calculated as the number of infections divided by total number of days patients on the teams were exposed to the devices. The rate of CAUTI per 100 urinary catheter days was 0.36 for the NP team and 0.28 for the Traditional Medical Teams. The rate of CLABSI per 1,000 central line days was 1.0 for the NP Team and 1.12 for the Traditional Medical Teams. The rate of VAP per 1,000 invasive ventilator days was 0.13 for the NP Team and 0.63 for the Traditional Medical Teams.

Discussion

In this project, we described the patient outcomes of a care model in an academic PICU that used primarily NPs as front-line providers and that limited work hours and patient-to-provider ratio at night and on the weekends, and compared these outcomes to those of the Traditional Medical Teams that simultaneously existed in the same PICU. We found that patients cared for by the NP Team had lower mean acuity, experienced equivalent mortality, shorter LOS, equivalent discharge delays and with the exception of CAUTI, slightly lower device associated hospital acquired infection rates compared to those cared for by a Traditional Medical Team. The higher mean acuity for patients on the Traditional Medical Teams was likely due to assignment of sicker patients to those teams for the purposes of training the critical care fellows. Although the difference in the mean LOS between the two teams was statistically significant, the shorter LOS for NP Team patients may be attributed to the lower patient acuity on the NP team.

Considering the higher acuity of patients on the Traditional Medical Team, and our inability to test statistical significance due to the nature of the data, we can conclude that both the LOS and infection rates of patients cared for by the NP Team and the Traditional Medical Team were equivalent. In addition, the similarity in length of discharge delay between the two team models suggested no difference in the operational efficiency of the discharge process for the teams.

The outcomes of the NP care model identified in this study support the existing evidence that NPs provide quality intensive care and are an appropriate substitute for shortages of physician trainees. While statistical significance was not established and the higher acuity of the Traditional Medical Team patients may have put them at greater risk for hospital acquired infections, the lower CLABSI and VAP rates for the NP team have potential clinical implications worthy of additional consideration. It has been reported previously that improved adherence to prevention protocols lowers infection rates and leads to improved outcomes for mechanically ventilated patients when NPs participate in front-line intensive care (Burns et al., 2003; Hoffman et al., 2005; Luyts et al., 2002). In addition, the NP Team in our study was staffed by master's educated and acute care specialty certified NPs who worked shorter shifts and fewer cumulative hours per week and who cared for lower patient-to-provider ratios at night and on weekends than the residents who staffed the Traditional Medical Teams. The outcomes of NP-driven care model in this study may be consistent with previous research in which lower rates of mortality and hospital acquired infection were correlated with nursing care models that were characterized by highly educated and specialty certified RNs, low patient-to-RN ratios and work hour limitations (Aiken et al., 2011; Aiken, Clarke, Cheung, Sloane, & Silber, 2003; Aiken, Clarke, Sloane, Lake, & Cheney, 2009; Aiken, Clarke & Aiken, 2008; Clarke, Sloane, Sochalski, &

Silber, 2002; Kendall-Gallagher, Aiken, Sloane, & Cimiotti, 2011; Stimpfel, Lake, Barton, Gorman, & Aiken, 2013; Stimpfel, Sloane & Aiken, 2012).

While the NP Team was staffed primarily by NPs, it was supplemented occasionally by hospitalist pediatricians and included training a monthly rotating pediatric resident and anesthesia fellow. The front-line providers on the Traditional Medical Teams were all pediatric residents who were assisted and supervised by pediatric critical care medicine fellows. In light of this, our study demonstrated the effectiveness of an NP team that accommodates physician trainees, and suggested that the model performed well in the absence of supervision by critical care fellows.

Limitations

The major limitation of this study was the inability to conduct statistical significance tests for the differences in outcomes between the two team models. Statistical significance was not evaluated because we calculated single rates for mortality and device-associated hospital acquired infection for a single study period and the incidence of deaths and infections was very low. Another important limitation was that there were differences in acuity between the two team models. The Traditional Medical Team's patients had higher mean acuity. Although we adjusted for the effects of acuity on mortality by using the SMR (ratio of actual mortality to acuity score based predicted deaths) to determine equivalence in mortality, it is unclear if the higher acuity resulted in the longer LOS and the slightly higher rates of the CLABSI and VAP identified in patients cared for by the Traditional Medical Team. In addition, we were unable to determine if the outcomes described were related solely to the use of NPs, because hospitalist pediatricians, residents, and anesthesia fellows also participated in the care of the team's patients. It was not possible to distinguish between the contributions to patient outcomes made by each provider type, but our results suggest that the provider team models yield differences in several outcomes. The two care models also varied in the front-line providers' work hours and patient-to-provider ratio at night and on weekends, so we were unable to distinguish the impact on patient outcomes of the provider mix from the impact of work hours and workload. Because it is unclear what element of the NP Team model contributed to the equivalency of outcomes with the Traditional Medical Team model, interpretation of the NP team's performance and any recommendations made based on the findings of this study apply only in the context of NP Team model as a whole.

Summary

Determining the conditions that promote high performing advanced nursing practice is important because hospitals are increasingly dependent on the use of NPs to deliver front-line care to critically ill patients. While research has generated evidence for the attributes of nursing care models that positively impact patient outcomes, less evidence is available to generate recommendations for the design of high performing front-line provider care models. This analysis of the performance of the NP team in the PICU at CHOP suggests that a front-line care delivery model that uses certified pediatric acute care NPs who are intermittently supplemented by pediatric hospitalist pediatricians and residents, and that limits work hours and night time and weekend patient-to-provider ratio, results in outcomes that are at least equivalent to those of traditional medical teams.

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Table 1

Characteristics of the PICU Front-Line Care Delivery Teams

Team	**NP Team**	**Traditional Medical Teams**
Capacity	17 to 22 beds	17 beds per team
Typical Weekday Front-Line Staffing	Three NPs supplemented intermittently by a hospitalist pediatrician and one resident (when resident is not available, four NPs/Hospitalist)	Four residents per team
Typical Weeknight and Weekend Front-Line Staffing	Two NPs (no fellow) or; The Resident and one Fellow	One resident with assistance and supervision by a fellow per team
Fellow/ Fellow's Role	Primarily Anesthesia Occasionally Critical Care Medicine Role is supportive	Primarily Critical Care Medicine Occasionally Pediatric Emergency Medicine Role is supervisory to the residents
Front-Line Provider to Patient Ratio	Weekdays 1 provider : 4 - 5 patients Weekends and nights 1 provider : 8 - 11 patients (Or the resident covers 17-21 patients with assistance of the fellow)	Weekdays 1 provider : 5 - 6 patients Weekends and nights 1 provider : 17 patients with assistance of a fellow
Hours	12 hour day shifts / 16 hour night shifts, including weekends (except resident who works traditional medical team hours)	Weekdays and 24 hour call every fourth night and 24 hour call on Saturdays and Sundays

Table 2

Patient Characteristics: Age, Gender, and Racial Distribution

Characteristic	**NP Team**	**Traditional Medical Teams**	**p**
Mean Age	7.2 years (standard deviation 6.6 years)	7.5 years (standard deviation 6.6 years)	0.016
Gender	**NP Team**	**Traditional Medical Teams**	
	43% female	45% female	
Racial Distribution	**NP Team**	**Traditional Medical Teams**	
• **African American**	28.1%	26.9%	
• **Caucasian**	44.3%	46.2%	
• **Hispanic**	8.8%	8.6%	
• **Mixed or Other**	14.8%	14.3%	

Table 3

Predicted Mortality Rate and Acuity Scores

	PIM 2 Predicted Mortality Rate	**Range of PIM 2 Scores**	**Mean PIM 2 Score**	**Standard Deviation of PIM 2 Scores**	**p**
NP Team	2.03%	-8.41 to 5.07	-4.84	1.38	<.001
Traditional Medical Team	2.53%	-8.41 to 5.61	-4.73	1.47	

	PRISM 3 Predicted Mortality Rate	**Range of PRISM 3 Scores**	**Mean PRISM 3 Score**	**Standard Deviation of PRISM 3 Scores**	**p**
NP Team	1.84%	0 to 42	2.81	4.74	<.001
Traditional Medical Team	2.51%	0 to 56	3.45	5.50	

Table 4

Most Frequent Primary Diagnosis on Admission

NP Team			Traditional Medical Teams		
Diagnosis	**Frequency** (total 4,047)	**%**	**Diagnosis**	**Frequency** (total 7,005)	**%**
Pneumonia	313	7.7	Acute bronchiolitis	474	6.8
Acute bronchiolitis	291	7.2	Pneumonia	466	6.7
Status asthmaticus	238	5.7	Septic shock	378	5.4
Septic shock	179	4.4	Status asthmaticus	357	5.1
Other respiratory disease	149	3.7	Grand mal seizures	238	3.4
Grand mal seizures	138	3.4	Other respiratory disease	180	2.6
Malfunction of VP shunt	126	3.1	Other lung disease	177	2.5
Obstructive sleep apnea	111	2.7	Obstructive sleep apnea	170	2.4
Other lung disease	95	2.3	Malfunction of VP Shunt	155	2.2
Anomaly skull/face bone	75	1.9	Anomaly skull/face bone	125	1.8
Total	1,715	42.1	Total	2,720	38.9

*VP = ventriculo-peritoneal

Table 5

Length of Stay and Discharge Delay

Operational Measure	**NP Team**	**Traditional Medical Teams**	**p**
Mean Length of Stay in Days	4.99	5.74	0.011
Mean Delay in Discharge in Hours*	4.53	4.71	0.20

*Delay in discharge is the time between medical clearance for discharge and physical discharge from the unit (patient no longer occupying bed space)

Table 6

Mortality Rate and Acuity-Adjusted Standardized Mortality Ratio

Mortality Measure	**NP Team**	**Traditional Medical Teams**
n (# admissions)	4,047	7,005
# deaths	59	140
Mortality Rate	**1.45%**	**1.99%**
PIM 2 Predicted Mortality Rate	2.03	2.53
PIM 2 Based Standardized Mortality Ratio (SMR)*	**0.71**	**0.79**
PRISM 3 Predicted Mortality Rate	1.84	2.51
PRISM 3 Based Standardized Mortality Ratio (SMR)*	**0.79**	**0.79**

* Standardized Mortality Ration (SMR) is the actual rate of death divided by the rate of death predicted by PIM and PRISM scores

Table 7

Device Associated Hospital Acquired Infection Rate

Infection Measure	NP Team	Traditional Medical Teams
# Central Line Days	9,995	25,657
# CLABSI*	10	31
CLABSI Rate per 1000 Central Line Days	**1.00**	**1.21**
# Invasive Ventilator Days	7,475	19,094
# VAP**	1	12
VAP Rate per 1000 Invasive Ventilator Days	**0.13**	**0.63**
# Urinary Catheter Days	1,671	4,578
# CAUTI***	6	13
CAUTI Rate per 100 Urinary Catheter Days	**0.36**	**0.28**

* CLABSI = Central Line Associated Blood Stream Infection
**VAP = Ventilator Associated Pneumonia
*** CAUTI = Catheter Related Urinary Tract Infection