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Patient and Provider Dependent Metrics in Team-Based Care Models in Military Intensive Care Units

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30 Dec 19

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1 Jun 16- 30Jul 18

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13. SUPPLEMENTARY NOTES

14. ABSTRACT

Health care systems are facing an increased demand for intensive care coupled with a shortage of intensivist-trained physicians in the United States. Recognizing that patients improve with around-the clock intensivist coverage, health care organizations are adopting health care models that expand these traditional physician intensivist models. Institutions are incorporating Acute Care Nurse Practitioners (ACNPs) into team-based care models to intercede for patient care in intensive care units (ICUs). While military hospitals have begun to adopt these team-based care models, no studies have addressed indicators to measure the role and outcomes of ACNPs in military ICUs. The purpose of this study is to identify and compare patient and provider dependent care outcome measures in military ICUs utilizing traditional and team-based staffing models. A retrospective review of medical records was conducted of all patients admitted to either medical, surgical, or trauma ICUs at one U.S. military medical center for the 12 months prior to study initiation. Twenty ACNP applicable outcome measures were identified from the literature and utilized as the variables for data extraction in both the traditional and team-based ICUs. Records from 2637 patients admitted to the ICUs were extracted to identify the outcome measures, incidence of outcome measures, and then compared to outcomes between units and to similar civilian units. Outcome measures evaluated were found to be comparable between team-based and traditional units as well as to similar civilian units. Identifying outcomes measures of the ACNPs in a military ICU to deliver safe, trusted care is the mission of the military medical services and these study results can inform their use in future in military medical settings.

15. SUBJECT TERMS

Aeromedical Evacuation, En Route Care, Acute Care Nurse Practitioners, Team-Based Care Model, Critical Care

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1.0 SUMMARY

Intensive care units in the U.S. are struggling with meeting the demand for intensivist-trained physicians coupled with an increase in the demand for this type of medical service. Health care organizations have begun to adopt health care models that expand these traditional physician intensivist models to incorporating Acute Care Nurse Practitioners (ACNPs) into team-based care models to bolster coverage for intensive care units (ICUs). While military hospitals have already begun to adopt these team-based care models, limited research has addressed outcomes of ACNPs in military ICUs. The purpose of this study was to identify and compare patient and provider dependent outcome measures in military ICUs between those utilizing team and traditional care models.

A retrospective review of medical records was conducted of all patients admitted to either medical, surgical, or trauma ICUs at one U.S. military medical center for the 12 months prior to study initiation. Data were extracted based on a list of outcome measures identified in a literature review of ICU quality outcomes. One unit utilized a traditional physician-only model of care and another unit used a team-based model of care. This military medical facility and these units were selected because of their level of care and similarity of organizational practices and policies. Data between the two units were examined and then compared to similar civilian units.

Based on the literature review, 20 outcome measures were identified and utilized as the variables in both the traditional and team-based ICUs to examine in all patients admitted for the previous year. Records from 2637 patients admitted to the ICUs were reviewed to identify if ACNP outcome measures exist within the data, to identify the incidence of outcome measures, and to compare outcomes between units and similar civilian units. Subsets of patient records were used to gain a deeper understanding of the data variables, such as blood pressure management. Outcome measures evaluated were found to be comparable between team-based and traditional units as well as to similar civilian units. Identifying the quality outcomes to measure the role of ACNPs in military ICUs can be used in future studies to determine the utility of this role to meet the high demand for delivering safe, trusted care in military medical settings.

2.0 BACKGROUND

Currently, health care systems are facing an increased demand for intensive care coupled with a shortage of intensivist trained physicians in the United States.[1] A study from the Health Resources and Services Administration (HRSA) concluded the following: 1) there is a physician intensivist shortage for coverage in intensive care units (ICUs); 2) patients improve with around-the-clock intensivist coverage; 3) if current trends continue, the number of physician intensivists will not be sufficient to provide an optimal level of health care for future ICU patient populations; and 4) organizations have an opportunity to improve access and quality for those needing critical care coverage.[2] In response, health care organizations have begun to adopt health care models that address this need for high quality intensive care services. Institutions are incorporating acute care nurse practitioners (ACNPs) into team-based care models to ameliorate care to patients in ICUs. Team-based care models incorporate attending critical care and resident medical doctors (MDs), ACNPs, and physician assistants to work together to provide cost-effective, high-quality, patient-centered care in ICUs.[3-5] A team-based care model was proposed in the Institute of Medicine Best Practice Collaborative (2012), and the American Association of Nurse Practitioners has voiced its support of this practice in its policy statements.[6] Newhouse et al. (2011) performed a systematic literature review that "supports a high level of evidence that Advanced Practice Registered Nurses (APRN) provide safe, effective, quality care to a number of specific populations in a variety of settings. American health care professionals will need to move forward with evidenced-based and more collaborative models of care delivery to promote national unified health goals." (p.248)[7] Research also supports the conclusion that similar quality care outcomes can be achieved in medical ICUs where patients are cared for in this physician/ACNP team model compared to those with solely physician coverage.[4]

In the 1960s, the role of the nurse practitioner (NP) began to evolve as advanced education and training demonstrated that these providers were fully capable of providing high-quality primary care to patients while increasing access to cost-effective health care.[8] As health care continues to witness increased demands in ICUs, ACNPs have stepped in to fill the gap in patient care. Patient satisfaction, perceived health, functional status, glucose control, lipid control, blood pressure, improved hospitalization/re-hospitalization rates, duration of ventilation, length of stay, and mortality were patient and provider dependent outcomes examined and found to be at least equivalent or better in several large randomized control trials when comparing NPs to physicians in the civilian sector.[7] Additionally, ACNPs provide cost-effective care to their patients. For example, the cost of training required to become an ACNP is, according to the American Association of Colleges of Nursing, 20-25% of what it cost for MD preparation.[9] In 2010, the median total compensation of primary care physicians ranged from $208,658 (family medicine) to $219,500 (internal medicine), while the mean full time NP salary was $97,345 across all varieties of NP care setting.[10,11] A simulated modeling computer system was created to provide insight into the metrics of utilization, revenues, and financial expenses of using NP and MD teams in primary care practices instead of the sole-physician model. A demonstration analysis predicted that it would increase revenues to partner NPs and MDs together to perform the duties of primary care.[11] While still in the early phases, the preliminary cost-saving indications of the modeling combined with high-quality care may indicate an opportunity to provide financial benefits organizations while supporting optimal patient care outcomes in ICUs.

NPs are currently collaborating practitioners within the military and measuring their sole impact is challenging. While military hospitals have begun to adopt these team-based care models, no studies have addressed patient and provider dependent outcomes in ICUs utilizing NPs. From the early 1980s, the role of the NP in the military has grown. Nurse practitioners in the military are being utilized within outpatient clinics, hospitals, and various deployment positions.[13-15] An emerging issue in active duty pediatric and family NPs in Navy medical areas is the inability to retain NPs in lower acuity/less critically ill patient areas potentially related to not being utilized to their full capabilities of practice entitled to these clinicians.[16] Nurse practitioners enlarge the capabilities of health care provisions in the military and are already utilized in many international models resulting in a significant impact.[15] Yet the extent of this impact is unknown within U.S. military ICUs. Research examining the outcomes of patient care in team-based models, especially the impact of ACNPs in military ICUs, is limited.

The purpose of this study is to identify patient outcome and provider dependent outcome measures specific to practices of ICUs that utilize a team-based approach to care rather than a traditional primary care model in military ICUs. As outcome metrics used to quantify the impact of team-based models incorporating NPs have not been examined within the military domain, this effort was a pilot study with the following aims: 1) to identify if outcome metrics are present within military ICUs; 2) of those that are measured in military ICUs, to identify the outcomes of patient care in team-based and traditional-based models of care; and 3) to examine how these outcomes within the team and traditional modeled military units compare to similar types of team and traditional modeled civilian facilities.

3.0 METHODS

A retrospective cohort study design was utilized after obtaining commander support, data sharing agreements, and approval of Institutional Review Boards at both the 711th Human Performance Wing and the selected medical treatment facility. To address the aims, medical records were examined from a medical intensive care unit and a surgical/trauma intensive care unit within one hospital organization. These units were selected based on the organizational, policy, and practice similarities they share. Data for patient outcomes and provider dependent outcome measures are recorded in patient medical records and therefore retrievable if initiated and documented.

To address the first aim of the study, provider dependent outcomes and patient outcomes to be measured for this study were derived from a review of literature for NP-associated outcomes used in similar studies in the civilian sector. Outcome measures in health care are defined by regulatory bodies such as federal and state agencies, institutional guidelines, and accrediting bodies such as the Joint Commission and Agency for Health Care Research and Quality.[3] For ease of data abstraction and reporting, we divided these indicators into two categories: 1) Provider dependent outcomes, those pertaining to measurements with sole responsibility on the provider such as safety checks were completed prior to a high-risk procedure; and 2) Patient outcomes, those with the patient as a participant/co-factor in the measurement such as blood glucose greater than 180mg/dL. Presence or absence of the indicator was reported for this aim.

To address aim 2, equivalent time samples of patient records for a period of 12 months were used to examine specific pre-defined patient outcomes, provider dependent outcomes, and demographics in intensive care patients from both units. Twelve months of records were determined to be a sufficient time frame for data collection based on the volume of patients that were admitted to these two units at this time. Data was collected for the time period of 1 Jul 2015 to 30 Jun 2016. Between the three ICUs at this facility, the average patient volume was estimated to be 130-150 patients/month, which is approximately 520 patients per year per unit (Maj Dunlevy. Personal communication; 6 Oct 2015). Since indicators for some of these outcomes can be small, such as the incidence of a catheter-acquired infection, and seasonal variations occur, 1 year of data was a responsible data goal for this pilot study.

Aim 3 described the association between the incidence of outcomes identified in the first and second study aim, by examining the outcomes in comparison to similar types of units in the civilian sectors. Patients were grouped according to assigned clinical unit and clinical outcome measure involved in care for statistical analysis. A description of the units, staffing types and models, and patient types was collected to examine similarities and differences in clinical outcomes. Data from medical records were initially queried by a data analyst at the medical facility based on the study inclusion criteria. Of the patient or provider dependent outcomes that were obtained in this manner, data was shared by electronic files only in a secured, Health Insurance Portability and Accountability Act (HIPPA) approved data file share system. The files containing Personally Identifiable Information (PII) were secured on a government-protected computer and only accessible by the onsite associate investigator. All data was de-identified prior to dissemination and analysis by other team members. Data was reported in aggregate.

Data was collected from inpatient records of three ICU's, at a level one military trauma facility, for the time period of 1 Jul 2015 to 30 Jun 2016. The three units included one traditional Medical Intensive Care Unit (MICU) staffed with resident physicians and attending physicians; the two-team units were Trauma/Surgical Intensive Care Units staffed with ACNP's, Physician Assistants (PA) and Attending Physicians. Inclusion criteria consisted of sequential patients admitted to each ICU for greater than 24 hours and subjects had to be greater than 18 years of age. Any person who did not meet the inclusion criteria was excluded from the study. Records were reviewed for predetermined patient and provider dependent outcomes. Data was abstracted through several means. First data was abstracted through a query by a data analyst based on the inclusion criteria employed by the military trauma facility. The data analyst abstracted records based on procedures performed, which resulted in a limited and non-randomized sample. Total number of records abstracted through this query was 397. This data set was de-identified by the military trauma facility Associate Investigator (AI) and then sent to other research team members via the Department of Defense (DoD) Secure Access File Exchange (SAFE). This data set is called 'subset one' in reporting.

The second data set was called the "deeper dive" subset. This data set came from the de-identified set called subset one. In order to have a clearer picture certain aspects of an outcome, the research team determined a deeper dive into the actual patient record was necessary. The research team sent a list of the de-identified records needing further exploration. The military trauma facility AI re-identified the data set and performed analysis of the data questions by reviewing medical records of the individual records. The data set was then again de-identified and sent to the research team at Wright Patterson Air Force Base (WPAFB) via DoD SAFE. This data set is named 'subset two' and consisted of 77 records.

The third method of data analysis was a de-identified aggregate data set provided by the physician medical director responsible for the surgical-trauma ICU's. This data came in the form of graphical reports for a limited number of the pre-identified outcomes measures. The total number of patient records used to develop this data set was 2,344 during the same time period identified for our current study. This data set is called 'subset three' in reporting. The subset three report had monthly summaries on ICU admissions, mortality and standardized mortality rates, delirium rates, average length of stay and average ventilator days for the surgical/trauma ICU's and the medical ICU. The subset three report also had reintubation and bounce back rates for the surgical/trauma ICU's, but not for the medical ICU.

To address the third aim of the study, after data analysis was completed for aim two, a literature review was conducted to find national standards or comparable studies for each of the reported outcomes in aims one and two.

3.1 Statistical Analysis

Summary statistics, including average monthly rates and averages, as well as yearly rates of infection, complaisance, and complication for the ICU's were generated. Chi-squared analysis with continuity correction for 2x2 comparisons was used to compare across ICU's when appropriate. Since the data from subset three, Quality Improvement Report, included only the monthly averages or rates, it was possible to calculate average monthly rates and averages, but it was not appropriate to perform formal comparisons between the ICU's, nor was it appropriate to collapse the two Team ICU's. All statistical analyses and calculations were performed using R version 3.2.0.

4.0 RESULTS

4.1 Indicators. Provider dependent and patient outcomes measured for this study were derived from a review of the literature for nurse practitioner associated outcomes used in similar studies conducted in the civilian sector, these outcomes are listed in Table 1 below. These indicators were divided into two categories: 1) provider dependent outcomes, those pertaining to measurements with sole responsibility on the provider such as safety checks were completed prior to a high-risk procedure; and 2) patient outcomes, those with the patient as a participant/co-factor in the measurement such as blood glucose greater than 180mg/dL.

Table 1: Patient and Provider Dependent Outcomes

Patient Outcomes	Provider Dependent Outcomes
Number of days patient is on a ventilator	Number of ventilator-associated pneumonia protocols initiated
Incidence of procedure complications	Frequency of pre-procedure safety check compliance for chest tubes, central venous lines, arterial lines
Development of a catheter-acquired urinary tract infection	Deep Vein Thrombosis prophylaxis initiated if indicated
Intensive care unit length of stay	ACNP satisfaction
Mortality	Glucose protocols initiated if indicated
Number of total Foley catheter days	Lipid protocols initiated if indicated
Proportion of patients with central line acquired blood stream infection	
Readmission rate to ICU	
Pressure ulcer development	
Patient satisfaction	
Perceived health status	
Glucose control	
Lipid control	
Blood pressure	

To address aim 2, initial record review showed that 2,637 patients were admitted to the all ICU's from July 1st, 2015 to June 30th, 2016. Electronic information on certain procedures (Pressure Ulcer Check, Bronchoscopy, Chest Tube Insertion, and Central Line Insertion) were selected from those 2,637 patients, resulting in information on 6,039 data points for 397 patients which made subset 1. Of those, 77 patient records were selected for in-depth, manual record review and became subset 2. The Quality Improvement Report which included de-identified aggregate data, included data from 2344 ICU admissions, and became subset 3. A summary of the numbers of patients captured in this study are given in Table 2.

Table 2: ICU Admissions from July 1st, 2015 to June 30th

ICU	Admissions (Total)	Subset 1	Subset 2	Subset 3
Traditional	1,122	263	35	990
Team One	717	63	42	634
Team Two	798	71	0	720
Team Combined	1,515	134	42	1,354
Total	2,637	397	77	2,344

4.1.1 Mortality. Overall mortality rates were recorded for all units and analyzed along with other mortality-like indicators such as Sequential Organ Failure Assessment (SOFA) score and delirium rates. Even within ICU's of the same type, mortality can be driven by other measures, such as the average SOFA score and delirium rates.[17,18,19] As such, along with the overall mortality rates and Standardized Mortality Ratio's (SMR), SOFA scores and delirium rates were examined. Other mortality indicators such as Acute Physiology and Chronic Health Evaluation (APACHE II) or Simplified Acute Physiology Score (SAPS III) were not available at the time of data extraction. Data regarding the average SOFA scores, ICU delirium rates, mortality rates, and monthly SMR's were reported for subset 3.

The Traditional ICU had an average monthly mortality rate of 6.7%, while the Team based units had an average monthly rate of 4.1/2.0%, respectively (Figure 1). However, in all three cases the ICU's stayed well below a SMR of 1, with Team One ICU having an average monthly SMR of 0.23, the Team Two ICU having a an average monthly SMR of 0.15, and the Traditional ICU having an average monthly SMR of 0.28 (Figure 2). The reported mortality rates vary greatly between the previous research we reviewed, with averages anywhere from 6.5% up to 14.4%, and with the American Thoracic Society reporting a range from 10%-29%.[20,21,22,23,24]

Figure 1: Monthly Mortality Rates by ICU

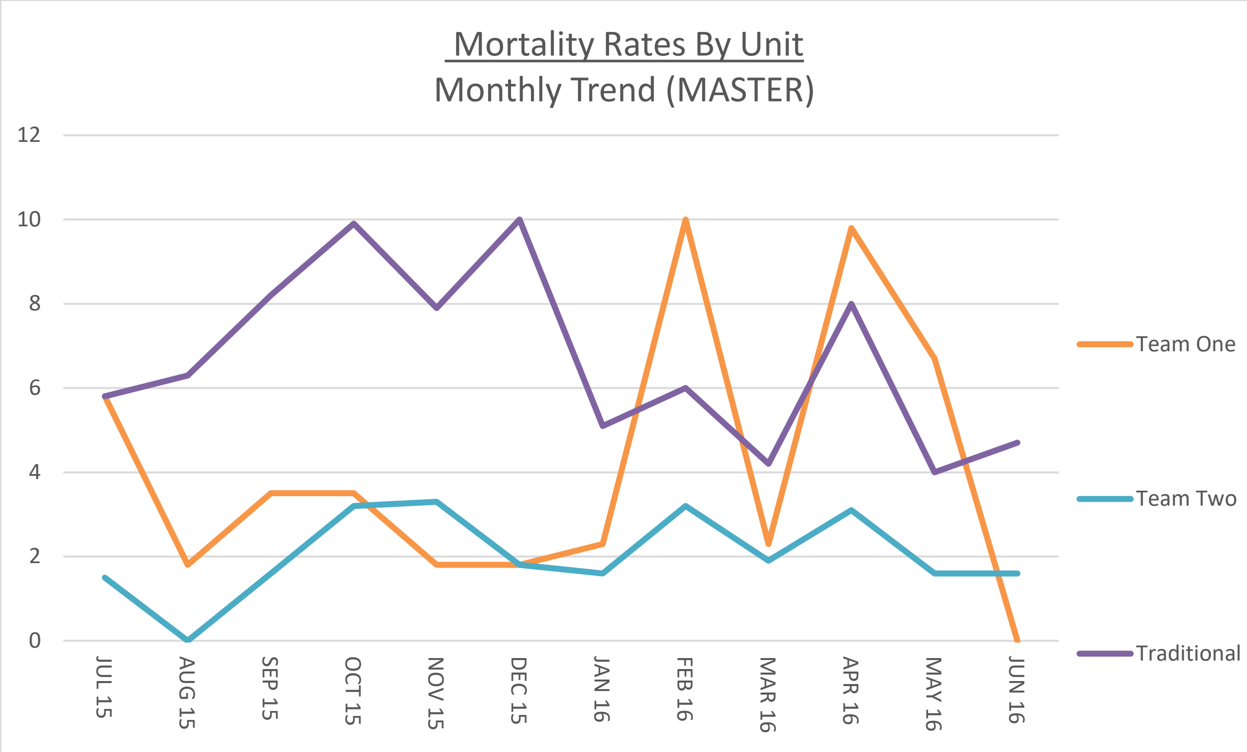
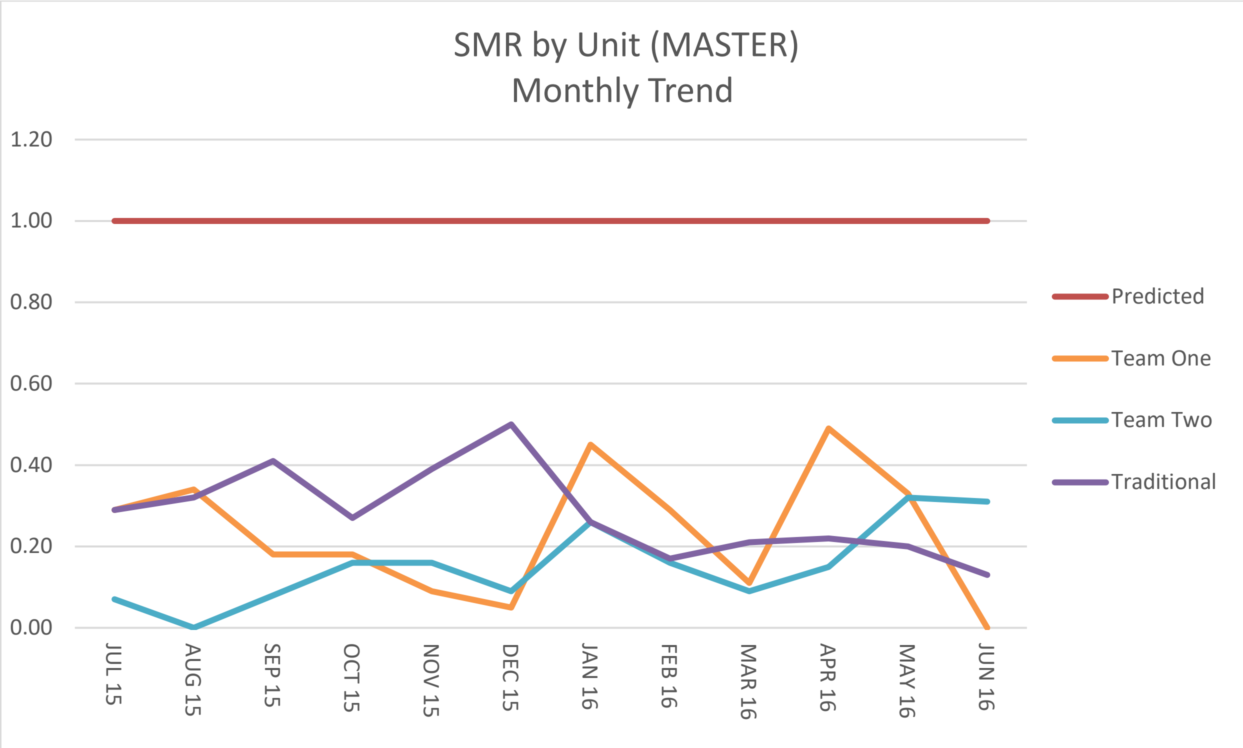
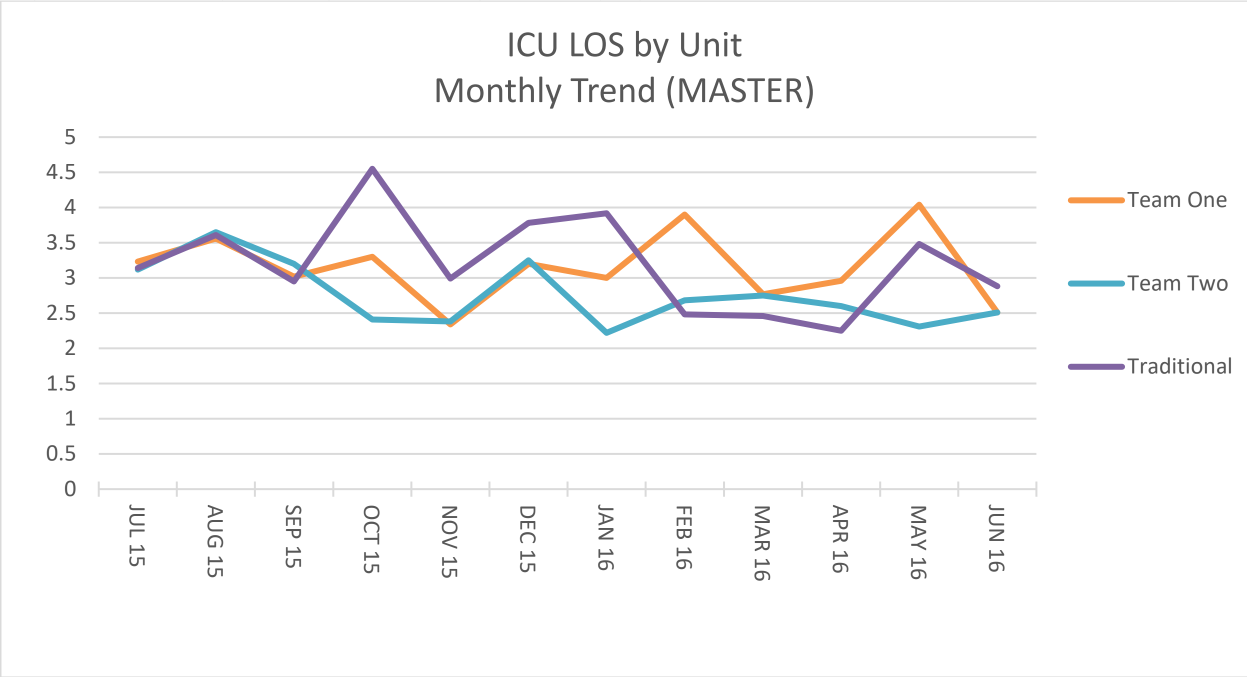


Figure 2: Monthly Standardized Mortality Ratio by ICU



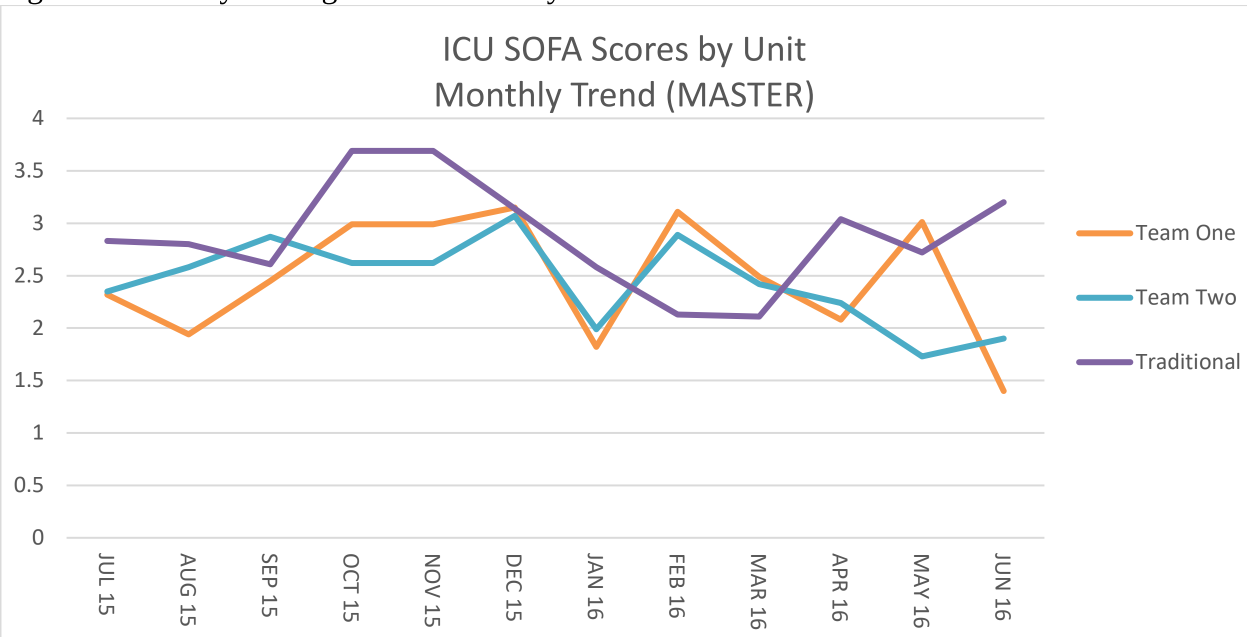
4.1.2 Length of Stay. Information regarding the monthly average length of stay (LOS) for the ICU's was supplied in the Quality Improvement Report for subset 3. The average length of stay was fairly similar between the ICU's, with the Traditional ICU having an average monthly length of stay of 3.21 days, while the Team One ICU had an average of 3.15 days and the Team Two ICU had an average of 2.76 days over the period of observation (Figure 3). When compared to similar civilian units Resident Physicians (RP) units had an average LOS of 3.9 ± 0.2 days vs. ACP, 3.7 ± 0.1 days (Level I trauma ICU at CMC in Charlotte, NC)[22]; 3.44 ± 0.49 days (18-bed ICU)[20]; 4.22 days ± 2.51 days for NP/PA team and 4.44 ± 3.10 days for RP, (MICU in New York)[25]; 4.6 days (all U.S. hospitals)[26].

Figure 3: Monthly Average ICU Length of Stay by ICU



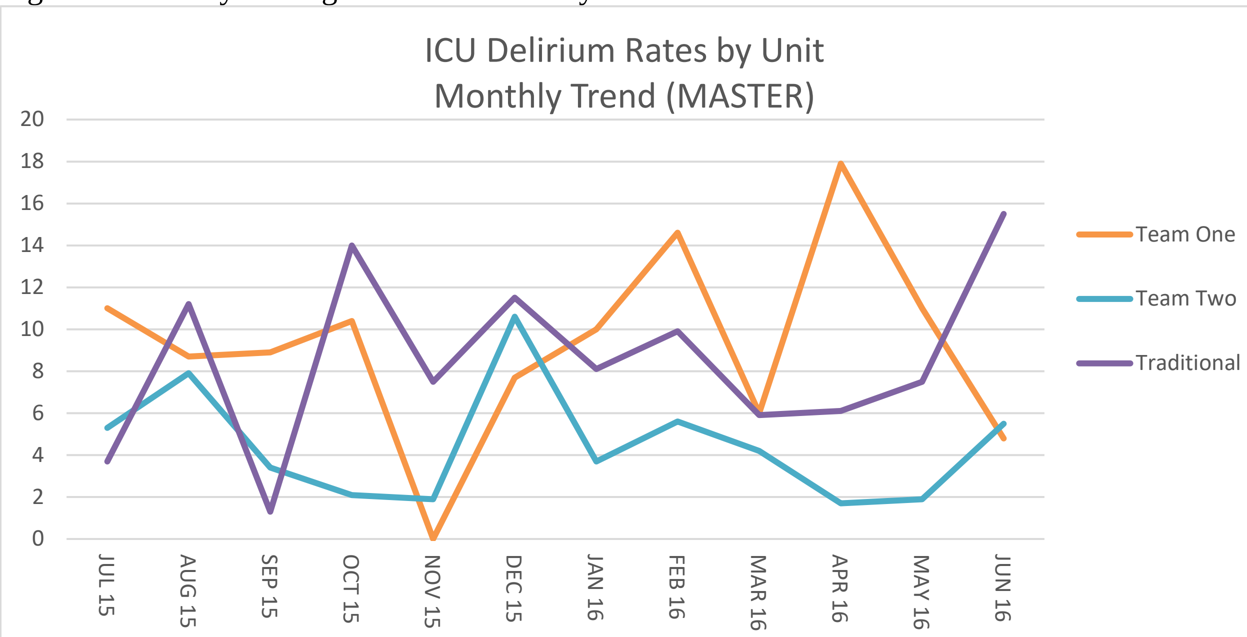
4.1.3 SOFA. Team One and Team Two ICU's had average monthly SOFA scores of 2.48 and 2.44 , respectively, while the Traditional ICU had an average monthly SOFA score of 2.88 (Figure 4). Salluh et al.[27] reported an average SOFA score of 4 across an international population of 497 ICU patients.

Figure 4: Monthly Average SOFA Score by ICU



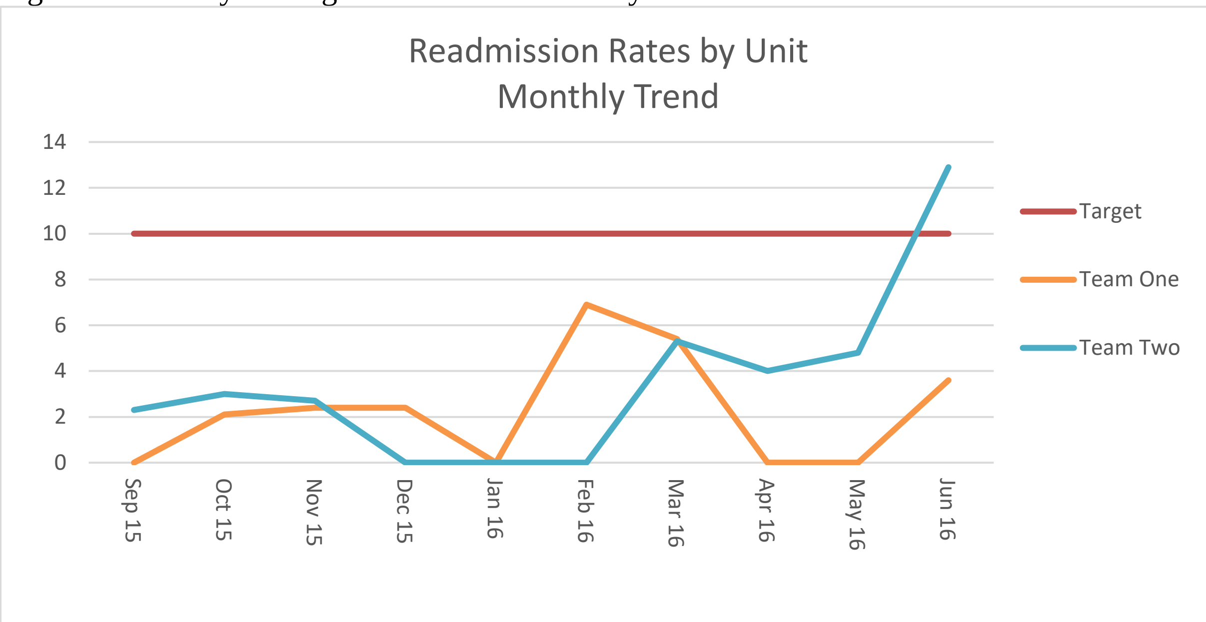
4.1.4 Delirium. Delirium was also reported in Subset 3, as the number of patients Confusion Assessment Method for ICU (CAM-ICU) positive on any CAM-ICU checks divided by the total number of ICU patients which resulted in a percentage of delirium incidence. Team One and Traditional ICU's had average monthly delirium rates of 9.3% and 8.5%, respectively, while Team Two ICU had an average monthly rate of 4.5% (Figure 5). The literature reported a wide variation of delirium rates in sedated and ventilated patients in ICU's from 20%[27] to 82%[18].

Figure 5: Monthly Average Delirium Rates by ICU



4.1.5 Readmit Rates. Information regarding ICU readmission rates was supplied in the Quality Improvement Report. As mentioned earlier, subset three data report did not report the readmission rates for the traditional ICU, but did report the monthly bounce back rates for the two Team based ICU's. Team One ICU had an average monthly bounce back rate of 2.3%, while Team Two had an average monthly rate of 3.5 % (Figure 6). Kramer, Higgins and Zimmerman[28] classified ICU readmission rates, with an average of less than 5% being low and median unit readmission rate of 5.9% with an interquartile range of 5.1% to 7.0%. They also stratified ICU's according to their readmission rate as high >7%, moderate 5-7%, and low <5%.

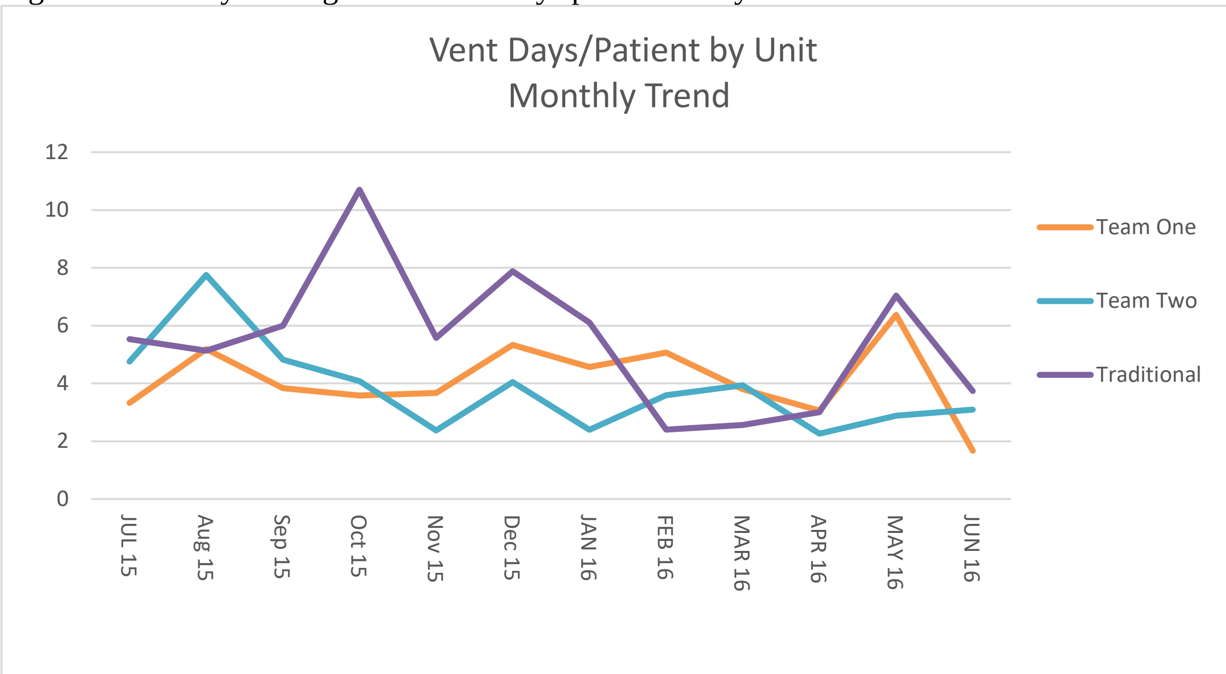
Figure 6: Monthly Average Readmission Rates by ICU



4.2 Ventilator Associated Indicators

4.2.1 Ventilator Days. Figure 7 shows the monthly trend of average ventilator days per patient, with the Traditional ICU having a monthly average of 5.5 days, Team One ICU having a monthly average of 4.1 days, and Team Two ICU having a monthly average of 3.8 days. Dosher, et al.[20] reported an average of 2.8 days to 3.7 days of mechanical ventilator days annually in a southern U.S. MICU. Navalesi et al.[29] reported a 5-5.6 ventilator day range in an international neuro ICU.

Figure 7: Monthly Average Ventilator Days per Patient by ICU



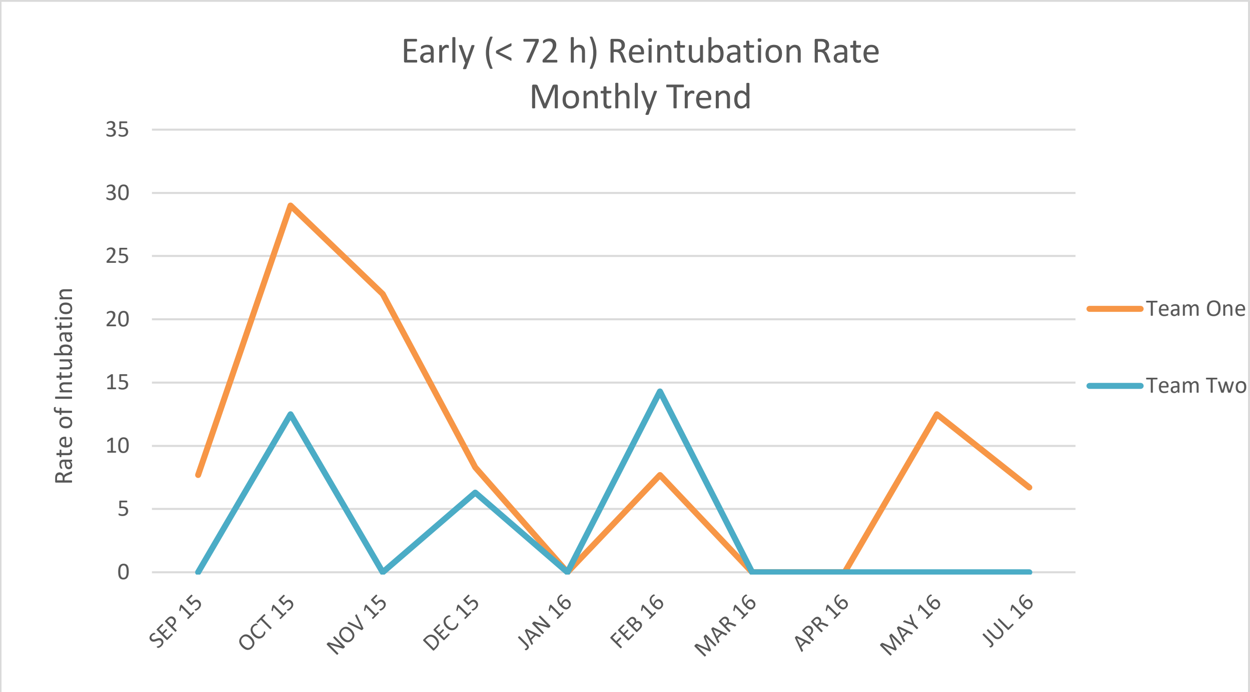
4.2.2 Ventilator Associated Pneumonia. Table 3 outlines the total number of ventilator associated pneumonia (VAP) cases, the total number of ventilator days, and the overall infection rate in the Traditional and Team ICU's. The Traditional Unit had zero infections, though having no VAP infections is not uncommon in ICU's at major teaching hospitals, with more than 25% having no reported instances in 2012.[30] The Team Units combined had a VAP rate of 1.8, which put them in the 25-50th percentile for trauma and 50th-75th percentile for surgical ICU VAP rates reported nationally.[30]

Table 3: Ventilator Associated Pneumonia

ICU	Infections	Ventilator Days	Rate
Traditional	0	1597	0.0
Team One	2	760	2.6
Team Two	1	886	1.1
Team Combined	3	1646	1.8

4.2.3 Reintubation Rates. As with the bounce back rate, subset three data only reported rates from the Team based ICU's, and only had data from September 2015 to June 2016. During that time, the Team One ICU had an average monthly reintubation rate of 9.4% and 3 of the reported 10 months having no reported reintubations while Team Two ICU had a monthly average rate of 3.1%, with 7 of the reported 10 months having no reported reintubations. (Figure 8). External reports showed rates of 5-12%[29], 15.5%[31], and 7.5%[32].

Figure 8: Monthly Early Reintubation Rate by ICU



4.3 Other Infection Rates. Along with the annual VAP rate, information was collected on the annual Central Line Associated Blood Stream Infection (CLBSI) and Catheter Associated Urinary Tract Infection (CAUTI) rates.

4.3.1 CLBSI. Table 4 gives the overall number of CLBSI, the number of central line days, and the yearly rate for the three ICU's, CLBSI rates for the Traditional Unit were 1.9 infections/1000 days. When compared to similar medical ICU's at major teaching hospitals, this unit CLBSI rates fell around the 75th percentile.[30] The Team Units had a combined rate of 3.4 infections/1000 days, which is in the 75th-90th percentile for trauma ICUs and above the 90th percentile for surgical ICUs.[30] Based on these rates, a deeper dive was completed on each individual chart with a CLBSI developed by the onsite AI. Of the 4 infections in the Traditional Unit, 3 were placed by one PICC nurse team member and the other placed by a unit physician. Of the 7 patients that developed a CLBSI on the Team Units, 1-placed in operating room, 1-placed in emergency situation with patient pulseless, 1-PICC nurse, 2-placed at another facility, 1-placed in emergency room, 1-placed by ACNP under direct supervision of attending.

Table 4: Central Line Associated Blood Stream Infection

ICU	Infections	Central Line Days	Rate (infections per 1000 days)
Traditional	4	2142	1.9
Team One	5	1105	4.5
Team Two	2	972	2.1
Team Combined	7	2077	3.4

4.3.2 CAUTI. Table 5 gives the overall number of CAUTI's, the number of catheter days, and the annual rate for the ICU's. The Traditional Unit rate was 1.4 infections/1000 days and compared to other major teaching hospitals rates for 2012 for medical ICU's, this rate was in the 25th–50th percentile.[30] The Team Units combined rate of CAUTI was 0.7 infections/1000 days. This rate put them in the top 10th percentile for trauma ICU's, but in the 25th-50th percentile for surgical ICU's.[30]

Table 5: Catheter Associated Urinary Tract Infection

ICU	Infections	Catheter Days	Rate (infections per 1000 days)
Traditional	4	2927	1.4
Team One	2	2075	1.0
Team Two	1	2109	0.5
Team Combined	3	4184	0.7

4.3.3 Pressure Ulcers. The Traditional ICU had a higher incidence of pressure ulcers (PU), both in patients who arrived in the ICU with a PU and with those reported to develop a PU while in the ICU (Table 6). Approximately 7.7% of the patients entered the Traditional Unit with a PU, with 11.1% of the remaining patients subsequently developing a PU while in the ICU. The Team One and Team Two ICU's, alternatively, had 1.7% and 1.8% of patients admitted with a PU, respectively, with a further 4.5% of patients subsequently developing a PU in both ICUs. Chi-square analysis showed that there was no difference in likelihood of either being admitted with a PU (χ^2=0.012, df = 1, p = 0.914) or subsequently developing a PU (χ^2<0.0001, df = 1, p = 1) in the two team based ICU's. Across all three ICU's, there were differences observed in rates of patients admitted with PU (χ^2=54.43, df = 2, p < 0.0001) and in subsequent development of a PU in the ICU (χ^2=39.74, df = 2, p < 0.0001). Overall, patients in the Traditional Unit seem more likely to be admitted with a PU and also more likely to develop a PU in the ICU.

PU were one of the four procedures performed that were pulled to make subset one, so we assumed that we caught every individual who presented with a PU to the ICU's. It should be noted that there were five individuals who appeared in more than one ICU during the same hospitalization. If a pressure ulcer was identified in the same location in subsequent visits to different ICU's, the patient was coded as entering the second ICU with a pressure ulcer. In addition, some individuals are supplying multiple observations and we did not correct for the repeated observations of the same individual.

Even though the team and traditional ICU's generally service different types of patients, e.g. medical vs trauma, the number of PU occurrences appeared too large for the research team so further records exploration was warranted. Seventeen records of those with a PU were randomly selected from all units for a deeper dive into the patient record. The onsite AI then re-identified the records to pull the individual patient record for the selected admission. In the manual patient record review, 17 patients had documented PU's in the electronic record. 14 of the 17 were not actually PU's or did not develop in the ICU units. They were the result of how the electronic charting was developed, triggering a positive pressure ulcer but they either; did not meet the defined criteria for a pressure ulcer, the wound had been documented on admission, a surgical wound was documented in the PU section of the electronic chart or a wound consult was placed but the wound nurse determined it not to be a pressure ulcer. In these cases, the electronic charting system was triggering a positive PU event, even though there was not an actual pressure ulcer, resulting in the incidence of pressure ulcer to appear to have a higher rate than what actually occurred. Of the three possible pressure ulcers listed, the pressure ulcer box was checked in the electronic charting but there was no nursing assessment documented of the wound and there was no wound consult so it is impossible to report actual rates from this deeper dive.

Table 6: Pressure Ulcers

ICU	Developed PU before entering ICU	Developed PU while in ICU	No PU reported
Traditional	86 (7.7%)	115 (10.2%)	921 (82.1%)
Team One	12 (1.7%)	32 (4.5%)	673 (93.9%)
Team Two	15 (1.9%)	35 (4.4%)	748 (93.7%)
Team Combined	27 (1.8%)	67 (4.4%)	1421 (93.8%)

4.4 Procedures. Select procedures were identified based on the literature review and as those that both physicians and ACNP's perform on patients in the ICU's. Table 7 outlines the number of bronchoscopies, chest tube insertions, and central line insertions performed in the Team and Traditional ICUs. The Traditional ICU performs far more procedures than the Team ICU's combined. Complications, potential complications, and missing entries in the electronic records for both the chest tube insertions and central line insertions are summarized in Tables 8 & 9.

Table 7: Procedures Performed

ICU	**Bronchoscopy**	**Chest Tube Insertion**	**Central Line Insertion**
Traditional	61	27	44
Team One	4	9	11
Team Two	2	6	22
Team Combined	6	15	33

Table 8: Chest Tube Complications

ICU Type	Chest Tube Insertions Performed	Complications Reported	Potential Complications	Missing Responses
Traditional	27	0 (0.0%)	1 (3.7%)	0 (0.0%)
Team 1	9	0 (0.0%)	0 (0.0%)	0 (0.0%)
Team 2	6	0 (0.0%)	0 (0.0%)	0 (0.0%)
Team Combined	15	0 (0.0%)	0 (0.0%)	0 (0.0%)

Table 9: Central Line Complications

ICU Type	Central Line Insertions Performed	Complications Reported	Potential Complications	Missing Responses
Traditional	44	0 (0.0%)	0 (0.0%)	1 (2.3%)
Team 1	11	0 (0.0%)	0 (0.0%)	1 (9.1%)
Team 2	22	0 (0.0%)	0 (0.0%)	1 (4.5%)
Team Combined	33	0 (0.0%)	0 (0.0%)	2 (6.1%)

The electronic records data pulled included whether the bronchoscopies and chest tube insertions had been performed according to institutional policy, and whether the central line insertions had been performed using sterile barriers and preparatory solutions and are reported in Tables 10 & 11. While there were no cases where it explicitly reported that these procedures were not followed, there were some instances where the data was missing. In both cases, the missing data was for bronchoscopies performed in the Team ICU. Since very few bronchoscopies overall where performed in the Team ICU's, this resulted in very high levels of missing data, as seen in table 10. Electronic records always indicated that sterile barriers were used during central line insertions. Aside from two instances in the Traditional ICU where data was missing (4.5% missing), the electronic records also indicated that preparatory solution was always used.

Table 10: Pre-Procedure Checklist

ICU Type	Procedures Performed Total (Bronchoscopy, Chest Tube)	Performed Per Institutional Policy	Missing	Percent Missing
Traditional	88 (61, 27)	88 (61, 27)	0 (0, 0)	0.0% (0.0%, 0.0%)
Team 1	13 (4, 9)	12 (3, 9)	1 (1, 0)	7.7% (25%,0.0%)
Team 2	8 (2, 6)	7 (1, 6)	1 (1, 0)	12.5% (50%, 0.0%)
Team Combined	21 (6, 15)	19 (4, 15)	2 (2, 0)	9.5% (33.3%, 0.0%)

Table 11: Central line sterile barrier and prep solution documented use

ICU Type	Procedures Performed	Sterile Barrier Used	Prep Solutions Used
Traditional	44	44	42
Team 1	11	11	11
Team 2	22	22	22
Team Combined	33	33	33

4.5 Other Outcomes. The electronic records data also included information regarding whether the patient had any recorded events of glucose levels greater than 180mg/dL, mean arterial pressures (MAP) of less than 60mmHg, lipid protocol initiated, gastrointestinal (GI) or deep vein thrombosis (DVT) prophylaxis was indicated for the patient, and whether the patient had been reported as being prescribed a statin following lipid management protocol. However, since the electronic records only included patients who had had a pressure ulcer check, a central line insertion, a chest tube insertion, or a bronchoscopy, overall rates for the ICU's could not be calculated fully. Furthermore, it is the response to these measures, not the presence of them, which is of most interest clinically.

4.5.1 Glucose Greater than 180mg/dL. Table 12 captures patients from subset one that had reported glucose values >180mg/dL at any point of time in their hospitalization either recorded in a point-of-care or a routine blood draw. To further investigate, some of the positive cases were explored with manual chart reviews (subset 2). Twenty-nine charts were randomly selected by the onsite AI and manually extracted for glucose events >180mg/dL. Three of these 29 charts were excluded for events that occurred outside of the ICU and of the remaining 26 cases were events occurring in the ICU. Titration of continuous insulin infusions, administration of insulin via sliding scale, recheck of glucose or reporting of the event occurred in all reported events of glucose incidences reported >180mg/dL for the charts reviewed.

Table 12: Blood Glucose Values from Subset One

ICU Type	Glucose > 180mg/dL	No Glucose > 180mg/dL
Traditional	147	116
Team 1	30	33
Team 2	31	40
Team Comb.	61	73

4.5.2 MAP Less than 60mmHg. MAP less than 60mmHg events were extracted from subset one and are seen in Table 13. Then a deeper dive was completed of subset two. Of the 77 charts explored by the onsite AI, 30 were found to have true MAP less than 60mmHg events. An event was defined as MAP falling below 60mmHg in two sequential recordings. Of these 30 true events, one recording was excluded because the patient expired within hours of admission to the hospital. Two events contained documentation that a provider had been notified and no treatment was indicated. Of the remaining 27 events, all had action taken in attempt to correct the blood pressure, e.g. bolus, vasopressors, or volume expanders. Some deeper dive events uncovered that these were BP's occurred during a code, or there were a few that were blood pressures of a dying patient and a patient was not to be resuscitated. Overall, during the deeper dive it was found that while there may have been an event of MAP less than 60mmHg, action may not be clinically indicated or appropriate action was taken to correct the MAP pressure.

Table 13: MAP Less than 60mmHg Events

ICU Type	Have MAP < 60mmHg	No MAP < 60mmHg
Traditional	160	103
Team 1	43	20
Team 2	40	31
Team Comb.	83	51

4.5.3 Lipid Protocol. Lipid protocol initiations was observed in subset one and displayed in table 14. Again, since it appeared that patients were pulled based on specific procedures and not on whether they were prescribed a statin, we did not capture everyone in the ICU who would have received been prescribed a statin. As such, the data represented only reflects those individuals who had received one of the four original pulled procedures. The large differences in numbers between the traditional and the team units is likely more representative of the differences in patient types (MICU vs. Surgical Intensive care Unit [SICU]).

Table 14: Lipid Protocol

ICU Type	Statin Prescribed	No Statin Prescribed
Traditional	92	171
Team 1	3	60
Team 2	10	61
Team Combined	13	121

4.5.4 GI Prophylaxis. GI prophylaxis information was pulled from subset one dataset and is displayed in Table 15. However, the pulled data only indicated whether or not GI prophylaxis was indicated for the patients, but did note specify whether the prophylaxis was actually ordered for the individual, or the amount of time it took to get it re-ordered.

Table 15: GI Prophylaxis

ICU Type	GI Prophylaxis Indicated	GI Prophylaxis Not Indicated
Traditional	11	252
Team 1	39	24
Team 2	36	35
Team Combined	75	59

4.5.5 DVT Prophylaxis. DVT prophylaxis was extracted from subset one and based on specific DVT medication ordered, sequential compression devices (SCD's) or "other' notes that may be DVT prevention specific. The total number of events for subset one is represented in table 16, but again there was no specific data on whether it was actually ordered for the individual, or the amount of time it took to get it re-ordered .

Table 16: DVT Prophylaxis

ICU Type	DVT Prophylaxis Indicated	No DVT Prophylaxis Indicated
Traditional	204	59
Team 1	50	13
Team 2	63	8
Team Combined	113	21

While GI prophylaxis was not investigated during the deeper dive, five cases of DVT prophylaxis were investigated. The deeper dive did reveal if SCD's and/or chemical prophylaxis were ordered, and revealed notes containing contraindication in the three cases where chemical prophylaxis were not ordered. Statin use were not investigated in the deeper dive dataset.

While Patient Satisfaction Surveys were queried, only two surveys had been filled out between July 1st, 2015 and June 30th, 2016, both of which were for the Traditional ICU, and both of which listed 100% satisfaction. Perceived Health Status and ACNP satisfaction were not reported in the records queried at the time of data extraction.

5.0 DISCUSSION

The first goal of this study was to identify evidenced-based provider dependent outcome indicators that could be used to quantify care deliver by ACNP. This goal was achieved by starting with a contributing authors' attendance at an evidenced-based practice immersion course where they explored the use of NP in care delivery as their EBP project, which required as extensive literature review and synthesis. This analysis reflected leading health organizations to conclude the use of team-based models of care in ICU's are as safe, if not better than other care delivery models[4], but little had been done to evaluate its relevance or applicability to military health systems. Therefore, a list of patient outcomes and provider dependent outcome indicators was derived from the literature to quantify care delivery for ACNP was assembled as to accomplish aim one of these project efforts (Table 1).

Once the list was obtained, we were able to take advantage of a unique opportunity in a large military health facility that was utilizing both types of care models within its one facility. This permitted evaluation of indicators from the literature within one system with similar organizational policies and practices, workplace rules and facility culture. The second aim of the study sought to examine actual patient records for the indicators abstracted in aim one from the traditional and the team-based ICUs and if available, report the outcome. Furthermore, the researchers compared these specific unit outcomes to one another if appropriate based on the differences of the units and patient types. Some indicators such as performing a pre-procedure checklist before an invasive procedure is inarguably conclusive that regardless of the unit type, providers should be completing this task as a standard of practice. For this study, we compared these types of indicators from each units to one another. If the outcome of the indicator had the patient as a factor in the outcome such as incidence of glucose greater than 180mg/dL, it was categorized into the patient outcome quality indicator, conversely, if the outcome was strictly provider dependent like incidence of performing pre-procedure checklist prior to central line insertion, it was categorized as a provider dependent quality indicator. Finally, we examined how these outcomes for a military facility compared to reported national standards or other reported findings in similar types of team and traditional modeled civilian facilities. All units were consistent in number of admissions throughout the time period extracted. When combining the two team based units and comparing to the traditional unit, the team units had more admissions overall. Mortality, LOS, SOFA, incidence of delirium and readmission rates are all outcomes that give some indication of severity of illness combined with treatment effect. The averages of the units for team one and traditional had comparable mortality average to each other and when compared to national averages with similar types of units. Team two had lower average mortality rates but is likely due to the patient types admitted to these units rather than a quality indicator. Demographics were not collected on patients but clinician's working within the units described the traditional unit as admitting older patients with a typical diagnosis of sepsis, pneumonia or GI bleed, whereas, the team units are younger patients who have experienced multiple bodily injuries and occasionally neurotrauma injury. LOS was comparable for all units with the traditional unit having a slightly higher overall rate but when compared with similar type external units, all units had lower rates to those reported in the literature.[20,22,25,33] The SOFA score numerically quantifies the number and severity of failed organs with the higher the number indicating increasing severity of illness. The SOFA score provides information on in-hospital survival when applied to patients with severe sepsis with evidence of hypoperfusion at the time of presentation.[34] All units had similar monthly SOFA averages (2.44-2.88) and these were lower than Salluh[27] who examined a cross-sectional ICU patient sample (N=975) from an international pool of hospitals and reported an average SOFA score of 4. This would indicate that the patients in these units tended to be less ill. Likewise, incidence of delirium is another measure that was independently associated with an increased risk of mortality and are reported at a higher rate in mechanically ventilated patients and the elderly.[35,36] In the units examined, Team one had the highest rate (9.25%) which would be consistent with the patient type typically admitted in this unit but all monthly averages were lower than similar types of external comparable units reported in the literature 20%[27] and 82%[18]. Notably, Arumugam, et al.[35] reports ICU delirium is poorly recognized, leading to inappropriate management which may or may not be a factor in these lower rates of delirium. Readmission rates were only available for the team units, were comparable to one another and less than reported rate of 5.9%.[28] The facility-based quality improvement goal for the units was reported as 10% or less (personal communication, Bradstreet, 2017). Another outcome reported in Subset 3 was SMR. This is a ratio between the observed number of deaths in a study population and the number of deaths that would be expected, based on the age- and sex-specific rates in a standard population. This summary measure is not used to derive an absolute ranking of facility or unit but rather is a tool that may be used to validate or assess efforts or prevention programs.[37] Ideally, what we wanted to know was there significant differences between team vs traditional units and since we did not have the raw data, this was impossible to calculate. Then next to consider is all units are similar and fall below the self-identified goal of SMR ≤ 1. When examining all these outcome indicators that primarily support the type of patient's in these units i.e. mortality, LOS, SOFA, incidence of delirium and readmission rates, the data supports that the populations are consistently the same and therefore suggests that some of data, where applicable, is comparable. Additionally, the data indicates that overall these patients tend to have lower acuity and a lower rate of adverse outcomes related to admission to these ICU's when compared to similar external units.

Some top quality indicators that were assessed were related to ventilators, infection rates, ICU initiated procedures and their complications and pressure ulcer development or progression. The number of days spent on a ventilator was higher for the traditional unit (5.47 days) than the two team led units. This difference is likely accounted for in the difference of patient types admitted to the units. Therefore, we examined this indicator to similar type units where the average ranged from 2.53 to 5 days.[20,29] Both team units were in this range and the traditional unit was slightly above the averages reported in the literature. However, when we looked at VAP rates, we saw that the traditional unit reported zero infections for the year whereas the team rate combined was 1.8. The traditional ICU reporting a VAP rate of 0 was not uncommon, with at least 25% of medical ICU's at major teaching hospitals achieving the same rate. The team combined was 25-50th percentile for trauma ICU's and 50-75th percentile of surgical ICU's.[30] As an example, this is interpreted as the unit score is reported as the 10th percentile then only 10% of hospitals reporting are score better and 90% are scoring worse. National VAP rates are overall expected to be higher for the trauma, followed by surgical then medical patients.[30] One reason may be that often times if a medical patient needs a ventilator, it is because they have pneumonia requiring ventilation therefore they are excluded from development of a VAP diagnosis. Additionally, trauma patients may suffer a lung or chest injury making VAP more likely because of poor lung or chest wall function or intubation is required outside of the hospital. This requires placement of the breathing tube within sub-optimal environmental conditions and with potential contaminates making VAP incidence more likely.[38]

Data was initially extracted according to performance of four possible procedures— nursing assessment of pressure ulcer, central line insertion, bronchoscopy and chest tube insertion so we assumed we captured all patients with these 'events' in this dataset. Overall, the frequency of these procedures are higher in the traditional unit. While there were zero confirmed complications for all chest tube and central line insertions, there was one potential chest tube insertion complication in the traditional ICU. Furthermore, each ICU had an instance were the complication data was missing for one of the central line insertions. Sirleaf [22] reports an overall rate of 1.5% for complications related to chest tube insertion and 2.7% for central line insertion. Complication rates are low to absent in our dataset and the overall number of procedures performed was low, making it difficult to make any comparisons. For example, if we assumed that the potential complication was a true complication, and that missing data also represented unreported complications, we would have had complications rates as high as 3.7% (Traditional ICU) for chest tube insertions and as high as 9.1% (Team 1 ICU) for central line insertions. However, the missing reports data on complications more likely represent missed documentation, and not an unreported complication. A similar indicator related to these procedures that we examined was the completion of pre-procedure checklist and central line sterile barrier and prep solution use. Regardless of the patient type, it can be assumed that since these are best practice procedures and institutional policy, all providers completing these procedures should perform and document these steps. All pre-procedure checklist documentation was performed by the traditional unit providers and the team units combined had two missing reports for bronchoscopy and chest tube insertion. Documentation of use of a sterile barrier for the insertion of a central line was 100% in compliance for all units and use of prep solution was 100% for team units with two missing reports of compliance in the traditional unit. Likely this highlights a lack of documentation rather than lack of compliance with the prep solution itself.

CAUTI's are another indicator of quality care therefore, we examined the rates of each unit along with total number of days a urinary catheter was in place putting the patient at risk for a CAUTI. The traditional unit had fewer total days with a catheter in place than both team units. When examining differences in the traditional rate of infection they had one more than the team units combined. We then compared them to reported external rate of similar ICU's and the traditional unit rate of infection was 1.4 which placed them in the 25th-50th percentile of other reporting major medical ICU's.[30] The team units combined had a rate of 0.7 infections, which placed in the top 10% when compared to similar Trauma ICU's in the 25th-50th percentile when compared to other surgical ICU's. Overall, both units scored well when compared to similar units. Differences in the rates between units is likely to be a result of different patient types.

Similarly, the rates of central line days and development of a CLBSI were similar when we combined the team units and compared to the traditional unit; however, the rate of infection was higher for the team units combined. The traditional unit rate was 1.9 that then placed them at around 75th percentile of medical ICU's at major teaching hospitals, while the team combined rate was 3.4 which put them in the 75th-90th percentile of trauma ICU's and above the 90th percentile of surgical ICU's. All unit rates were troublesome for the onsite AI, therefore, a manual review of medical records were completed. The records were re-identified by the onsite AI and it was noted in five of the 11 records to have been inserted by the same person, three placed outside the hospital or in the ED under urgent conditions, one placed in the operating room and one was placed by a physician on the traditional unit and one placed by the NP on the team unit.

One of the four procedures performed were pressure ulcers, so we assume that we caught every individual who presented with a pressure ulcer in the ICU. Of note, there were five individuals who appeared in more than one ICU during the same hospitalization. If a pressure ulcer were identified in the same location in subsequent visits to different ICU's, the patient was coded as entering the second ICU with a pressure ulcer. Patients admitted to traditional unit were more likely to be admitted with a PU and are were also more likely to subsequently develop a PU in the ICU. However, it was revealed in the deeper dive data, not everything marked as a PU was necessarily a pressure ulcer, but some may indicated other wounds such as surgical wounds. Of the records reviewed in the manual review, 17 were documented as having pressure ulcers. Upon review of those 17 charts, 14 were not pressure ulcers or did not develop in the

ICU, of the 3 possible pressure ulcers listed, the pressure ulcer box was checked but no RN assessment was documented and there were not wound consults placed, so we cannot confirm or refute the PU. Also, it was reported that wound consults are generated automatically when a pressure ulcer is indicated, suggesting this may not be a useful measure for measuring provider dependent outcomes or if it is used, perhaps a different way to collect the data would be warranted. When comparing rates to other external ICU's Sill et al.[39] reported PU rates in ICUs ranged from 8.8% to 23% with the variance dependent upon the type of ICU setting and Gonzalez-Mendez, M., et al.[40] reported the incidence of PU's in ICU patients was 8.1%. Overall, our conclusion was that the data extraction methods narrowed down patients who had or developed any kind of wound but then requires a manual review of each patient record and likely is more an indicator of nursing care rather than prescriptive care such as those performed by the MD or NP.

Other indicators examined that resulted in limited useful data was patient satisfaction, perceived health status, provider satisfaction, glucose and blood pressure control, and initiation of DVT prevention or lipid and GI prophylaxis protocols. There were only two patient satisfaction cards reportedly collected for the study period, both being for the traditional unit and both rated the patient satisfaction at 100%. Perceived health status and ACNP satisfaction are not collected at this facility. Glucose control was extracted from those patients in subset one with events occurring of glucose >180mg/dL. Manual review of the 'deeper dive' subset suggested that action was always taken when the glucose > 180mg/dL even if it was just to continue to monitor. In cases where there were multiple incidents of glucose greater than 180mg/dL, insulin orders were changed in attempt to control glucose levels. There were a couple cases where action was taken even when no events occurred during the ICU stay (i.e. when the glucose <180mg/dL but insulin coverage was given). There was also no direct indication from our data extraction methods of how long it took to respond to the events. Again, we much reiterate that this data only applies to patients captured in the subset one dataset, and cannot be generalized to the ICU's as a whole.

Blood pressure events of a MAP < 60mmHg were also extracted from dataset one. We then completed a manual chart review for those with blood pressure events. Of the deeper dive charts reviewed, 30 were found to have true MAP < 60mmHg event. An event was defined as MAP falling below 60mmHg in two sequential recordings. One recording was excluded because the patient expired within less than 24 hours within admission to the hospital. Three events had no documentation indicating that a provider had been notified. Of the remaining 27 events, all had action taken in attempt to correct the blood pressure, e.g. bolus, vasopressors, or volume expanders. Some deeper dive events uncovered that these were MAP's occurred during a code, or there were a few that were blood pressures of a dying patient (with a do not resuscitate order). Overall, during the deeper dive it was found that while there may have been an event of MAP <60mmHg, appropriate action was taken to correct the MAP pressure.

The number of events for DVT and GI prophylaxis and lipid protocols initiated if indicated were extracted from subset one. We extracted based on medications by names and associated orders such as SCD's or DVT prevention. Similar rates for traditional and team units combined were found and differences were likely associated with the type of patient admitted to the unit. Lipid protocols were extracted based on an order for statin drug or no statin prescribed. GI prophylaxis was extracted for those that had the intervention indicated and those that did not. If the GI prophylaxis was indicated as not applicable, none, or the patient was eating a regular diet, we marked it as having no indicated GI prophylaxis. None of the information gathered indicated whether the prophylaxis was actually given to the individual patient. For DVT prophylaxis, we took a random sample of five charts from those that had 'none indicated' to see if we could understand why there was a high volume of records for all units that had no indication recorded. In this deeper dive of the individual patient records, either there was DVT prophylaxis ordered or it was documented as contraindicated and our initial data extraction methods did not pick it out. It was difficult to track the data throughout the records since a large part of the records needs to be assessed to ensure compliance with the orders. The deeper dive indicated data extraction methods were ineffective. To use this intervention as a quality indicator, we suggest to manually extract those patients that it was indicated, follow them throughout admission to see if it's carried out daily and documented correctly.

5.1 Limitations

Challenges occurred during data collection. The first difficulty encountered was related to the initial data query. A medical records member at the selected facility was assigned to assist the research team in addition to their regular duties. Instructions were given for the query. The query was to include all patients admitted to the ICU's. The data then went to a local AI at the selected facility to be de-identified before distribution to the rest of the research team. After the de-identified data set was received by the research team, it was realized that data was queried for patients who had a certain procedure performed in the ICUs. This resulted in a limited and non-randomized data set.

The next challenge the research team had to overcome was limited access to identified patient records. Per Institutional Review Board (IRB) agreement between the Air Force Research Lab (AFRL) and the selected facilities IRB, only research team members employed by the selected facility were able to access identified patient records. Due to the limited query, a deeper dive into the records was needed but the team's ability to review records was constrained and subject to the selected facility team members' availability to review records. We also did not realize the volume of individual records that would need to be explored in the deeper dive. Frequently, the first data extraction did not give us complete data or the reported frequencies were suspicious that we may not be capturing all events, thus seeking the need for further exploration of the individual patient records. From these obstacles, the team learned that if a similar methodology was to be employed again, a team member (or several) would need to be dedicated and IRB cleared to complete data abstraction and records review.

The research team learned that the list of outcomes identified from the initial literature review did not all apply to the military medical facilities. In addition, the way the data was abstracted greatly impacted the ability of the quality indicator to inform the study aim. The outcome of the indicator may have proved more reliable if we completed an individual chart review of all eligible patient records from the start. Our research team drastically underestimated the time and intensity of abstracting these large datasets. And finally, our comparison of outcomes to similar civilian facilities or national standards may not be represent a true or fair comparison since there are some distinct differences such as reimbursement, rank structure and types of injury profiles. Our team was not aware of any military medical facility data reporting systems to compare military to military medical facilities.

6.0 CONCLUSIONS

Since limited information was available in a literature review and limited research has been conducted previously on this topic within the military, this study defined some useful NP-associated metrics in team-based care models to use for future evaluation of utility of this practice within its ICUs. Military hospitals are faced with similar challenges for intensivist coverage within their health care facilities as civilian facilities encounter. ACNPs have demonstrated quality patient care management in ICUs that is at least similar or better when managing patients as a part of a team-based care model in the civilian sector. Little data are available from military ICUs that NP-associated metrics are tracked and are a reliable indicator for quality of care.

Improved care outcomes for patient's within an ICU is the ultimate goal for those within healthcare systems. Our study found that of the indicators we examined, the use of team-based models in ICUs within the military is at least equivocal to care outcomes in the traditional model of care. If there was differences found in care outcomes, it was likely related to the demographics of patient type, illness, etc. that was attributed. The incidence of outcomes was mostly similar, if not better in all outcomes examined than their civilian counterparts. For the one outcome that was worse, it was poor for both units and has been turned into a quality improvement project at the study facility.

Use of team-based models of care could lead to a positive impact for the United States Military. This impact to intensive care in military facilities may potentially improve health outcomes of critically injured service members at a cost-saving benefit. Additionally, if more ACNPs are integrated into ICUs and are being used to their trained capacity, the United States Air Force (USAF) may not need to provide additional sustainment training to keep them current in their training. Equivalent or improved patient outcomes may result from the adoption of a team-based model that includes ACNPs within the ICU care teams. Ultimately, the ICU's that we examined had two broad differences – ICU type and type of provider – and we cannot easily distinguish between the two. One could argue that the differences observed are driven by differences in patients/injuries, not differences in team setup therefore care could be determined as at least equal as it relates to overall quality indicator outcomes.

This study was conducted in direct response to the Deputy Division Chief of Manpower and Personnel and Personnel Associate Director for the Nurse Corps request for information pertaining to the utility of ACNPs in military ICUs (Lt Col Golden. Personal communication; 8 Dec 2015). Since limited information was available and limited research had been conducted on this topic within the military, this study attempted to define NP-associated metrics in team-based care models to use for future evaluation of utility of this practice within its ICUs. Military hospitals are faced with similar challenges for intensivist coverage within their health care facilities as civilian facilities. ACNPs have demonstrated quality patient care management in ICUs that is at least similar or better when managing patients as a part of a team-based care model in the civilian sector. Little data was available from military ICUs that NP-associated metrics are tracked and are a reliable indicator for quality of care.

Our study was the first that we are aware of, in military medical facilities to establish what care outcomes are plausible to track that would indicate quality care for MD or NP's. In addition, we were able to complete some comparisons between units and also look to see where the military facilities rank in regards to similar types of civilian units. We tirelessly detailed extraction details, hurdles and challenges with data extraction and analysis to support future researchers that may want to continue the work.

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8.0 LIST OF ABBREVIATIONS AND ACRONYMS

ACNP Acute Care Nurse Practitioner

AI Associate Investigator

AFRL Air Force Research Lab

AMRDEC United States Army Aviation and Missile Research Development and Engineering Center

APACHE II Acute Physiology and Chronic Health Evaluation

APRN Advanced Practice Registered Nurse

CAM-ICU Confusion Assessment Method for Intensive Care Unit

CAUTI Catheter Associated Urinary Tract Infection

CDC Center for Disease Control

CLBSI Central Line Associated Blood Stream Infection

DoD Department of Defense

DVT	Deep Vein Thrombosis
GI	Gastrointestinal
HIPPA	Health Insurance Portability and Accountability Act
HRSA	Health Resources and Services Administration
ICU	Intensive Care Unit
IRB	Institutional Review Board
LOS	Length of Stay
MAP	Mean Arterial Pressure
MD	Medical Doctor
MICU	Medical Intensive Care Unit
NHSN	National Healthcare Safety Network
NP	Nurse Practitioner
PA	Physician Assistant
PII	Personally Identifiable Information
PU	Pressure Ulcer
RP	Resident Physicians
SAFE	Secure Access File Exchange
SAPS III	Simplified Acute Physiology Score
SCD	Sequential Compression Device
SICU	Surgical Intensive Care Unit
SMR	Standardized Mortality Ratio
SOFA	Sequential Organ Failure Assessment
USAF	United States Air Force

VAP Ventilator-associated Pneumonia

WPAFB Wright Patterson Air Force Base