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The Effect of an Acuity Adaptable Unit on Efficiency in Non-critical Trauma Patients

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Abstract

Problem Statement: It was observed a large academic medical center is experiencing impeding congestion of non-critical care patients due to challenges with bed availability and high patient volumes. Delays in transferring patients to an appropriate level of care can impose safety risks and prolong length of stay. Implementation of an acuity adaptable unit may be a cost-effective approach to a growing problem.

Background: A fixed bed model limits the acuity of patients admitted to a specific space. Using the Iowa Model of Evidence Based Practice as the framework for design, moving to an acuity adaptable unit could facilitate patient throughput by allowing the bed accommodation to be flexible between acute and progressive care needs freeing up bed capacity for critical care (ICU), post anesthesia care unit (PACU), and emergency department (ED) needs. Decreasing unnecessary transfers and handoffs have shown to improve quality and safety among hospitalized patients (Hendrich et al., 2004). Utilizing available resources and training nurses to practice at their highest skill provide a more efficient and comprehensive approach to care through implementation of an acuity adaptable unit.

Methods: This was a retrospective, comparative analysis evaluating patient outcomes, and efficiency during 11-months pre- and 14-months post- implementation of the acuity adaptable unit. Patients were included or excluded based on the nature of the admission and level of care required. The sample consisted of adult trauma patients ages 16 and older, admitted to UK HealthCare with any diagnosis related to trauma, and that did not require critical care. Exclusion criteria included those admitted to hospice, and those that discharged to the morgue.

Results: Demographics between the two groups were well matched and did not differ significantly between pre and post groups. The implementation of the acuity adjustable unit

showed an improvement of efficiency by providing the nurse the ability to care for the patient in the same room despite the change in level of care. In the post group there was a significant decrease in emergency department boarding times. Significantly more patients were discharged home and efficiency of the unit significantly improved evidenced by a decrease in unnecessary movement due to the ability to remain in the same room regardless of monitoring needs. Additionally, nursing productivity data supported the demand for an additional staff nurse to accommodate as the number of progressive level beds increased.

Discussion: The implementation of an acuity adaptable model was an efficient and cost-effective option. As nursing shortages and overpopulated hospitals continue, the challenge remains to find innovative ways to provide safe high quality, safe patient care at minimal cost. This model was demonstrated to be an effective solution in this trauma center.

Conclusion: The combined results of this study illustrate the benefits of an acuity adaptable unit on efficiency and patient outcomes without increasing the number of physical beds, making it a viable option for addressing challenges with patient throughput.

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Table of Contents

List of Tables

The Effect of an Acuity Adaptable Unit on Efficiency in Non-Critical Trauma Patients

Background and Significance

For years, hospitals across the United States have experienced an ongoing shortage of nurses, high volumes in emergency departments, and peak surgical volumes resulting in the inability to admit new patients efficiently (Hendrich, Fay, & Sorrells, 2004). Patients often experience multiple transfers due to changing acuity during their hospital stay. Continued challenges with bed availability increase cost, delay transfers, decrease quality care, and satisfaction of patients and staff (Hendrich et al., 2004). Many hospitals function with fixed acuity models, which can further add to the impeding congestion of patients when geographical resources are scarce (Hendrich et al., 2004). When patients require specialty care, such as trauma, impeded throughput can result in boarding creating significant safety concerns for those patients. In an effort to provide the required, necessary treatment, and maintain high quality care to the patients, alternative ways to optimize scarce resources should be considered. Implementation of an acuity adaptable unit may provide a cost-effective approach to a growing problem.

In a fixed patient acuity bed assignment unit, nursing skill, staff ratios, patient acuity, and monitoring capabilities determine which patients are assigned to specific beds. Characteristics of progressive care patients are those that do not require invasive monitoring and have an overall improvement in patient condition. These patients transferring from critical care will continue to require close observation and frequent nursing intervention (Chaboyer, James, & Kendall, 2005). As progressive care patients improve their overall patient condition, they will transfer again to an acute care unit. These patients require less intervention from nursing and have an increased ability to participate in their own care before discharging from the hospital. Because progressive level bed needs continue to increase, limited space and nursing resources further complicate the ability to accommodate these patients resulting in longer stays in the ED, ICU, and PACU settings.

An acuity adaptable unit eliminates unnecessary transfers while providing a comprehensive approach to care (Brown & Gallant, 2006). These units allow flexibility when adjusting to the immediate and changing clinical needs of the patient to ensure safe quality care. The acuity adaptable unit allows for patients to remain in the same room who may have changes in monitoring needs until discharge. Eliminating the need of unnecessary transfers prevents loss of important information through multiple handoff reports, improves continuity of care, and decreases the expense of non-value-added time and resources, improving overall quality of care (Kwan, 2011).

The acuity adaptable model requires a nursing skill mix that can accommodate changing acuity levels while providing continuity of care, thus providing the nurse a better understanding of the patient condition resulting in a more rapid assessment, and lowering the risk for readmission to the critical care environment (Brown & Gallant, 2006). The education associated with the skill mix can provide the nursing staff with increased confidence in their abilities, allow them to practice more fully in their scope of practice, and improve nurse retention and satisfaction (Brown & Gallant, 2006). Continuity of care improves nurse-patient relationships in which patients experience an increased confidence in the nurses' skill, and feel a more personal connection with the staff (Emaminia et al., 2012).

There is sufficient evidence that unnecessary transfers have negative impacts on patient care. Multiple hand-offs can result in medication errors, lost information about events during hospitalization, increase in hospital acquired conditions, and an overall waste in nursing hours

(Kwan, 2011). Previous investigators found that after implementation of the acuity adjustable model, transports of patients decreased by 90% and medication errors decreased by 70% suggesting this model to be a reasonable approach to improve patient safety (Hendrich et al., 2004). Despite evidence supporting implementation of acuity adjustable units, institutions may face challenges to justify the adaptation. Thus, the purpose of this project was to evaluate the implementation of the acuity adaptable unit for efficiency in the trauma population, and determine if the model is a reasonable evidence-based solution to address challenges of limited resources, throughput, and patient safety concerns.

Evidenced-Based Framework for Project

The Iowa Model of Evidence-based practice is an evidenced-based framework that has been used successfully in implementation of practice change (Titler et al., 2001). This model, commonly used in academic medical centers, consists of five steps: assess, decide, plan, intervene, and evaluate (Titler et al., 2001). This sequential approach provides an organized structure to clinical and process improvements. The first step for this project was to analyze and assess the current challenges with throughput. Next, available resources and those proven successful in other organizations were examined. This included literature reviews, identification of gaps, and approaches used to implement the change. The successes and challenges of others will help identify solutions that may be adaptable to addressing the current issues. The planning step was one of the most important steps, and typically takes the most time. It was important to include frontline staff and other key stakeholders in this phase. Data collection was completed and evaluated for cost, time efficiency, intended and unintended outcomes. Implementing the practice change heavily included staff, and supporting them through the practice change was important.

Review of Literature

A review of literature was conducted to guide the development of the project. The search strategy included research completed within the last 15 years. A search of Cochrane database did not deliver any results. The next database search was completed through PubMed to include key terms: “acuity-adaptable”; “universal bed”; “adult inpatient”; “length of stay”; and “efficiency” in the titles and abstracts that resulted in three articles. An additional search was completed to include key terms: “delayed transfer” and “cost analysis” which yielded five additional articles. The reference lists of all articles were inspected to identify more literature that included implementation of an acuity adjustable unit and the effects on cost, patient outcomes, and efficiency. Selection criteria for the articles included: published in English, adult patients managed in an inpatient setting in which an acuity adaptable unit had been implemented, those that evaluated causes of delays in transfers, and the cost of those delays both in terms of financial impact and patient outcomes. In total, 13 papers were selected for review. There are limited studies of this model requiring the search to go beyond 10 years.

The levels of evidence for eight articles were Level II, two were Level III, and three were Level IV according to Melnyk & Fineout-Overholt’s model (Melnyk & Fineout-Overholt, 2019). Studies were conducted either inside or outside the United States. The majority were prospective and/or observational cohort studies. The remaining included a retrospective review, a pre-post design method, descriptive comparison, and two qualitative descriptive designs were conducted.

The studies occurred in a wide range of facilities and specialty units including academic medical centers. Lack of available beds was identified as the most prevalent cause of delay in transfer. Study results supported longer length of ICU stay correlated with increased overall cost and longer hospital length of stay. Researchers conducted a study in 5 hospitals over 4 years and found a correlation between delayed transfers out of the ICU and longer hospital stays of approximately 2 days ($p<0.001$) (Churpek et al., 2016). Investigators in a large academic medical center found the cost associated with delayed transfers from the ICU to a non-critical care bed was $581,790 during the study period, which further calculates to $21,547 per week (Johnson et al., 2013). Another group implemented the acuity adjustable model in a rural setting which included ICU, progressive and acute levels of care. There was no statistical significance impacting overall hospital LOS (average LOS 3.71 pre- to 3.73 post- implementation) or quality of care (falls, $p=0.59$; medication errors, $p=0.78$) likely due to the short study period of 4 months (Ramson, Dudjak, August-Brady, Stoltzfus, & Thomas, 2013). Emaminia and colleagues evaluated the acuity adjustable model in post-surgical cardiac patients between the years 2006 to 2009 and found significant cost savings between $6200 and $9500 per patient. Further this group concluded a decreased length in both hospital and critical care stay as well as improved postoperative outcomes in this patient population (Emaminia et al., 2012).

Many of these studies had limitations such as small sample sizes and lack of comparison groups. Studies from larger cohorts with adequate sample sizes resulted in decreased length of stay, cost efficiency, and improved patient outcomes. Despite these limitations, there is supporting evidence that delayed transfer out of the ICU directly affects both hospital length of stay and cost.

Historically, acuity adaptable units maintain patients in the same room from admission to discharge providing all levels of care. The term universal bed model is also used to describe the concept and has been utilized for cardiac, urology, oncology, and transplant services (Kitchens, Fulton, & Maze, 2018). Brown and Gallant (2006) suggested the academic medical center as an optimal setting to implement and research this care model (Brown & Gallant, 2006), however it could prove successful in multiple settings. Historically ICU nurses are in critical care because they enjoy caring for the sickest assignments. While the original definition of an acuity adjustable unit included critical care, once the patients are over the critical care period this creates another level of care these nurses must assume (Emaminia et al., 2012).

There is little data to determine why an acuity adaptable model works in some environments and not in others. Zimring & Hyun-Bo Seo interviewed 6 different hospitals inquiring about the characteristics and identify strategies for success. One key element found was that the care pathway of the patient should be predictable in order to decrease any unexpected workloads that would create stress among staff (Zimring & Seo, 2012). This predictability may be more challenging in some settings and will require investigation before implementing the model.

Hendrich's vision for an acuity adaptable model was one that would "support future delivery of care while solving problems with the flow of patients" (Hendrich, Fay, & Sorrells, 2004, p. 38). As healthcare evolves and new challenges are experienced, it is critical that flexibility and innovative thinking be utilized to overcome barriers to quality care. Each hospital has unique challenges. These challenges should be studied prior to implementing any version of the model to determine which aspects should be modified to better fit the needs of the patients within the organization (Kwan, 2011). It is well understood that delays in transfer to the appropriate level of care can impact overall length of stay and patient outcomes.

The acuity adaptable model is a viable option to overcome challenges with throughput and length of stay. Identification of specific needs of the patient population and organization will be needed to properly identify factors that should be included in the model to ensure success.

Methods

Design

The study design was a retrospective comparative analysis evaluating 11-months pre-and 14-months post implementation of the acuity adaptable unit.

Study Setting

UK HealthCare is a 945-bed quaternary care and regional referral center serving central and southeastern Kentucky. UK HealthCare is an academic medical center verified by the American College of Surgeons Committee on Trauma (ACSCOT) as an adult Level 1 trauma center. The trauma service treats mostly rural and suburban trauma with some urban trauma. Approximately 3000 patients each year are evaluated and admitted by the trauma team. Blunt injury accounts for an estimated 90% of those patients with the remaining 10% penetrating.

Additionally, the hospital is recognized as a comprehensive stroke center, nationally designated cancer center, ventricular assist device (VAD) certified, and extracorporeal membrane oxygenation (ECMO) certified. Other inpatient facilities included within the UK HealthCare organization are Good Samaritan Hospital, UK Children's Hospital (recognized as a Level 1 pediatric trauma center), and Eastern State Hospital.

As a quaternary care center, UK HealthCare provides many advanced sub-specialty services such as trauma care. The complexity of trauma requires different levels of care at different times due to the nature of those injuries. The specialized care required for these patients demands flexibility and forward thinking in how we meet the challenges with volume, patient experience, quality care and outcomes in the wake of a continuously evolving complex system.

A 6-bed fixed progressive care unit and a 14-bed fixed acute care unit was the pre-implementation model that was combined to create a 20-bed acuity-adaptable unit. This post-implementation model enables the admission of patients to any available bed with progressive or acute level of care orders. Nurses received training to include progressive care allowing them to practice to their highest skill. Rooms that did not have monitoring capability in the fixed bed model were outfitted with equipment necessary to allow for acuity adjustments as needed.

The pre-intervention standard staffing model in the fixed acuity unit was for the nurses to have an acuity-based assignment. Two assignments were 5 patients to 1 nurse, and one 4 patients to 1 nurse assignment in the 14-bed unmonitored unit. In the 6-bed monitored unit the assignments were 3 patients to 1 nurse. This model limited the number of progressive care patients, and created the need to move patients more frequently based on level of acuity. In some cases, the patient would be moved to a room located immediately next door in the same space depending on monitoring requirements. Average turnover time for a room in this facility is approximately 8 hours. This includes discharging or transferring the patients, time to clean and set up the room to receive a new patient, and giving and receiving the handoff report. The post- intervention acuity adaptable staffing model continued the acuity-based assignments, but with the increase in skill mix the nurses were able to even the workload by assuming 4 patients to each nurse. The assignments were adjusted to acuity with workload in mind, and would have a mix of progressive care and acute care patients. This allowed the patient to remain in the same room regardless of change in monitoring between the two levels of care. In order to safely work within 24/7 staffing of 5 RNs, the 20-bed adaptable model allowed for an increase in progressive level patients to cap at 10 with the remaining 10 patients acute, for an average assignment being 2 acute and 2 progressives patients to one nurse.

The implementation of an acuity adaptable unit directly aligns with the organization's goals outlined in the strategic plan that is patient-centered, multi-disciplinary, and collaborative (UK HealthCare, 2015-2020). Much of the research around the acuity adaptable units identify them as patient centric. Providing the patient opportunity to remain in the same room for the majority of their hospital stay strengthens nurse patient relationships and eliminates unnecessary handoffs and patient transports that can lead to failed communication and medical errors (Kitchens, Fulton, & Maze, 2018).

The nursing strategic plan, mission, vision, and values fully supports patient centric environments while encouraging advanced practice in specialty care (UK HealthCare, 2017-2019). Optimizing throughput through the care continuum can be achieved with this model by decreasing unnecessary patient transfers due to acuity changes. Providing the training necessary for nurses to recognize patient decline quicker could decrease re-admissions to the critical care areas and overall length of stay for the patient. This also is in direct alignment with both the organization and nursing strategic plans.

Key stakeholders for this proposed change are the bedside staff, patients, and the organization. Support through executive leadership and hospital finance will be necessary for any resources, added funding, and data collection needed to evaluate current and future benefits of the change in practice model.

Sample

The study population consisting of all adult patients, age 16 and older, that arrive to UK HealthCare admitted with a diagnosis of trauma in the acute or progressive level of care was included in the pre- and post- data collection. Exclusion criteria included hospice patients, and those that discharged to the morgue. The patients admitted to the 20-bed fixed acuity unit during the pre- implementation time period May 1, 2018 to March 31, 2019 were compared to those admitted to the 20-bed acuity adaptable unit during May 1, 2019 to June 30, 2020 during the post- implementation period. April 2019 was removed from the study period to account for the transition to the acuity adaptable model.

Procedure

Trauma patients at UK Chandler Medical Center are boarding in an overburdened ED, the Trauma ICU, and PACU. The acuity adaptable unit was created to evaluate efficiency in the trauma population, and determine if it is a reasonable evidence-based solution to address challenges of limited resources, throughput, and patient safety concerns.

Prior to this study, the organization approved the additional monitoring equipment to be installed in the unmonitored rooms. The nursing staff who were not currently trained to the progressive skill level were provided web-based training that included hemodynamics, certifications in advanced cardiac life support (ACLS) through the American Heart Association, Trauma Nurse Core Course (TNCC) through the Emergency Nurses Association, code simulation classes, and 4 weeks of formal orientation with progressive care trauma nurses. The nurse manager, staff development specialist, and the clinical nurse specialist (CNS) were highly engaged in the development of staff, and ensured patient safety and evidenced-based practice were maintained. The medicine units in this facility had an acuity adaptable unit established, and arrangements were made for the trauma nurses to shadow or work in the environment to gain more insight into the function of the unit if desired. Focus groups were conducted before, during, and after the transition period to ensure staff had the resources and support needed for a successful transition. This allowed discussion for how to appropriately create assignments, and develop plans for challenges they may face. The central monitoring unit was made aware of the additional monitored beds. The capacity command center was notified of the go-live date and the limit of 10 progressive care patients to the space were discussed to maintain safe patient assignments with 5 nurses 24/7. The two units were moved to one cost center to ensure accurate data was captured after the implementation. An evaluation of communication devices was completed to ensure staff would continue to receive alerts to call lights and alarms.

The study was approved by the University of Kentucky Medical Institutional Review Board to assure protection of human subjects. The institution's Trauma Data Base which is managed internally by the Trauma Program office was queried for patient records that met inclusion criteria and had no exclusion criteria. Data about age, gender, injury severity score (ISS), mechanism of injury (MOI), hospital length of stay (LOS), ED, PACU, and ICU boarding hours were collected on identified records. The database also provided information about patient movement with and without level of care change and discharge disposition. Monthly productivity reports were utilized to provide data about bed charges, hours per patient day (HPPD), progressive and acute patient days. All data were de-identified before analysis and reporting, and stored on a secure password protected computer.

The outcome data for patient boarding is reported in hours. Overall hospital LOS is reported in both days and hours. Discharge disposition and transfers within the unit are reported as percentage of the sample. Hospital acquired pressure injuries (HAPI) and falls are reported as totals during the respective time periods with all patients admitted to the units, not specific to trauma patients reviewed within the rest of the data. Transfers within the same 20-bed space were evaluated because it was one of the biggest drivers of cost for a hospital stay, along with boarding times in areas outside of appropriate care level. Nursing productivity data evaluated full time employee (FTE) usage for the pre- and post- implementation time using the Vizient

Operational Database (ODB). The institution benchmarks with Vizient for clinical, staffing, and financial outcomes.

The two groups were compared for age, gender, ISS, and MOI defined as blunt and penetrating. Comparisons were performed with independent t-tests or Chi square/Fisher's exact test based on level of measurement and distribution of data. Significance was set at $p<0.05$ for all statistical tests. SPSS version 27.0 was used for analysis.

Nursing productivity was qualitatively compared using the average FTE usage between the pre- and post- implementation groups. Hours per Patient Day (HPPD) targets calculated by Vizient ODB compare groups were compared with the unit's actual FTE usage. Patient days were obtained from monthly productivity reports. A patient day is determined from the midnight to midnight census. Total patient days divided by the number of days during the defined study period determine the average daily census (ADC).

Results

There were 1,407 trauma patients admitted to the study unit during the pre- and post-implementation periods meeting criteria. After the removal of hospice patients and those that discharged to the morgue, 1,372 records remained to be analyzed (pre- implementation group, n=690; post- implementation group, n=682).

The average age of the sample was 52 years old and 63% were male. The average ISS score was 14 and 86% was blunt force trauma. Upon comparison, the pre- and post-groups were demographically similar (Table 1).

When comparing efficiency outcomes between the pre- and post-groups mean ED boarding time was shorter for the post- group (12.06 ± 18.56 versus 15.53 ± 19.92); $p=0.001$; Table 1). There were differences in the groups among discharge disposition ($p=<0.001$). More patients in the post-implementation group were discharged home (29.9% versus 39.7%); requiring fewer post-acute care services, such as home health, (23.8% versus 17%) or rehabilitation facilities (34.4% versus 30.5%).

There was statistical difference when comparing patients who changed level of care and were able to stay in their room (4.8% in the pre-group compared to 32% in the post-group); p=<0.001; Table 2). There were 12.8% of patients who changed rooms with a change in level of care in the pre- group compared to 3.5% in the post- group (p=<0.001).

While there were no qualitative changes in hospital acquired pressure injuries or patient falls, there was a decline (11 HAPI and 16 falls in the pre-group compared to 9 HAPI and 10 falls in the post; Figures 1 and 2).

The FTE average usage during the pre- implementation time period was 7% FTE under budget, and 26% FTE under budget post (Table 3). The over/under was obtained by the unit ODB Vizient actual FTE divided by the target FTE.

During the 335 days in the pre- implementation period, the fixed 20 bed unit saw 1835 progressive care patient days and 4527 routine patient days for an average daily census of 5.5 progressive and 13.5 acute (Table 4). During the 395 days in the post- implementation period, the 20-bed acuity adjustable unit saw 3309 progressive care patient days and 4899 routine patient days for an average daily census of 8.4 progressive and 12.4 acute. The daily charge in the fixed bed unit during the pre- time period was $52,457.50. The post- time period daily charge was $64,066.80 in the acuity adjustable unit, for a difference of $11,609.30. The ability to care for more progressive care patients means a potential profit of $4,237,394.50 annually.

Discussion

The implementation of the acuity adaptable unit in this trauma population demonstrated substantial decrease in transports, nurse HPPD, and an increase in progressive level of care bed days, reducing the boarding of these patients in the ED. The first mention of the acuity adaptable concept was studied in 1970 in a cardiovascular unit at Loma Linda University in California after which there have been many different models with different patient populations studied (Bonuel & Cesario, 2013). Hendrich identified acuity adaptable units an effective solution to decrease intrahospital transports, barriers to throughput, medical errors due to handoffs, nursing HPPD, increase in nurse efficiency and patient bed days (Hendrich et al., 2004).

ED boarding has been linked to hospital mortality (Singer et al., 2011), and is a significant factor in ED crowding, and delays in care (Boudi et al., 2020). One group found that mortality increased from 2.5% in patients who boarded less than 2 hours to 4.5% for those patients boarding 12 hours or more (Singer et al., 2011). Other research has shown that non-ICU patients that survived hospitalization had shorter boarding times in the ED than those that died during hospitalization (Reznek et al., 2018). The implementation of the acuity adaptable unit decreased the ED boarding time by 3.47 hours ($p=0.001$), but did not have a significant impact on ICU or PACU boarding. This could be due to the shortage of bed availability, and patients that are placed where feasible. Overall length of stay for these patients was not statistically significant ($p=0.024$) and was slightly longer in the post group by approximately one day. Given the ICU and PACU boarding times resulted in a slight increase in the post group it is plausible that patients who initially required critical care on admission had longer ED boarding hours because of the inability to get those patients to the appropriate level of care therefore lengthening the overall length of stay.

There was an increase in patients who were able to stay in the same room regardless of change in level of care (p=<0.001) after the implementation compared to the fixed bed model between acute and progressive care. Conversely, there was also a decrease in movement with a change in level of care from (p=<0.001) after implementation. It is well documented that reducing the number of handoffs and transfers increases bed days, reduces medication errors and improves patient safety by giving the nurses more productive and meaningful time at the bedside (Hendrich et al., 2004). Our study did evaluate the impact on HAPI and falls and did not find significant improvement, however was able to see a slight reduction in both during the study period, supporting future research into these areas of patient safety. An increase in the average daily census (ADC) in progressive care patients increased from 5.5 days to 8.4 days, supporting the need for more progressive care availability. Nursing productivity was 26% under the Vizient ODB target after implementation. Those findings supported the need for an additional nurse (6 RNs 24/7) for the 20-bed unit. The additional nurse provided the capability of increasing progressive beds to 20 instead of the cap of 10 with the initial change in model.

Lastly, there was a statistical significance in discharge disposition (p=<0.001) with 39.7% of patients discharged home in the post group. There was subsequently a decrease in patients who required a service, such as home health or rehabilitation facility, in the post group.

The burden of overflow demands flexibility and the overall acuity of the patients is an ongoing concern. The results of this study illustrate the benefits of an acuity adaptable unit on efficiency and patient outcomes without increasing the number of physical beds, making it a viable option for addressing challenges with throughput.

Implications for Practice, Education, and Future Research

The minimal staffing model of 5 RNs for 20 patient beds supported a maximum of 10 progressive care patients. Due to the increase in progressive care days, nursing productivity supported the increase of 6 RNs to the staffing model. This adjustment eliminates the need to keep the progressive patients to 10 and opens all 20 beds to be progressive care if needed. Currently there is no standard criteria for acuity adjustable rooms and staffing ratios (Bonuel & Cesario, 2013). Therefore, these key elements are left to be defined by individual institutions. Nursing shared governance should be considered before, during, and after implementation of this model with other specialties to ensure appropriate resources can be supported. Implementing a design that could spread workload across nursing staff for more equitable assignments will assist with buy in from front line stakeholders potentially improving staff satisfaction. This model may also show improvements in patient satisfaction, as found in previous studies.

The possibility of implementing this program to other areas who have a high volume of progressive care needs and addressing challenges with throughput is promising.

Limitations

This study was retrospective and performed at a single center. The evaluation was strictly limited to one 20-bed unit and the trauma patient population. There is opportunity to further evaluate the extent to which medication errors or patient safety is affected with the decrease in handoff and transfers. Our study did evaluate the impact on HAPI and fall incidents specific to the 20-bed unit during both the pre- and post- implementation period, but they were not specific to the trauma patients only. There was not significant improvement, however a slight reduction in both during the study period were found, supporting future research into these areas of patient safety. Other patient safety concerns such as infection rates and medication errors were not studied. The significant decrease in the number of handoffs, transfers, and nursing productivity would support findings in favor of patient safety improvements.

There is opportunity for future study pertaining to staff and patient satisfaction with this model. Limited time of the study did not provide opportunity to study staff or patient satisfaction with this model.

Conclusions

The implementation of an acuity adaptable model proved to be an efficient and cost-effective option as measured by a decrease in emergency department boarding times, a decrease in unnecessary transfers, increase in discharges to home, and increase in patient days and nursing productivity. As nursing shortages and overpopulated hospitals continue, the challenge remains to find innovative ways to provide high quality, safe patient care at minimal cost. This model has proven to be an effective solution in trauma patients within this Level one trauma center.

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Tables

Table 1: Demographic description and comparison of sample

Demographics	Total (n=1372)	Pre (n=690)	Post (n=682)	p-value
Age (years)	52.15 ± 21.07	51.55 ± 20.47	52.79 ± 21.66	0.276
Gender				0.432
Male	865 (63%)	428 (62%)	437 (64.1%)	
Injury Severity Score (ISS)	14.15 ± 9.07	14.05 ± 8.94	14.25 ± 9.20	0.679
Mechanism of Injury				0.306
Blunt	1185 (86.4%)	603 (87.4%)	582 (85.3%)	
Penetrating	113 (8.2%)	49 (7.1%)	64 (9.4%)	
Other (water, bike, farm)	74 (5.3%)	38 (5.5%)	36 (5.3%)	
Boarding Hours				
ED	13.81 ± 19.33	15.53 ± 19.92	12.06 ± 18.56	0.001
PACU	2.76 ± 8.05	2.51 ± 8.10	3.00 ± 7.99	0.263
ICU	7.24 ± 26.55	7.10 ± 30.04	7.38 ± 22.48	0.840
Length of Stay				
Days	9.74 ± 10.4	9.09 ± 8.61	10.38 ± 11.92	0.024
Hours	233.70 ± 249.70	218.20 ± 206.76	249.09 ± 286.08	0.024
Discharge Disposition				0.000
Home with Home Health	279 (20.3%)	164 (23.8%)	115 (17%)	
Home	475 (34.6%)	206 (29.9%)	269 (39.7%)	
LTC/SNF	136 (9.9%)	69 (10%)	67 (9.9%)	
Rehab	444 (32.4%)	237 (34.4%)	207 (30.5%)	
Other (psychiatric facility, prison, AMA)	33 (2.4%)	13 (1.9%)	20 (2.9%)	

Values are mean ± SD or n (%); p ≤ 0.05 denotes significance.

Comparisons were performed with independent t tests or Chi square/Fisher's exact test based on level of measurement and distribution of data.

Abbreviations: ISS, Injury Severity Score; ED, Emergency Department; PACU, Post Anesthesia Care Unit; ICU, Intensive Care Unit; LTC, Long Term Care; SNF, Specialized Nursing Facility; AMA, against medical advice

Table 2. Comparison of Intrahospital transfers

Intrahospital Transfers	**Total (n=398)**	**Pre (n=134)**	**Post (n=264)**	**p- value**
Changed LOC/Stayed in Room	250 (18.2%)	33 (4.8%)	217 (32%)	0.000
Changed LOC/Changed Room	112 (8.2%)	88 (12.8%)	24 (3.5%)	0.000
Changed Room/Stayed LOC	36 (2.6%)	13 (1.9%)	23 (3.4%)	0.085

Values are n (%); $p \leq 0.05$ denotes significance.

Comparisons were performed with independent t tests or Chi square/Fisher's exact test based on level of measurement and distribution of data.

Abbreviations: LOC, level of care

Table 3. RN FTE Usage

Pre- implementation (May 2018-March 2019)	**May '18**	**June '18**	**July '18**	**Aug '18**	**Sept '18**	**Oct '18**	**Nov '18**	**Dec '18**	**Jan '19**	**Feb '19**	**Mar '19**	**No Data**	**No Data**	**No Data**	**Average RN FTE**
RN Over/Under	0.12	0.12	0.13	0.13	0.08	0.02	0.06	0.02	0.03	0.04	0.03				0.07
Post implementation (May 2019-June 2020)	**May '19**	**Jun '19**	**Jul '19**	**Aug '19**	**Sept '19**	**Oct '19**	**Nov '19**	**Dec '19**	**Jan '20**	**Feb '20**	**Mar '20**	**Apr '20**	**May '20**	**Jun '20**	**Average RN FTE**
RN Over/Under	0.10	0.08	0.33	0.42	0.44	0.44	0.46	0.45	0.16	0.18	0.35	0.19	0.07	0.03	0.26

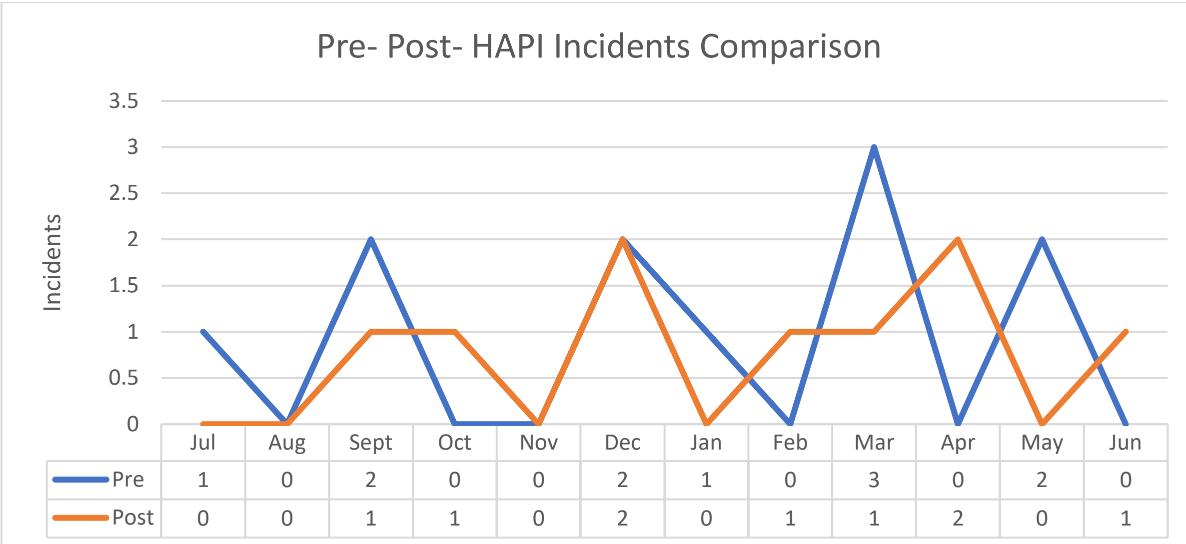
RN FTE Over/Under was obtained in 7-100 20-bed unit using Actual worked FTE divided by the ODB Vizient Target FTE within monthly productivity reports. April was not included in the pre- data time period as this was the transition month between the fixed unit and adjustable unit. The post data began during the last two months of a fiscal year.

Table 4. Patient Days

Pre-implementation (May 2018-March 2019) n=335 days	**May '18**	**June '18**	**July '18**	**Aug '18**	**Sept '18**	**Oct '18**	**Nov '18**	**Dec '18**	**Jan '19**	**Feb '19**	**Mar '19**	**No Data**	**No Data**	**No Data**	**Total Pt. Days**	**ADC**
Progressive Pt. Days	172	172	163	166	162	169	153	170	175	157	176	No data	No data	No data	1835	5.5
Routine Pt. Days	407	410	403	421	407	423	415	414	422	371	434	No data	No data	No data	4527	13.5
Totals	579	582	566	587	569	592	568	584	597	528	610	No data	No data	No data	6362	19.0
Post-implementation (May 2019-June 2020) n=395 days	**May '19**	**Jun '19**	**Jul '19**	**Aug '19**	**Sept '19**	**Oct '19**	**Nov '19**	**Dec '19**	**Jan '20**	**Feb '20**	**Mar '20**	**Apr '20**	**May '20**	**Jun '20**	**Total Pt. Days**	**ADC**
Progressive Pt. Days	256	270	270	222	231	263	250	265	228	163	233	236	255	167	3309	8.4
Routine Pt. Days	346	298	318	367	360	352	340	345	376	400	363	277	345	412	4899	12.4
Totals	602	568	588	589	591	615	590	610	604	563	596	513	600	579	8208	20.8

Patient days obtained from monthly productivity reports. A patient day is determined from the midnight to midnight census. Total patient days divided by the number of days during the defined study period determine the average daily census (ADC).

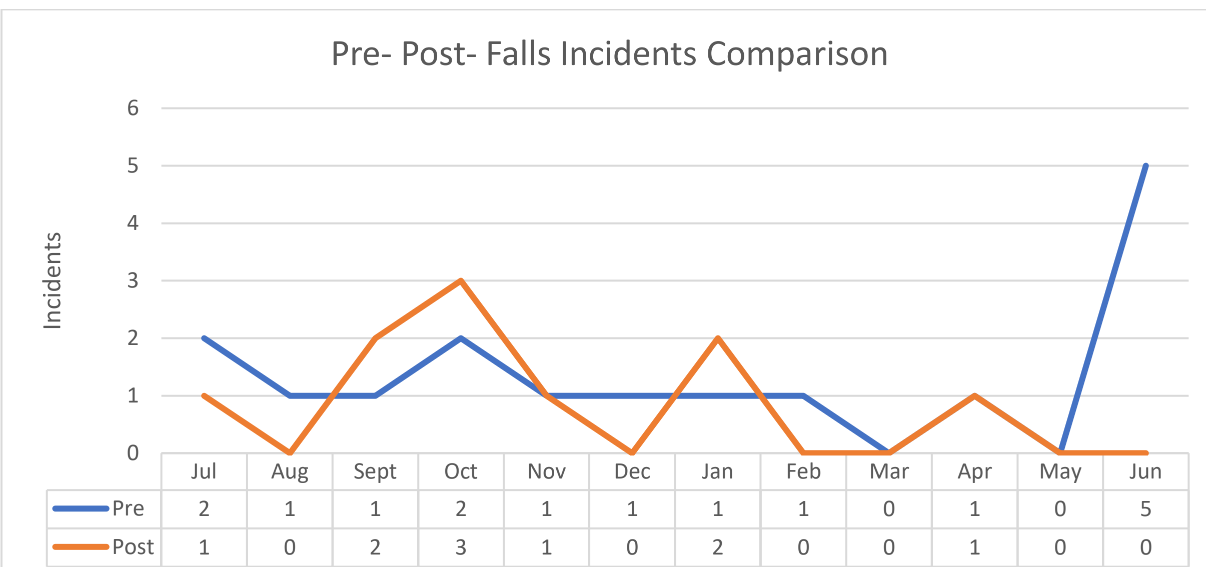
Figure 1.



	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Pre	1	0	2	0	0	2	1	0	3	0	2	0
Post	0	0	1	1	0	2	0	1	1	2	0	1

Incidents reported for all patients admitted to the 7-100 fixed 20 bed unit during the pre-time period. compared to the 7-100 acuity adjustable 20 bed unit during the post- time period.

Figure 2.



	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Pre	2	1	1	2	1	1	1	1	0	1	0	5
Post	1	0	2	3	1	0	2	0	0	1	0	0

Incidents reported for all patients admitted to the 7-100 fixed 20 bed unit during the pre-time period compared to the 7-100 acuity adjustable 20 bed unit during the post- time period.