RETROSPECTIVE ANALYSIS OF UNPLANNED ICU ADMISSIONS AMONG

ADULT TRAUMA PATIENTS

by

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As members of the DNP Project Committee, we certify that we have read the DNP project prepared by Amanda Katherine Zeagler, titled Retrospective Analysis of Unplanned ICU Admissions Among Adult Trauma Patients and recommend that it be accepted as fulfilling the DNP project requirement for the Degree of Doctor of Nursing Practice.

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DEDICATION

I would also like to dedicate this work to anyone who has experienced an adverse outcome such as an unanticipated ICU admission. As a DNP I will continue to promote continuous evaluation and improvement aiming to achieve care that is patient-centered, safe, effective, timely, and equitable. “Getting to zero” will remain a driving force for continuing research to better predict and prevent adverse outcomes among trauma patients. As a leader in healthcare, I understand and will work to foster a culture that advances scientific knowledge, innovates clinical practices, and disseminates evidence-based practice to improve healthcare delivery and patient outcomes.

TABLE OF CONTENTS

TABLE OF CONTENTS – Continued

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

Background: Unplanned Intensive Care Unit (ICU) admissions are hospital-acquired events associated with increased risk of in-hospital mortality and greater length of stay.

Purpose: The purpose of this Doctoral of Nursing Practice (DNP) project is to 1) identify the incidence of trauma patients with unplanned ICU admissions, and 2) describe characteristics among patients with unplanned ICU admissions, including activation level of the trauma team, patient demographics (e.g., Age), Glasgow Coma Scale, mean Injury Severity Score (ISS), pre-existing conditions, delirium, frailty, Emergency Department disposition, mean ICU length of stay, and mean ventilator days.

Methods: A retrospective analysis using the National Trauma Database (NTDB) for unplanned ICU admissions was performed to describe characteristics of trauma patients with unplanned ICU admissions. Inclusion was limited to trauma patients with unplanned ICU admissions admitted to a large academic medical center in the Southwest region of the United States during August 1, 2019 and July 31, 2021.

Results: During the two-year period, 109 adult trauma patients met the criteria for unplanned ICU admission. The 109 unplanned admissions were divided by the 5,713 total adult trauma admissions resulting in a 2% incidence. Among these trauma patients with unplanned ICU admissions, the mortality rate was 22.9%, and the average length of hospital stay was 18.5 days + 18.4 days (SD) (95% CI, 15.01 - 21.98 days). The median age of adult trauma patients with unplanned ICU admissions was 68 years (IQR [Q1 52, Q3 77]). The average ISS was 14.9 + 10.5 (SD), consistent with higher mortality risk from multiple traumatic injuries. A greater number of unplanned ICU transfers (n = 50) was identified when compared to ICU readmissions

(n = 39). A majority (80%) of patients with unplanned ICU admissions had at least one comorbidity, with the average number of comorbidities per patient being three.

Conclusions: The opportunity to prevent adverse outcomes, including unplanned transfer to the ICU, exists among adult trauma patients. Findings from this DNP project can help inform triaging of geriatric trauma patients and improve management of chronic diseases to prevent unplanned ICU admissions and hospital-acquired events.

INTRODUCTION

Unplanned Intensive Care Unit (ICU) admissions are associated with adverse outcomes including a greater length of stay and increased in-hospital mortality. According to the National Trauma Data Registry, unplanned ICU admissions are defined as unexpected admission to the ICU during their hospitalization and includes patients with an unplanned return to the ICU also termed ICU readmission (American College of Surgeons National Trauma Data Standard Data Dictionary, 2021). There is a significant body of literature describing potential risk factors and patient characteristics associated with unplanned ICU admissions. These variables include but are not limited to age, the severity of illness, Glasgow Coma Scale (GCS), pre-existing conditions, frailty index, variation in triage and discharge practices, and resource constraints (Hamidi et al., 2019; Morgan et al., 2020; Mulvey et al., 2020; Nates et al., 2016; Niven et al., 2014; Ofoma et al., 2018; Ponzoni et al., 2017; Stelfox et al., 2015; Vollam et al., 2015; Wong et al., 2016).

Problem Statement

As unplanned ICU admissions are adverse outcomes associated with increased risk of mortality, greater length of stay, and excess healthcare costs. Currently, there is a significant body of evidence suggesting that patient characteristics, relative risk factors, and considerable variation among transfer processes lead to significant heterogeneity. Thus, current guidelines and recommendations for clinical practice are limited by the inability to generalize findings across studies. Therefore, further analyses of unplanned ICU admissions are needed and highly valuable to inform quality improvement interventions for reducing and preventing unplanned ICU admissions (Fakhry et al., 2013; Nates et al., 2016; Niven et al., 2014; Ofoma et al., 2018; Stelfox et al., 2015; Wong et al., 2016).

The purpose of this Doctoral of Nursing Practice (DNP) project was 1) to identify the total number of trauma patients with unplanned ICU admissions retrospectively from July 31, 2021, to August 1, 2019, and 2) describe characteristics among patients with unplanned ICU admissions, including activation of the trauma team, patient demographics (age on admission), GCS, mean ISS, pre-existing conditions, delirium, frailty, Emergency Department disposition, mean ICU length of stay, and mean ventilator days. The findings from this DNP project can provide meaningful data for further analyses and can support local quality improvement projects aiming to reduce unplanned ICU admissions and improve patient outcomes.

Background

Patients with unplanned ICU admissions include any unexpected admission to the ICU and encompasses patients subsequently readmitted to the ICU within the same hospitalization. There is an increased risk of mortality and greater hospital LOS noted across the literature among patients with Unplanned ICU admissions (Al-Jaghbeer et al., 2016; Alarhayem et al., 2019; Fakhry et al., 2013; Kramer et al., 2012, 2013; Morgan et al., 2020; Mulvey et al., 2020; Nates et al., 2016; Stelfox et al., 2015; Vollam et al., 2015; Wong et al., 2016). Also, there is a statistically significant greater length of stay and unfavorable final discharge disposition among patients with unplanned ICU admissions (Morgan et al., 2020; Mulvey et al., 2020; Nates et al., 2016; Vollam et al., 2015; Wong et al., 2016). Thus, identifying trends and potential risk factors of unplanned ICU admissions is necessary to inform evidence-based interventions for improving the quality of care (Morgan et al., 2020; Mulvey et al., 2020; Nates et al., 2016; Vollam et al., 2015; Wong et al., 2016). Furthermore, analyzing characteristics among patients with unplanned ICU admissions is essential to develop sustainable strategies to reduce adverse outcomes among trauma ICU patients.

Currently, there are risk assessment tools to identify patients at greater risk for requiring ICU care or at increased risk for ICU readmission. There is a significant association between positive risk assessment scores and unplanned ICU admissions (Gajic et al., 2008; Kareliusson et al., 2015; Rosa et al., 2015). For example, the Stability and Workload Index for Transfer (SWIFT) is a validated assessment tool that has been studied to identify patients at greater risk of bouncing back to the ICU (Gajic et al., 2008). The elements and scoring system of SWIFT are described in Table 1. ED disposition is an important element included in this assessment tool as variations in discharge practices are described to influence adverse outcomes.

Table 1

Categories and Associated Scores for the Stability and Workload Index for Transfer (SWIFT)

SWIFT (Stability and Workload Index for Transfer) **Variable**	
The original source of ICU admission	
Emergency Department	0
Transfer from the floor or outside the hospital	8
Total ICU LOS	
Less than 2 days	0
2 – 10 days	1
Greater than 10 days	14
PaO2/FiO2 (last measured)	
Greater than 400	0
Less than 400	5
Less than 150	10
Less than100	13

Table 1 – *Continued*

GCS at time of ICU Discharge	
Less than 14	0
11-14	6
8-11	14
Less than 8	24
PaCO2 (most recent arterial blood gas)	
Less than or equal to 45	0
Greater than 45	5

(Adapted from Gajic et al., 2008)(ICU, Intensive Care Unit; LOS, Length of Stay; GCS, Glasgow Coma Scale; FiO2, Fraction of Inspired Oxygen; PaCO2, partial pressure of carbon dioxide)

The Rothman Index (RI) is also a validated clinical assessment tool commonly described to identify patients needing transfer to a higher level of care and is comparable to electronic medical record (EMR) early warning systems (EWS) (Alarhayem et al., 2019; Gotur et al., 2020). The RI uses vital signs, nursing assessments, and laboratory data to compute an index score representing the odds ratio associated with the likelihood of potential unplanned ICU admission, ICU readmission, and in-hospital mortality (Table 2).

Table 2

Rothman Index

Vital Signs
Temperature
Systolic Blood Pressure
Diastolic Blood Pressure
Pulse Oximetry
Respiratory Rate
Heart rate

Table 2 – *Continued*

Nursing Assessment
Cardiac
Respiratory
Gastrointestinal
Genitourinary
Neurological
Skin
Safety
Peripheral vascular
Food & Nutrition
Psychosocial
Musculoskeletal
Nursing Assessment
Braden Score
Laboratory Tests
Creatine (Cr)
Sodium
Chloride
Potassium
Blood Urea Nitrogen (BUN)
White Blood Cell Count (WBC)
Hemoglobin (Hgb)
Cardiac Rhythm
Asystole
Sinus Rhythm
Sinus Bradycardia
Sinus Tachycardia
Atrial Fibrillation
Heart Block
Junctional
Paced
Ventricular Fibrillation

(Adapted from Alarhayem et al., 2019) SBP, Systolic Blood Pressure; DBP, Diastolic Blood Pressure; Cr, Creatinine; BUN, Blood Urea Nitrogen; WBC, White Blood Cell; Hgb, Hemoglobin

The Sequential Organ Failure Assessment (Table 3) measures the risk of mortality using six variables to identify the presence of multi-organ dysfunction with a higher score increases the likelihood of mortality (Kareliusson et al., 2015; Rosa et al., 2015). This parallels with the ISS among trauma patients objectively measuring acuity and severity of injuries. The clinical utility of these risk assessment tools provides measurable scores related to risk factors described to be associated with a greater risk of mortality. These risks factors include poor GCS, presence of multiple organ dysfunction, pre-existing conditions, and longer mean ICU length of stay. Thus, it is important to understand how these measures can be effectively translated into clinical practice to predict and reduce adverse outcomes in patients at risk for unplanned ICU admissions. Such data can inform evidence-based interventions to reduce the risk of and prevent unplanned ICU admissions among trauma patients.

Table 3

Sequential Organ Failure Assessment Score

Variable	
Respiratory	
PaO2/FiO2 ratio < 400 +/- respiratory support	1
PaO2/FiO2 ratio < 300 +/- respiratory support	2
PaO2/FiO2 ratio < 200 + respiratory support	3-4
Cardiovascular	
Mean Arterial Pressure < 70	1
Dopamine < 5mcg/kg/min or Dobutamine	2
Dopamine > 5 mcg/kg/min or epinephrine < 1 mcg/kg/min or norepinephrine <1 mcg/kg/min	3
Dopamine > 15mcg/kg/min or epinephrine > 1mcg/kg/min or norepinephrine >1 mcg/kg/min	4
Liver	
Serum Bilirubin 1.2 to 1.9 mg/dl	1
Serum Bilirubin 2.0 – 5.9	2
Serum Bilirubin 6.0- 11.9	3

Table 3 – *Continued*

Variable	
Serum Bilirubin >12.0	4
Coagulation	
Platelets < 150,000/mm^3	1
Platelets < 100,000/mm^3	2
Platelets < 50,000/mm^3	3
Platelets < 20,000/mm^3	4
Glasgow Coma Scale (GCS)	
13- 14	1
10 – 12	2
6 – 9	3
< 6	4
Renal	
Serum Creatine 1.2 – 1.9 mg/dL	1
Serum Creatine 2.0 – 3.4 mg/dL	2
Serum Creatine 3.5 – 4.9 mg/dL or UOP < 500ml in 24 hours	3
Serum Creatine > 5 mg/dL or UOP < 200ml in 24 hours	4

(PaO2 partial pressure of oxygen; FiO2, Fraction of Inspired Oxygen, mcg micrograms; mg, milligrams; kg, kilogram; mm millimeter) (Adapted from Rosa et al., 2015)

Unplanned ICU admissions contribute to increased healthcare costs as critical care services are substantially more than general care. This is a significant healthcare financial burden because critical care costs are on average three times than general care (Nates et al., 2016). Additionally, unplanned ICU admissions also are associated with increased hospital and ICU length of stay. Currently, the process of triaging ICU level care and transferring a patient from the ICU to a general or progressive care unit is highly variable across healthcare organizations and clinical specialties (Nates et al., 2016; Niven et al., 2014; Ofoma et al., 2018; Stelfox et al., 2015; Vollam et al., 2015; Wong et al., 2016). Additionally, resource availability among different health organizations also influences the transfer process and whether patients receive care congruent with their acuity (Nates et al., 2016; Niven et al., 2014; Vollam et al., 2015; Wong et al., 2016). Furthermore, the burden and influence the Coronavirus (COVID-19) pandemic has had on resource availability and organizational processes cannot be underappreciated when analyzing resource constraints. For example, many organizations have been forced to operate under code purple status, which occurs when there is a critical shortage of staff and or bed availability. Such resource constraints have a great impact on patient safety, outcomes, and quality of care. Therefore, further research is vital to analyze system and process barriers that influence unplanned ICU admission. This can potentially lead to reducing excess healthcare costs associated with the greater LOS and adverse patient outcomes. In summary, ineffective resource utilization and excess healthcare spending are known serious sequela associated with unplanned ICU admissions (Al-Jaghbeer et al., 2016; Fakhry et al., 2013; Kramer et al., 2012, 2013; Morgan et al., 2020; Mulvey et al., 2020; Nates et al., 2016).

Beyond system and process barriers that influence the likelihood of unplanned ICU admissions are patient-specific characteristics such as the Injury Severity Score (ISS), presence of pre-existing conditions (comorbidities), patient’s age, and poor GCS (Al-Jaghbeer et al., 2016; Christmas et al., 2014; Fakhry et al., 2013; Johns, 2014; Kramer et al., 2012, 2013; Morgan et al., 2020; Mulvey et al., 2020; Nates et al., 2016); Wong et al., 2016). Patients with greater ISS may represent a vulnerable population as these patients are at increased risk of clinical deterioration, prompting an unplanned ICU admission (Christmas et al., 2014; Fakhry et al., 2013; Johns, 2014; Kramer et al., 2012, 2013; Johns, T., 2014; Morgan et al., 2020; Mulvey et al., 2020; Nates et al., 2016).

As the increased demands for ICU beds continue to surpass the beds available, there is a significant need to establish appropriate criteria for the use of ICU resources (Morgan et al., 2020; Mulvey et al., 2020; Nates et al., 2016; Wong et al., 2016). Therefore, external pressure from critical care societies, hospital administrators, and governing authorities to reduce ICU length of stay exists. Premature ICU discharge may occur from pressure to reduce ICU LOS may lead to increase ICU bounce backs within the first 48 hours of ICU discharge. Conversely, ICU length of stay constitutes an essential quality metric. There is robust evidence that correlates reduced ICU LOS and improved patient outcomes and reduced healthcare costs (Fakhry et al., 2013; Kramer et al., 2012, 2013; Morgan et al., 2020; Mulvey et al., 2020; Nates et al., 2016). There may be an association among patients with greater ICU LOS and risk for unplanned ICU admission.

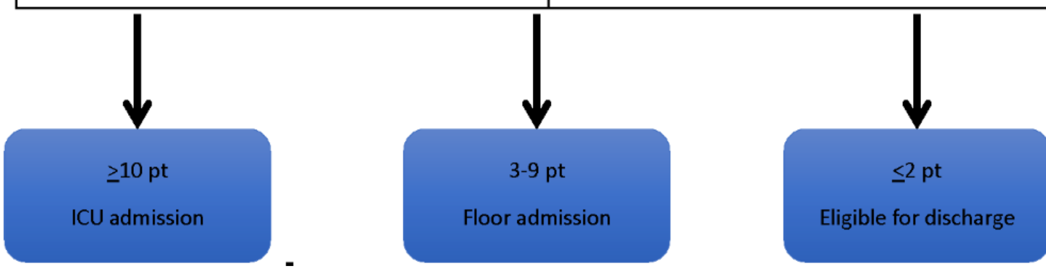
Local Problem

At a local medical center, the trauma critical care team uses clinical acumen coupled with a risk assessment tool to admit patients with multiple rib fractures and increased “rib scores” to the ICU for aggressive pulmonary hygiene and hemodynamic monitoring. A Rib Score (Figure 1) is a patient-focused assessment considering multiple variables such as age and comorbidities coupled with the severity of the injury that increases a patient’s risk of developing severe complications such as acute respiratory failure, pneumonia, and worsening pneumothorax when admitted to the hospital for multiple rib fractures. The rib score assessment is a practice unique to the surgical trauma ICU, aimed at improving patient outcomes and quality of care. The evidence supporting the rib score assessment is that patients with multiple broken ribs and pulmonary contusions are at significant risk for respiratory compromise due to atelectasis, infections, and reduce alveolar gas exchange (Christmas et al., 2014; Nates et al., 2016; Rosa et al., 2015; Scuster et al., 2020). As respiratory failure is the most common indication for unplanned ICU admissions, this strategy aims to reduce respiratory complications precipitating unplanned ICU admissions (Christmas et al., 2014; Morgan et al., 2020; Mulvey et al., 2020; Nates et al., 2016). Further research guiding local strategies to reduce unplanned ICU admissions is pivotal for improving patient and health outcomes among trauma ICU patients (Christmas et al., 2014; Nates et al., 2016).

Figure 1

Rib Fracture Protocol

Criteria	Points
Age > 60 years old	4
Incentive Spirometer < 750 Assessed 1hr after given PO pain medication	4
Imaging demonstrates severe pulmonary contusions in one or both lungs	2
Number of rib fractures > 4	2
History of any of the following: COPD, smoker, or asthma	2
Presence of hemothorax, pneumothorax on imaging and/or chest tube placed	2
Pain score > 6/10, assessed 1hr after given PO pain medication	1
Weak or absent cough	1



Engaging key stakeholders is necessary when planning and implementing a quality improvement project. Key stakeholders of the surgical trauma ICU (SICU) include the critical care director, intensivists, residents, advance practice nurses (APN), senior nursing managers, hospital administrators, and unit staff. Each of these stakeholders has a unique role and is vital to support and cultivate sustainable improvement through multidisciplinary collaboration. The critical care director provides essential leadership and support, including appropriate resource and policy changes that may be needed to implement evidence-based practice changes. Attendings, residents and APNs primarily make up the critical care team and thus should be included in the planning and implementing interventions for reducing unplanned ICU admissions. Moreover, the attendings, residents, and advanced practice providers determine a patient's readiness to transfer to the floor. They are also members of the critical care code team which responds and manages patients that become hemodynamically unstable or require unexpected admission to the ICU. Senior nurse managers and hospital administrators must also support quality improvement efforts and allocate adequate resources. Lastly, the unit staff is vital stakeholders as their support is critical for improving patient outcomes and quality of care. To summarize, engaging these critical stakeholders will ensure the success of continuous quality improvement.

Project Question

Among patients with unplanned ICU admissions from August 1, 2019 – July 31, 2021, is there any difference in the prevalence of the following characteristics activation of the trauma team, patient demographics, ED GCS, ISS, pre-existing conditions, delirium, frailty, emergency department disposition, ICU length of stay, and ventilator days?

Intended Improvement

There is a significant opportunity to improve the adoption of evidence-based interventions to reduce the risk of unplanned ICU admissions among trauma patients. A large body of evidence describes patient-specific and clinical resource constraints as possible risk factors associated with a higher risk of unplanned ICU admissions. The purpose of this Doctor of Nursing Practice (DNP) project is to 1) identify the total number of adult trauma patients with unplanned ICU admissions, 2) describe characteristics of unplanned ICU admissions, including activation of the trauma team, patient demographics, GCS, ISS, pre-existing conditions, delirium, frailty, emergency department disposition, ICU length of stay, and ventilator days.

THEORETICAL FRAMEWORK

The delay in adopting evidence-based practices influences the efficiency, cost, and quality of healthcare. This delay is in part because healthcare organizations and interdisciplinary teams are complex systems. In clinical practice, implementing evidence-based practices (EBP) is complicated by the multifactorial and complex factors influencing clinical practice changes. Thus, simplistic linear models for implementing change fall short of understanding and considering the multifaceted and multifactorial influences that are intricately involved in necessitating a change in clinical practice. Complex adaptive systems are unique in that they interact with the environment in non-linear ways, making them difficult to predict and analyze (Marshall & Broome, 2016, p. 42). Understanding the complex and intricate elements that self-organize, yielding large healthcare organizations is essential for planning and sustaining EBP changes to improve patient outcomes and quality of care. Historically, Lewin's theoretical framework is well described and associated with successful and sustainable clinical practice improvements (Shirey, 2013; Wojciechowski et al., 2016). Thus, Lewin's change theory is a relevant framework to reduce unplanned ICU admissions to improve patient outcomes.

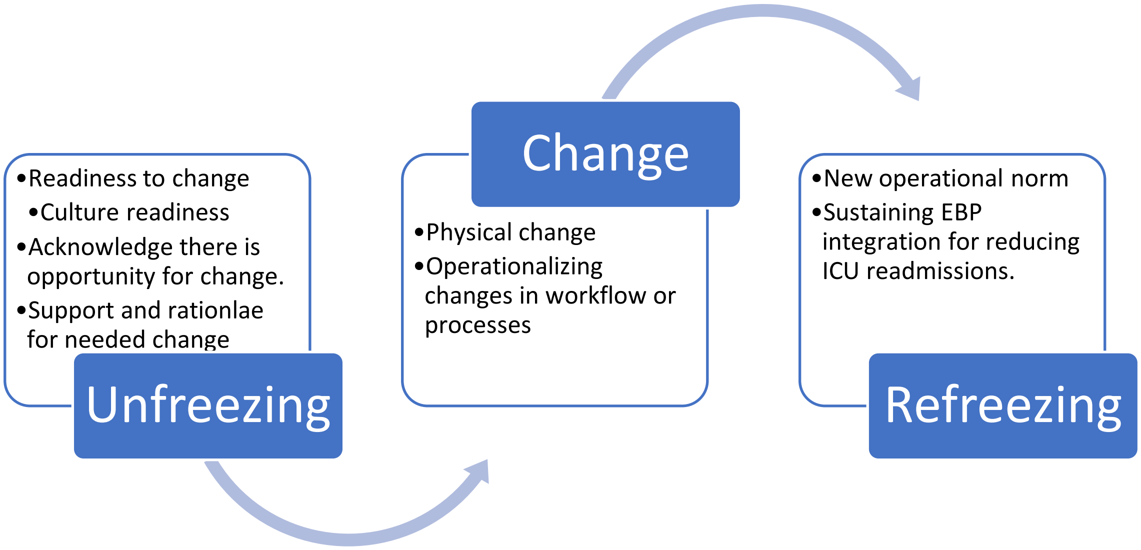
Three stages categorize Lewin's change theory: unfreezing, change, and refreezing (Schein, 1996). The unfreezing stage involves cultivating acceptance and preparing the organization to assimilate readiness for change (Lewin, 1947; Schein, 1996). The change period implements a proposed change in clinical practice (Lewin, 1947; Schein, 1996). Finally, the refreezing stage returns to a new operational norm (Lewin, 1947; Schein, 1996). Throughout each of these stages, there are intricate dynamics among extraneous and internal factors that precipitate driving forces supporting or impeding the implementation of evidence-based practices. Therefore, Lewin's change theory is pivotal to planning and implementing sustainable changes in clinical practice as it suggests that we cannot begin to understand an organization until we have tried to influence and change it (Schein, 1996, p. 35). Moreover, Lewin's theory considers external and internal factors when identifying, planning, and implementing change, which helps to gain the support needed for changing clinical practice.

Illustration of Theoretical Framework

Lewin's change theory is a mid-range theory that identifies facilitators and barriers influencing planned change within a system or organization. Figure 2 illustrates the different stages and provides a practical application of how this framework improves change within complex systems (Lewin, 1947). Identifying the opportunity for change and engaging support are vital elements of this theory. In collaborating with the trauma quality improvement team, the issue of unplanned ICU admission was identified. This parallels with the unfreezing stage described by Lewin's change theory, which is to recognize and identify an opportunity to improve. The findings from this DNP project can inform the "change" stage once the incidence and characteristics among unplanned ICU admissions are identified.

Figure 2

Adapted from Lewin's Change Theory



(Lewin, 1947)

Continuous evaluation and re-evaluation of progress to identify improvement opportunities is an essential aspect of this theory. Clinical practice change considering the internal and external factors influencing the etiologies and preventability of unplanned ICU admissions can then be developed.

As healthcare organizations and multidisciplinary teams increase in complexity, this theoretical framework provides a rich understanding of the multifaceted elements and intricate relations influencing successful and sustainable improvements. Lewin's change theory can provide foundational knowledge for successfully promoting a culture ready for a change to support EBP intervention derived from the findings of this project.

Model for Improvement

The Institute for Healthcare Improvement (IHI) provides a necessary framework for operationalizing proposed changes in clinical practice and is commonly known as the Model for

Improvement (MFI). This framework, coupled with Lewin's theory for change, is necessary to foster and promote the translation of evidence-based medicine into clinical practice. The MFI includes three essential questions and the Plan-Do Study--Act cycle for change (IHI, 2020b. Historically, the MFI framework has been essential for accentuating current organizational models optimizing the timeliness of planning, implementing, and evaluating improvement within diverse clinical settings, facilitating a just culture prioritizing improvement (IHI, 2020b). The foundational questions that help facilitate improvement in a complex system include 1) setting an aim by establishing what will be accomplished, 2) delineating objective measures demonstrating whether improvement is occurring, and 3) selecting a change that can reduce the adverse event of unplanned ICU admissions and in-hospital mortality (IHI, 2020b). This project aims to identify and describe the incidence and characteristics of unplanned ICU admissions. This analysis will inform each step of the Plan-Do-Study-Act cycle for quality improvement projects to reduce adverse outcomes and improve patient outcomes. This cyclic process is continuous and helps test small-scale changes to identify potential barriers and facilitators that influence the efficacy and sustainability of quality improvement (IHI, 2020b).

Plan: Change in clinical practice begins with planning, which will consist of essential data collection to identify the current incidence of unplanned ICU admissions. This will help to establish a foundation from which improvement can be measured from baseline. Identifying characteristics among patients with unplanned ICU admissions can inform the development of interventions to reduce unplanned ICU admissions and associated adverse outcomes.

Do: The second phase involves the implementation of a proposed change (IHI, 2020b). There is currently some evidence supporting the use of clinical assessment tools, including ISS, Rothman Index, and SWIFT, to objectively identify patients with increased risk of unplanned ICU admissions. The current literature inconsistently demonstrates moderate predictability; thus, further prospective studies are needed to evaluate the efficacy and utility of these assessment tools in clinical practice.

Study: Unplanned ICU admissions are adverse events, and therefore it is a priority to reduce and prevent them. Findings from this DNP project can inform the future development of locally appropriate strategies to reduce the risk of unplanned ICU admissions. The findings of this analysis will identify trends in characteristics among adult trauma patients that can help to inform risk reduction and prevention initiatives.

Act: When a possible change in clinical practice is identified, implementing a new process is the final phase in the MFI cycle (IHI, 2020b). Spreading and sustaining change is an active process requiring a commitment to multidisciplinary collaboration and continuous improvement (IHI, 2020b). An active commitment helps to overcome the physical and financial factors that influence both dissemination and sustainability of clinical practice changes. Thus, to achieve sustainable improvement this commitment is essential for reducing unplanned ICU admissions.

Stakeholders

Active engagement and support from key stakeholders are prerequisites for planning and sustaining quality improvement efforts. In addition to the previously described vital stakeholders, the trauma quality improvement team, including data analysts, are important stakeholders to facilitate data collection related to unplanned ICU admissions. As unplanned ICU admissions are considered a measure of quality care and hospital performance, there is a vested interest among stakeholders to support the project scope and its clinical implications.

Synthesis of Evidence

A comprehensive literature search of PubMed, CINAHL, and Embase with expert consultation from the College of Nursing Associate Librarian Maribeth Slebodnik, BSN, MLS, was performed. The initial PubMed search identified 200 articles and used the following search strategy: (((“Patient Readmission”[MeSH]) OR (“unplanned admission”[Title/Abstract])) AND ((“Critical Care”[MeSH] OR “Intensive Care Units”[MeSH]) OR (“intensive care”[Title/Abstract] OR ICU [Title/Abstract] OR “critical care”[Title/Abstract]))) AND (“Hospital Mortality”[MeSH]). The search was delimitated by the following criteria: adults aged 19 and older, English language, and published within the last five years. These criteria resulted in 133 articles. The results were further narrowed using the following inclusion criteria: peer-reviewed articles, surgical, and trauma ICU populations. Literature on medical, cardiac, and neurosurgical populations was excluded due to significant heterogeneity among the different populations. Also, articles analyzing hospital readmissions post ICU discharge were excluded as they are beyond this project's aim and scope. Therefore, nine articles were included. In addition, a secondary search strategy was conducted to generate more pertinent articles related to preventing ICU readmissions and unplanned transfers to ICU using the following search strategy (“Critical Care”[MeSH] OR “Intensive Care Units”[MeSH]) OR (“intensive care”[Title/Abstract] OR ICU [Title/Abstract] OR “critical care”[Title/Abstract])) AND ((“Patient Readmission”[MeSH]) AND (reduction [Title/Abstract] OR prevention [Title/Abstract] OR reduce [Title/Abstract] OR prevent [Title/Abstract])). This identified a total of 114 articles. After the above filters and criteria were applied, four additional articles were identified for review. In total, 13 articles from PubMed were included in this review.

In addition to PubMed, the search strategy for CINAHL and Embase included the Boolean and operators ((“Surgical trauma intensive care unit”) AND (“Post ICU Readmission”) AND (“Unplanned Transfer”) AND (Patient Outcomes) OR (Mortality). After applying the filter criteria, which included peer-reviewed, English language, published within the last five years, and adults age older than 19,156 articles were identified. With limiting publications to surgical trauma patients readmitted to the ICU and excluding hospital readmissions and other subspecialty ICU populations, only 24 articles remained for consideration. Furthermore, duplicate articles were removed, resulting in 22 articles from PubMed, CINAHL, and Embase being included. The Cochrane Database was searched using the same search criteria, but no additional articles were found.

Strengths, Weaknesses and Knowledge Gaps

There is robust evidence describing the complexity of preventing and reducing unplanned ICU admissions. There is a significant increase in in-hospital mortality ranging from 19-35% among patients with unanticipated ICU admissions (Alarhayem et al., 2019; Araujo et al., 2013; Azevedo et al., 2015). The significant increase in in-hospital mortality and LOS among patients with unplanned ICU admissions demonstrate the importance of preventing this adverse patient outcome (Alarhayem et al., 2019; Araujo et al., 2013; Azevedo et al., 2015). Furthermore, a large body of evidence consistently identifies cardiovascular and respiratory compromise as the top two indications prompting unplanned ICU admissions (Bradburn et al., 2020). There is a significant opportunity to improve the quality of care by preventing adverse outcomes associated with unplanned ICU admissions (Brown et al., 2012).

Throughout the literature, relative weaknesses limit the recommendations of systematic reviews and meta-analyses aiming to reduce unplanned ICU admissions. The current evidence primarily consists of retrospective cohort studies analyzing ICU readmissions. In addition, the definition and parameters measuring unplanned ICU admissions and ICU readmissions are inconsistent, which leads to significant heterogeneity and reduced generalizability of current systematic reviews and meta-analyses. This currently limits recommendations for using patient characteristics to predict and prevent unplanned ICU admissions. For example, although a greater Injury Severity Score (ISS), Acute Physiology and Chronic Health Evaluation (APACHE) score, and various patient demographics are frequently associated with an increased risk of unplanned ICU admissions, there is a gap in generalizing these findings and correlations across cohort studies and clinical practice (Bradburn et al., 2020; Lee et al., 2015; Markazi-Moghaddam & Ramezankhani, 2020). These patient-specific variables, including but not limited to GCS, age, frailty index, ISS, and delirium, have been associated with increased length of stay, higher mortality risk, and unplanned ICU admissions (Hamidi et al., 2019; Khan et al., 2017; Mulvey et al., 2020; Morgan et al., 2020; Niven et al., 2014, Oh et al., 2019; Silveira et al., 2019). In summary, there is support for further research to strengthen the evidence supporting patient characteristics predictive of unplanned ICU admissions.

The recommendations regarding the development of predictive models of ICU readmission are increasing, however currently are limited. Only very few studies have demonstrated modest efficacy of achieving an Area Under the Receiving Operator Curve

(AUROC) of 0.7 or greater in predicting ICU readmissions or clinical deterioration requiring unplanned ICU admission (Bradburn et al., 2020; Brown et al., 2012; Hammer et al., 2020; Lee et al., 2015; Markazi-Moghaddam & Ramezankhani, 2020; Martin et al., 2019). Thus, with the current limitations in developing cost-effective and accurate predictions models, there may be greater efficacy in using characteristics from validated assessment tools for improving risk stratification. There is strong evidence that the variables derived from validated assessment tools, including the SWIFT, ISS, and Rothman Index, are associated with a greater risk of unplanned ICU admission (Gajic et al., 2008; Kareliusson et al., 2015; Rosa et al., 2015). In summary, current evidence is limited widescale implementation of predictive models for preventing and reducing unplanned ICU admissions.

The average prevalence of unplanned ICU admissions varies globally, with significant confounding variables such as varying admission/triage processes and resource constraints which, influence the incidence and preventability of these adverse events (Al-Jaghbeer et al., 2016; Fakhry et al., 2013; Kramer et al., 2012, 2013; Morgan et al., 2020; Mulvey et al., 2020; Nates et al., 2016). Thus, there is some evidence that interventions for reducing unplanned ICU admissions may be more effective on a case-by-case approach instead of widespread adoptions (Brown et al., 2012, 2015; Hoffman et al., 2017). This is because, across all studies, characteristics and risk factors associated with unplanned ICU admissions diverge considerably. Thus, further analyses and locally tailored changes to improve clinical practice outcomes are commonly reported, although this can further increase variation in clinical practice (Kramer et al., 2012, 2013; Moore et al., 2018; Ponzoni et al., 2017).

There is a relative knowledge gap limiting robust recommendations for preventing unplanned ICU admissions associated with quality issues, including premature discharge, communication breakdown, system barriers, and or medication errors (Morgan et al., 2020; Nates et al., 2016; Niven et al., 2014; Ofoma et al., 2018; Ponzoni et al., 2017). There remain controversial discussions describing whether these factors are preventable, with continued discussions proposing optimal benchmarks. Thus, further analysis of unplanned ICU admissions can inform evidence-based practice changes to reduce unplanned ICU admissions and associated adverse outcomes.

In conclusion, there are significant strengths among the current literature that aim to reduce adverse events associated with unplanned ICU admissions. Validated clinical assessment tools and characteristics comprising predictive models can be used to identify patients with increased risk of unplanned ICU admissions and greater length of stay. In contrast, there are knowledge gaps relative to implementing evidence-based interventions to prevent or reduce unplanned ICU admissions. Specifically, a large portion of evidence is comprised of level III evidence with significant heterogeneity, limiting implications for clinical practice. Thus, there is substantial support for further research to improve the strength of evidence to inform clinical practice recommendations and quality improvement projects. There remains a significant opportunity to reduce adverse outcomes among adult trauma patients with unplanned ICU admissions. This supports the importance of further analyses to improve our ability to predict and prevent unplanned ICU admissions.

METHODS

Project Design

A retrospective descriptive analysis was performed to identify the number of patients with unplanned ICU admission and to identify the characteristics commonly associated with unplanned ICU admission. These characteristics included higher ISS, age greater than 65, low GCS, greater ICU length of stay, diagnosis of delirium, and ED dispositions. The findings of this study can help to inform evidence-based risk assessment strategies for reducing potentially preventable unplanned ICU admissions.

Setting

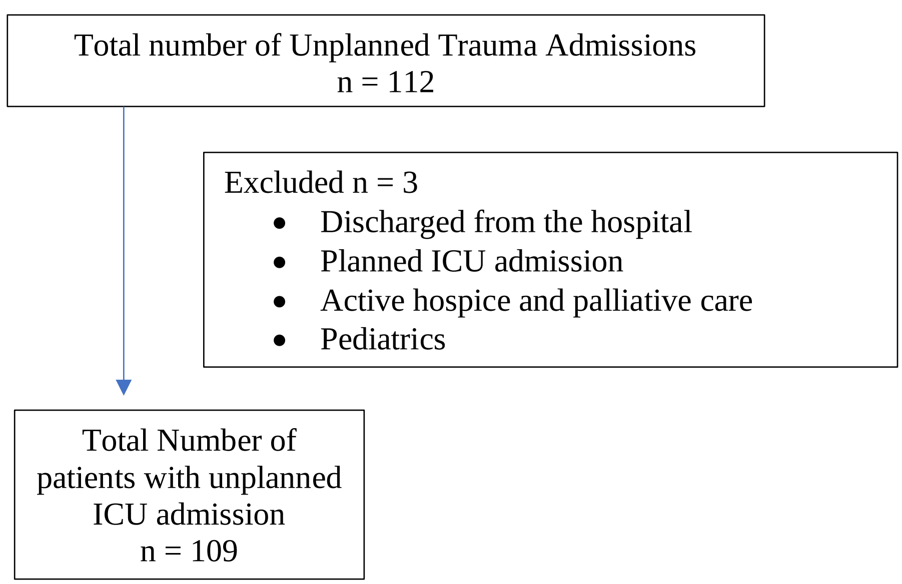
The data were collected from a large urban American College of Surgeons (ACS) certified academic level-one trauma center in Southern Arizona. This is a high-volume trauma center with reported more than 5,000 trauma activations annually (Arizona Department of Health Services, State Trauma Advisory Board 2020 Annual Report, 2020). This academic medical center is in Tucson, Arizona, within Pima County. It also serves Santa Cruz, Graham, and parts of Pinal County, including more than 1.7 million people. According to the 2020 Annual Report, trauma can affect any individual at any age, however statistically, there is a higher prevalence of trauma among people aged greater than 65 than younger adults and higher incidences of assault in males versus females (Arizona Department of Health Services, State Trauma Advisory Board 2020 Annual Report, 2020). Furthermore, in 2020, falls were responsible for an estimated 45% of traumas, with the second most common mechanism of trauma being motor vehicle accidents (19.88%) (Arizona Department of Health Services, State Trauma Advisory Board 2020 Annual Report, 2020). The trauma center has four specialty-specific adult ICUs, including medical, cardiovascular, neuro, and surgical trauma, totaling 91 critical care beds. The surgical trauma ICU is a 25-bed unit staffed with residents, fellows, attendings, clinical pharmacists, nurses, and allied health professionals.

Participants and Recruitment

Data from the NTDB trauma registry were used to perform retrospective analyses for this DNP project. Only adult and geriatric trauma patients with inpatient admission and unplanned ICU admissions or ICU readmissions within the same index hospitalization from August 1, 2019 – July 31, 2021, were selected for analysis. Patient exclusion criteria (Figure 3) included planned ICU admissions, ICU readmission not within the same index hospitalization, patients with active hospice or palliative care, and pediatrics.

Figure 3

Patient Selection



Consent and Ethical Considerations

This retrospective analysis did not involve direct interaction with human subjects. All patient data were de-identified to ensure adequate protection of privacy. Data analysis occurred after human subject protection approvals were received from the University of Arizona Institutional Review Board (IRB) through a data use agreement with the affiliated academic medical center. Data retrieval was performed in compliance with the above agreement. Specifically, all data extracted from the Cerner electronic medical record were de-identified to protect patients' privacy. The data were collected using the Trauma One v.21 ESO Lancet by a Trauma Quality and Data specialist and a unique case number was generated. and de-identified using the Safe Harbor method to eliminate the 18 unique Health Information Privacy Protection Act (HIPPA) identifiers. These identifiers included patient names, social security numbers, medical record numbers, account numbers, and any other unique identifying number, characters, or code. Variables extracted included the trauma activation, age of the patient on admission, GCS, ISS, pre-existing conditions, delirium, frailty, emergency department disposition, mean ICU length of stay, and mean ventilator days. Additionally, the partnership with the trauma quality improvement team will allow for the data to be compared to national averages within the American College of Surgeon's Trauma Quality Improvement Project (TQIP) database. The data were securely stored using a password-protected electronic drive owned by the Department of Surgery Division of Trauma, critical care, burns, and emergency surgery. In summary, a retrospective descriptive analysis, without interaction with human subjects, was performed upon receiving approvals from the affiliated medical center and University of Arizona IRB reviews.

Data Collection

A retrospective analysis was performed to describe characteristics among patients with unplanned ICU admissions at a large academic level one trauma center. The retrospective analysis was performed electronically, and only de-identified data were abstracted for analyses. The variables included the level of activation of the trauma team, age on admission, GCS, mean ISS, pre-existing conditions, delirium, frailty, emergency department disposition, mean ICU length of stay, and mean ventilator days. It is important to note that there may be a historical bias as data were collected during the COVID-19 pandemic.

Data Analysis

The data analysis was completed using Stata 16 following the acquisition of de-identified data. The incidence of unplanned ICU admissions was calculated by dividing the total number of trauma admissions by the total number of patients with unplanned ICU admissions. Continuous variables, including age, GCS, mean ICU length of stay, and mean ventilator days, were calculated using standard measures of central tendency (mean, median), and spread (standard deviation, range), and categorical variables in terms of absolute and relative frequencies (percentages). Standard measures of central tendency, including frequencies, were used to describe characteristics among unplanned ICU admissions (Table 4).

Table 4

Characteristics of Patients with Unplanned ICU Admissions

Variable Name	Type of Variable	
Trauma Activation • Red (life-threatening injuries or unstable) • Yellow (serious but stable) • Green (non-life-threatening) • Consult	Ordinal (Red, yellow, Green)	Frequencies and relative frequencies
Patient Demographics Age, the patient's age at the time of injury (best approximation)	Continuous	If skewed, minimum, Q1, median, Q3, maximum If normally distributed, mean and standard deviation Frequencies and relative frequencies
GCS • Standardized assessment evaluating the level of consciousness, a total of 15 points. A GCS of 3 is ominous (Eyes 1-4, Verbal 1- 5, Motor 1-6) whereas 15 is normal.	Ordinal	Frequencies and relative frequencies or Mode, median, min, and max
Emergency Department Disposition the transfer order was written by a physician	Categorical • general floor • observation • telemetry/step down • OR • ICU	Frequencies and relative frequencies (percentages)
Mortality • All-cause in-hospital mortality	Dichotomous (yes/no) • Lived or Died	Frequencies and relative frequencies
Mean ISS • The severity of injury localized to specific body regions ranges from 1 – 75. ISS >15 indicates multiple serious and or life-threatening injuries.	Ordinal • Minimum 1 • Max 75	Frequencies and relative frequencies or Mode, median, min, and max
Pre-existing conditions (Comorbidities)	Categorical • Advanced Directive limiting care (DNR) (yes/no) • Alcohol Use Disorder (yes/no) • Anticoagulant therapy (yes/no, excludes ASA) • ADD/ADHD (Yes/no) • CVA (yes/no) • COPD. (Yes/no) • Chronic renal failure (yes/no) • Cirrhosis (yes/no)	Frequencies and relative frequencies (percentages)

Table 4 – *Continued*

Variable Name	Type of Variable	
	• CHF (yes/no) • Current Smoker (yes/no) • Dementia (yes/no) • Diabetes Mellitus (yes/no) • Disseminated Cancer (yes/no) • Functional Dependent Health Status (yes/no) • Hypertension (yes/no) • Mental/Personality Disorders (yes/no) • Myocardial Infarction (yes/no) • Peripheral Artery Disease (yes/no) • Steroid use (Patients that require the regular administration of oral or parenteral corticosteroid medications within 30 days before the injury for a chronic medical condition) Substance abuse disorder (yes/no)	
Delirium Diagnosis of delirium	Dichotomous (yes/no)	Frequencies and relative frequencies (percentages)
Frailty	Dichotomous(yes/no)	Frequencies and relative frequencies (percentages)
Mortality Lived or Died	Dichotomous (yes/no)	Frequencies and relative frequencies
Mean ICU LOS Number of calendar days in ICU	Continuous	Minimum, Q1, median, Q3, maximum and or Mean and standard deviation
Mean Ventilator days Number of calendar days requiring mechanical ventilation	Continuous	Minimum, Q1, median, Q3, maximum and or Mean and standard deviation

RESULTS

There were 109 out of 5,713 adult trauma patients that had an unplanned ICU admission between August 1, 2019, to July 31, 2021, resulting in an incidence of 1.9%. A total of 24 patients died, resulting in a 22.92% mortality. The average hospital LOS was 18.5 days ± 18.4 *days (SD)* (Figure 4). There were differences in mean hospital LOS between and among several comorbidities, although further studies are needed to demonstrate whether this is statistically significant (Figure 5). Additionally, the median injury severity score (ISS) was representative of patients with life-threatening injuries (Median ISS of 15). There was also a statistically significant difference in the mean ISS among at least two of the ED disposition groups. In summary, age, comorbidities, and ISS are important characteristics to assess and consider when triaging trauma patients. In clinical practice, the efficacy of assessing patient characteristics that are described to be associated with adverse outcomes can help to prevent complications, including hospital-acquired events or exacerbations of chronic diseases.

Figure 4

Hospital and Intensive Care Unit (ICU) Length of Stay (LOS)

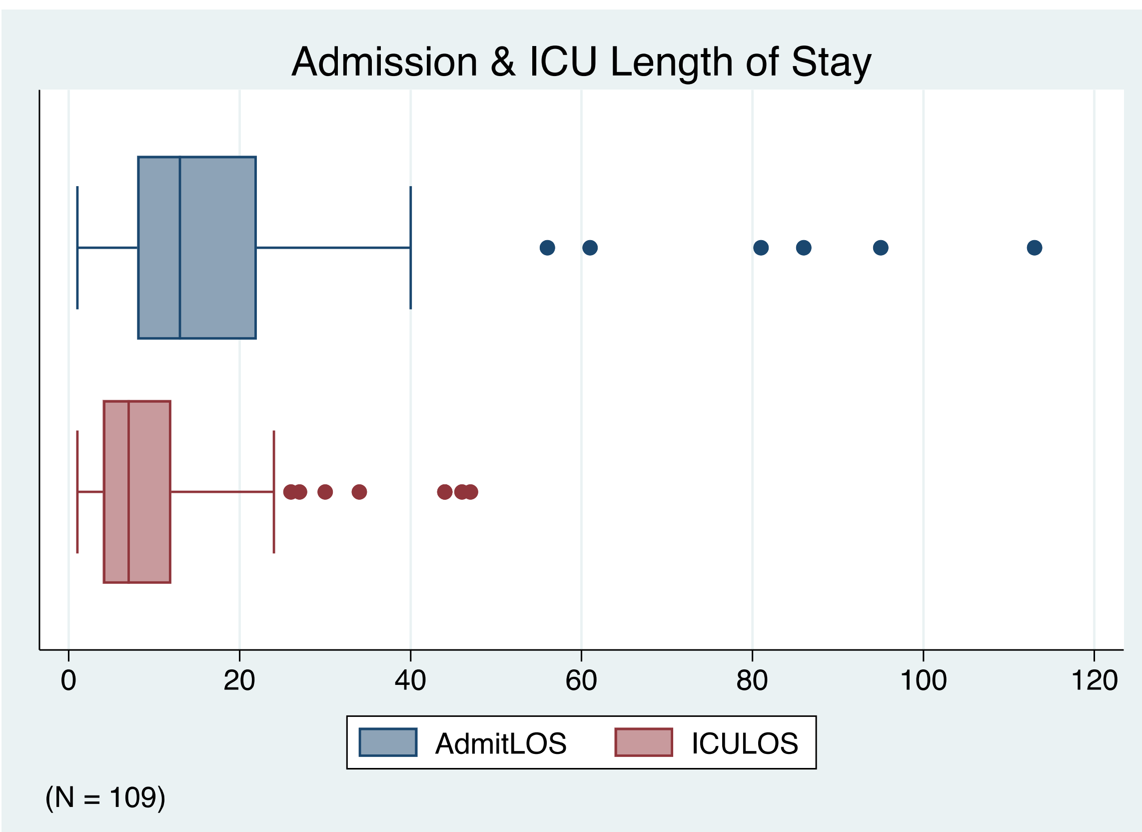
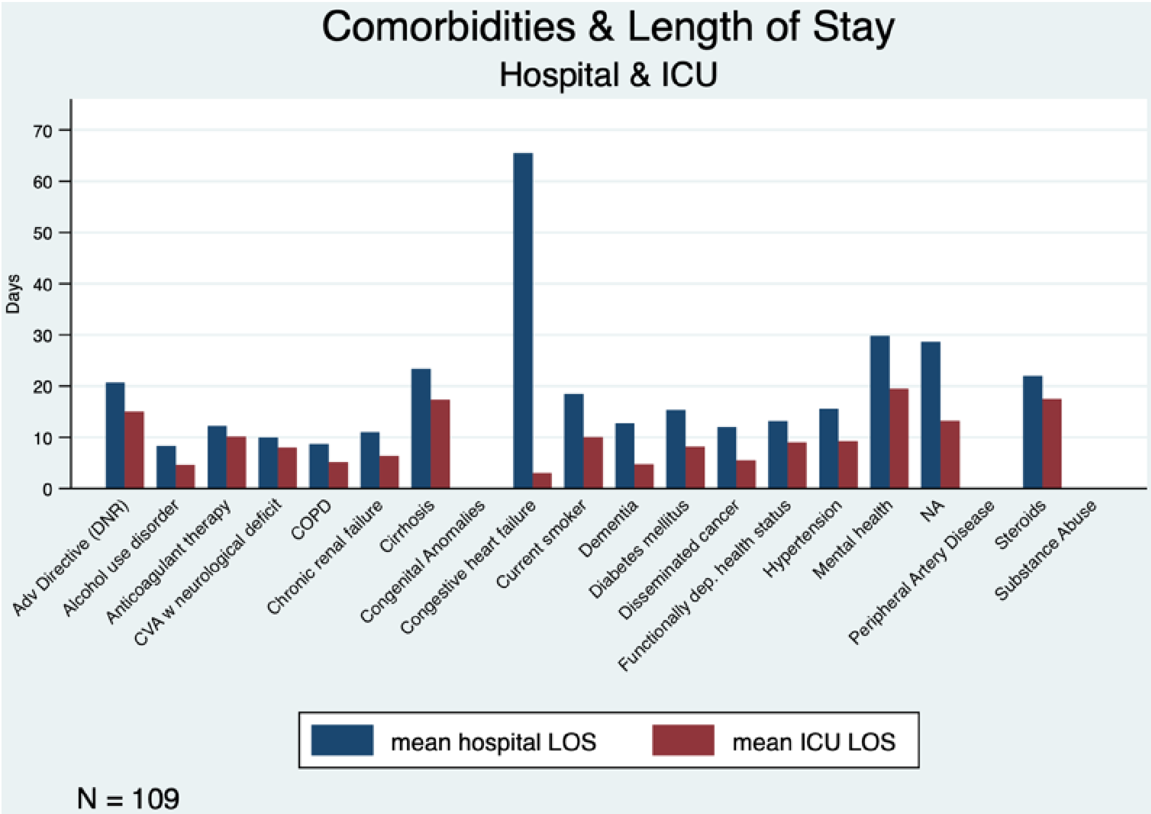


Figure 5

Hospital and ICU LOS and Comorbidities

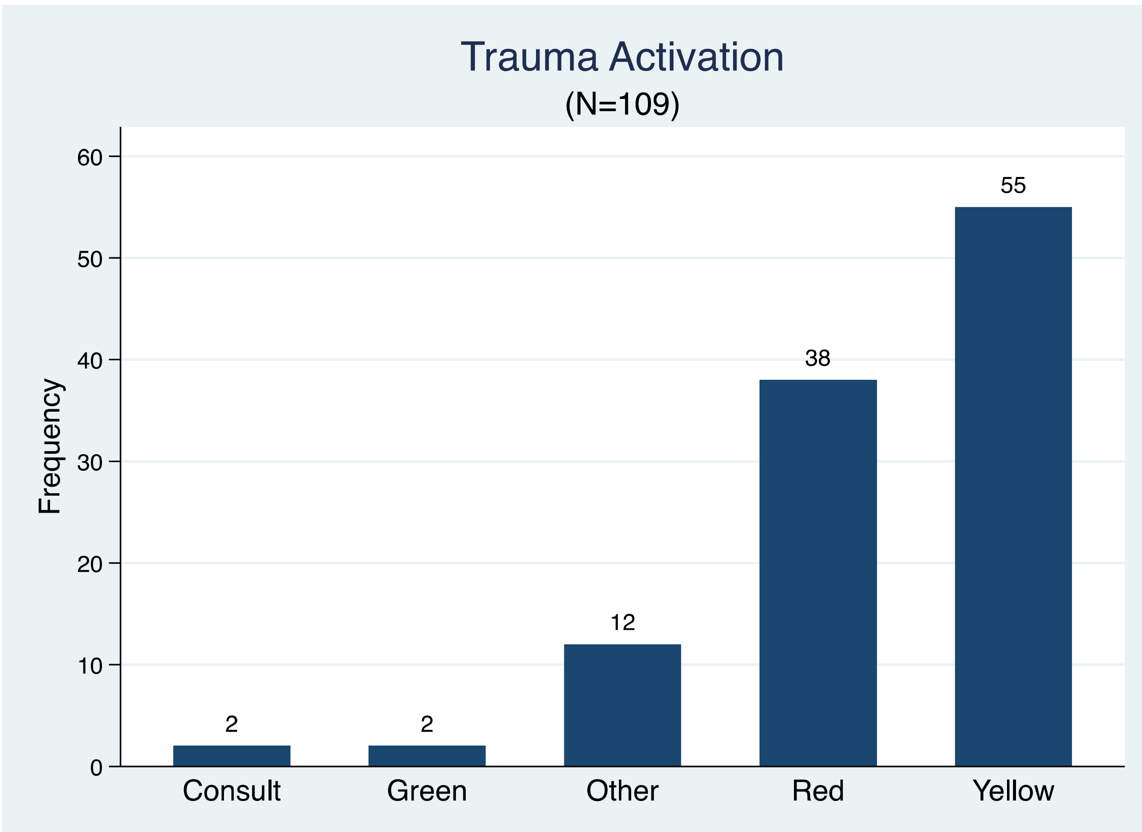


Trauma Activations

The Trauma activation objectively indicates the acuity and anticipated resources needed to provide adequate care and optimize outcomes among trauma patients. The majority of the trauma activations that occurred during the analysis period were yellow (n= 55; 51%) followed by red (n= 38; 35%) (Figure 6). A trauma yellow indicates that the patient is hemodynamically stable, whereas a trauma red indicates the patient is hemodynamically unstable or the trauma mechanism is associated with a high incidence of mortality.

Figure 6

Trauma Activation



ED Disposition

Among adult trauma patients with unplanned ICU admissions, there were 50 (45.9%) ED dispositions to the floor, 39 (35.8%) to the ICU, 16 (14.7%) to the OR, 3 (2.8%) to a progressive care unit, and 1 (0.9%) to observation unit (Figure 7). Additionally, the hospital LOS varied considerably among patients with unplanned ICU admissions based upon their ED disposition. A Kruskal Wallis test was performed which showed a statistical difference in the median hospital LOS among ED disposition groups (Chi-square 14.96, df 4, p-value 0.0048) (Figure 8).

Figure 7

ED Disposition and Length of Hospital Stay

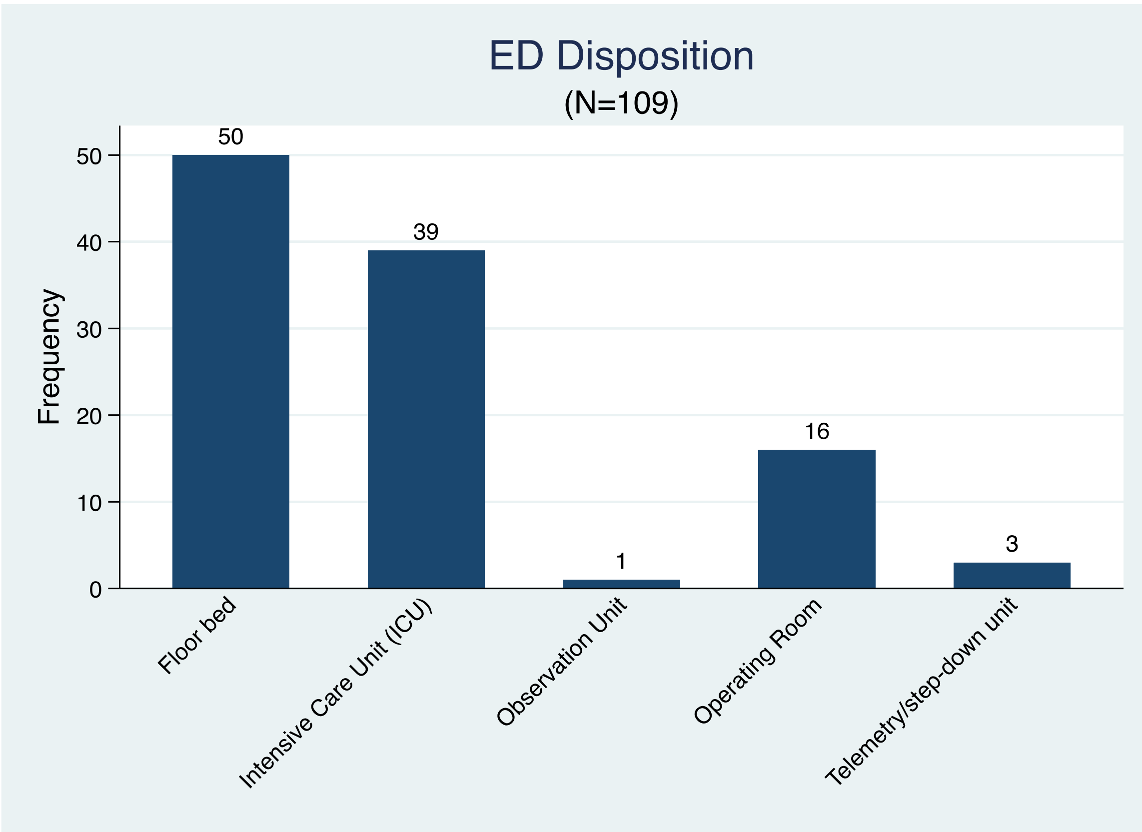
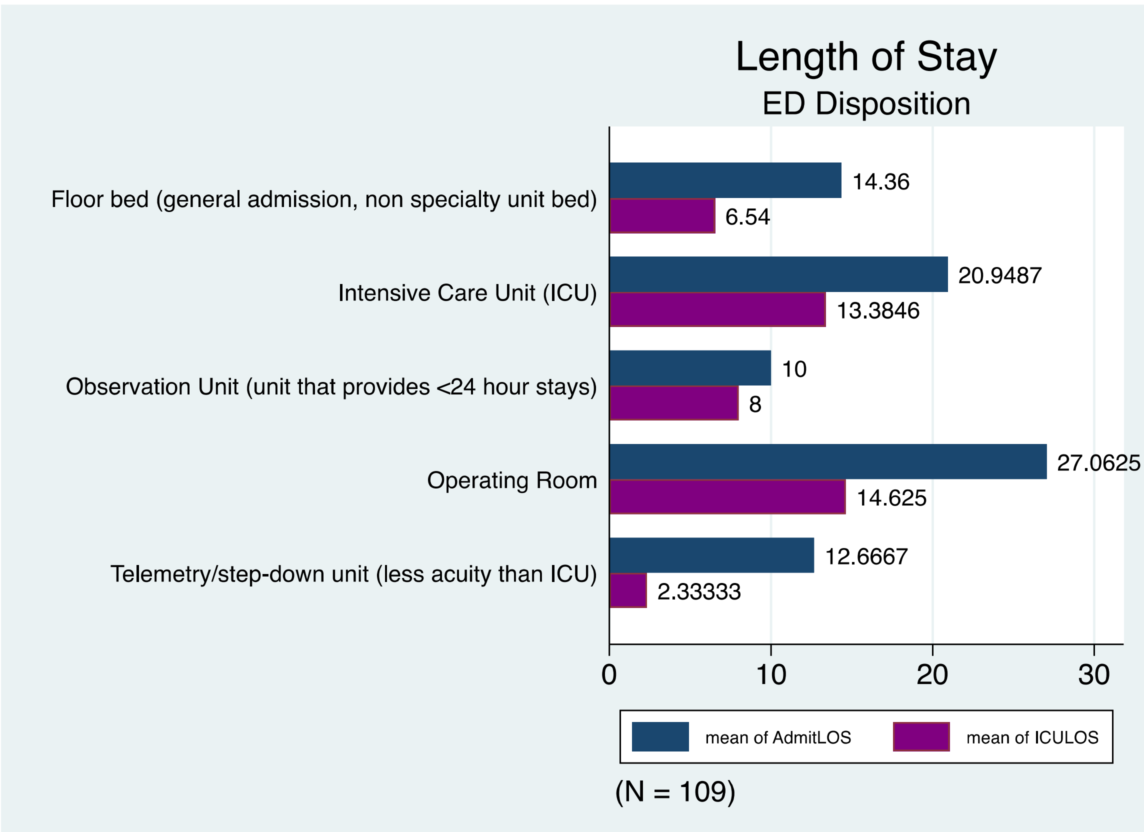


Figure 8

ED Disposition: Length of Stay



Age

The mean age of adult trauma patients with unplanned ICU admissions was 64 years ± *20.5 (SD)* (95% CI: 59.5 - 67.3). The minimum age was 18 and the max was 96. A more significant proportion of unplanned ICU admissions occurred among the geriatric population aged greater than 60 (Table 5). The data distribution for the age of patients with unplanned ICU admissions did not follow a normal distribution. Thus, the interquartile range provided a more accurate representation of the spread. The 25th percentile was 52 years, median 68 years, and seventy-fifth percentile was 77 years of age. Among patients with unplanned ICU admission, there was a greater number of geriatric patients that had pre-existing conditions (Figure 9).

Figure 9

Unplanned ICU Admissions by Age

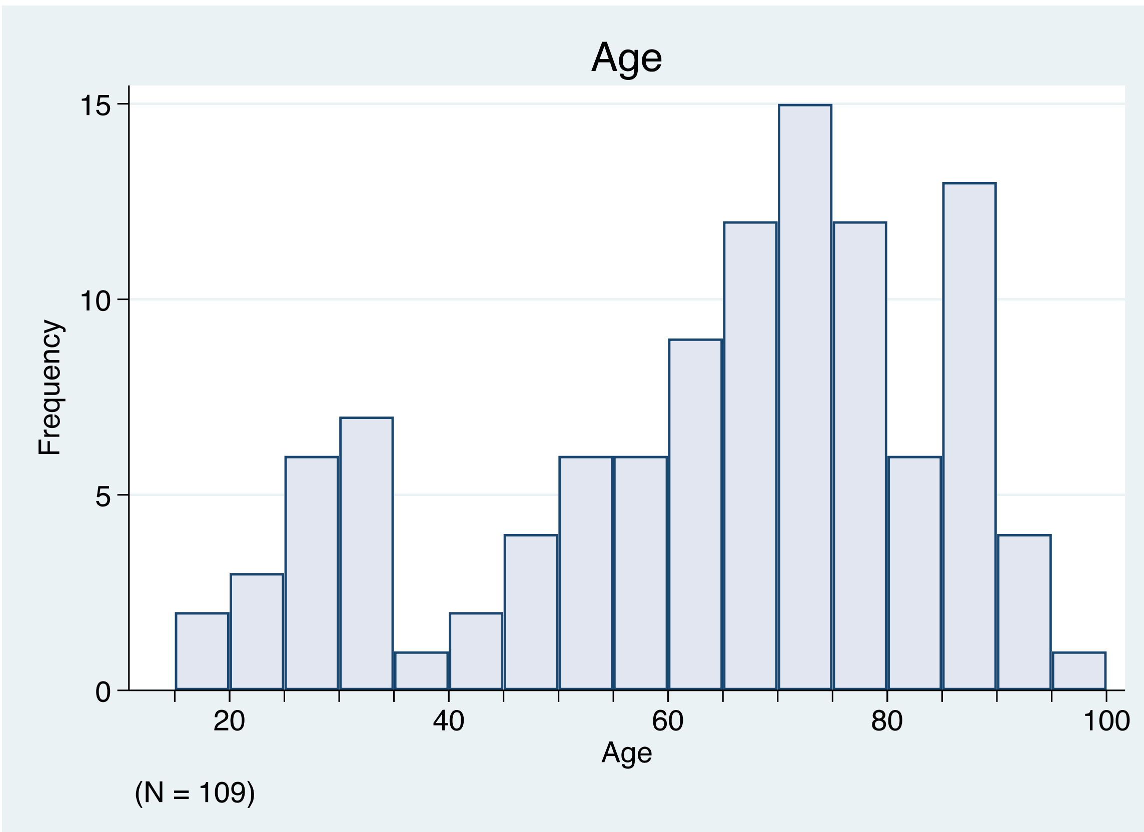


Table 5

Age

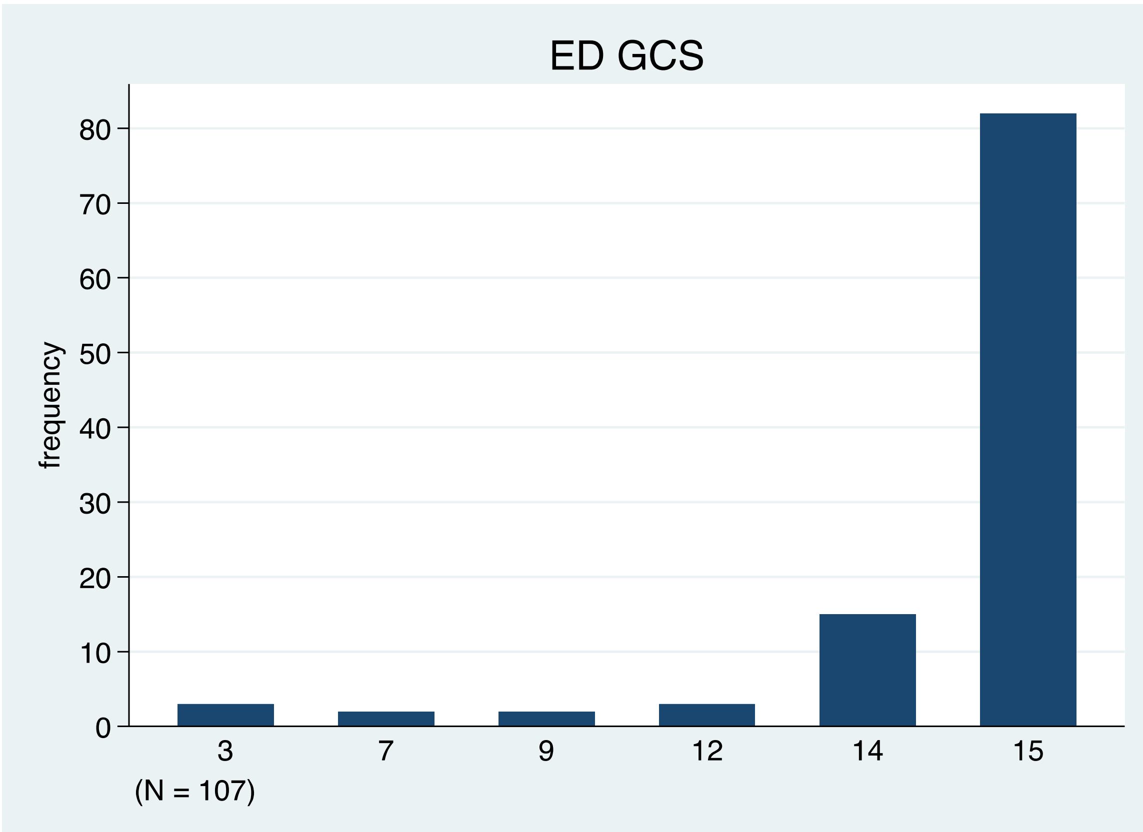
Age (years)	**N = 109 (%)**
18-29	11 (10.1%)
30-39	8 (7.3%)
40-49	6 (5.5%)
50-59	12 (11%)
60-69	21 (19.3%)
70-79	27 (24%)
80-89	19 (17.4%)
>89	7 (6.4%)

ED GCS

Of the 109 patients with unplanned ICU admissions, the GCS recorded in the ED were unavailable in two patients. The two missing values were replaced with non-numerical placeholders to prevent skewing of the data. The mean, median, and mode GCS of adult trauma patients with an unplanned ICU admission in the ED were 14, 15, and 15, respectively (Figure 10).

Figure 10

GCS Recorded in the ED



ISS

The mean ISS of adult trauma patients with unplanned ICU admissions was 14.5 $\pm$ *10.5 (SD)* (95% CI 14.5 – 16.5). The interquartile range for ISS included a lower limit of 5, median 15, an upper limit of 21. Given the unequal distribution of the median, the IQR is more reflective of the overall average ISS (Figure 11). To identify any difference in the median ISS among the ED Dispositions, a Kruskal Wallis Sign Rank test was performed as the distribution of the data is skewed. There was a statistically significant difference between at least two groups (chi square18.4, df 4, p = 0.001) (Figure 12). Although there was no relationship between the mean ISS and Age (Figure 13).

Figure 11

Injury Severity Score

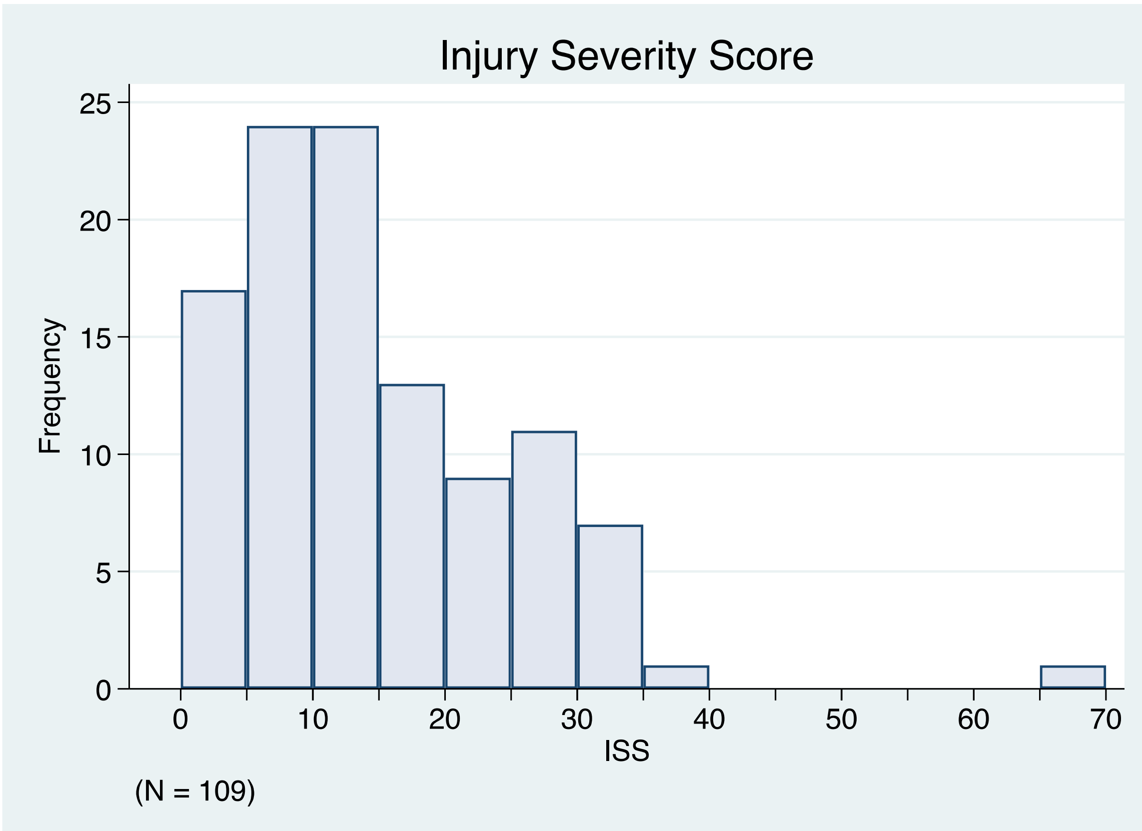


Figure 12

Injury Severity Score and Emergency Department Disposition

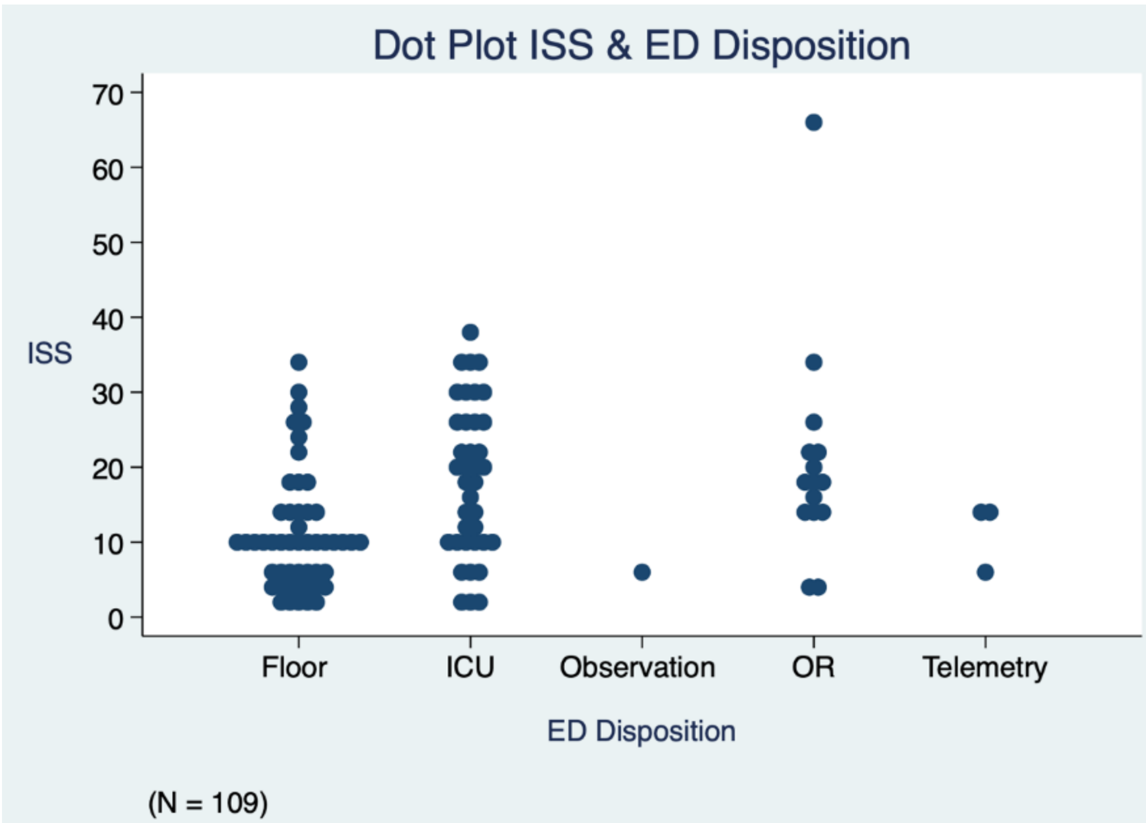
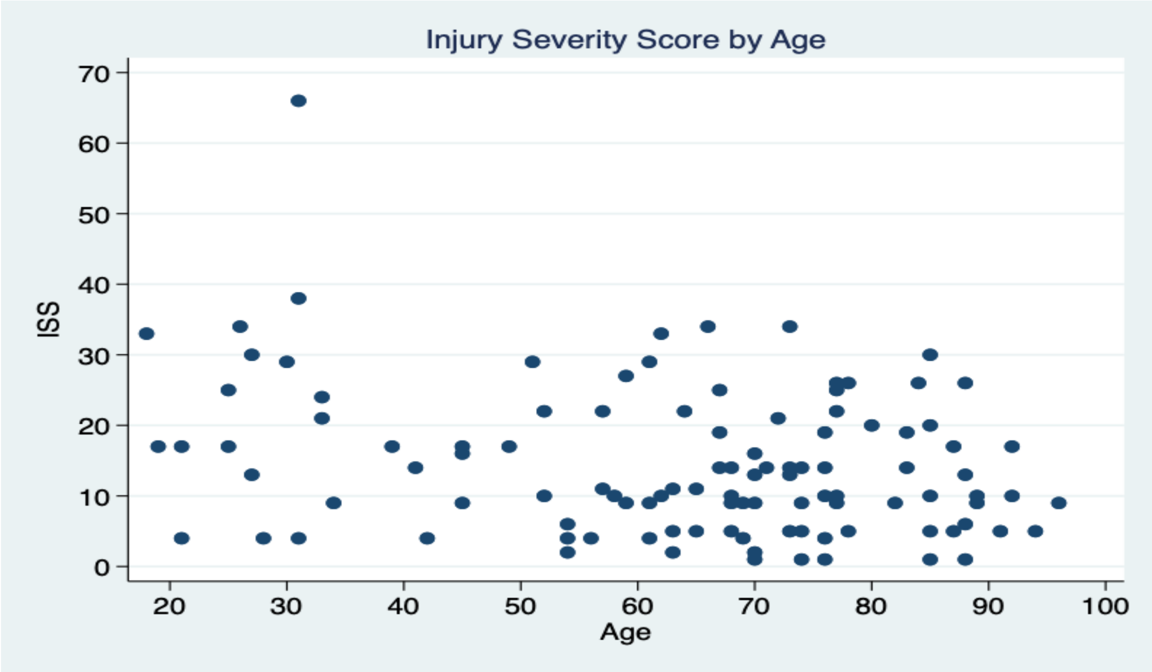


Figure 13

Injury Severity Score by Age



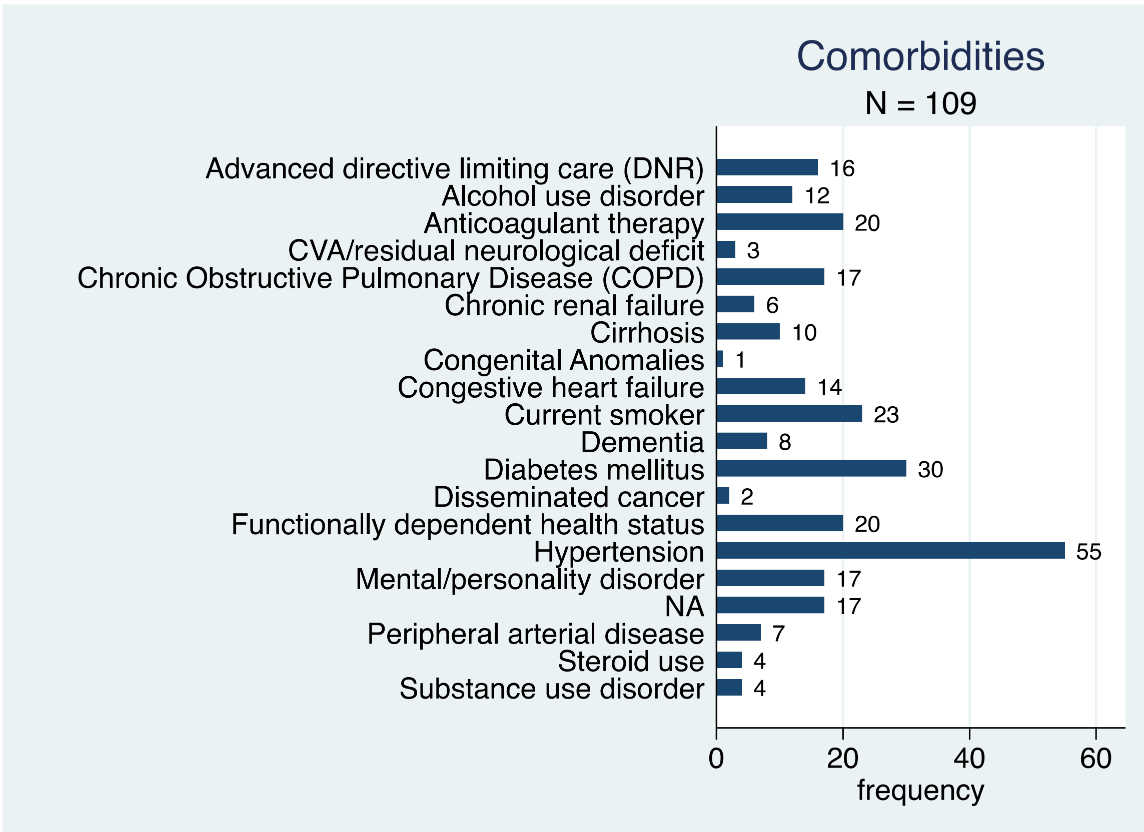
(There was no relationship between ISS and Age)

Comorbidities

Pre-existing conditions influence an individual's health status and can increase the risk of adverse outcomes in any population. The majority (n = 92, 84.4%) of patients had at least one pre-existing condition among patients with unplanned ICU admissions. Among patients with unplanned ICU admission, the average number of pre-existing conditions per individual was three. Most frequently reported comorbidities were hypertension (n=55, 51%%), diabetes (n=30, 27%%), current smoker (n=23; 21%), anticoagulation (n=20, 18%), and functional dependent health status (n=20; 18%) (Figure 14 & Table 6, 7).

Figure 14

Comorbidity Count



(Of the 109 adult trauma patients with unplanned ICU admission, 55 were previously diagnosed with Hypertension, 30 (28%) had Diabetes Mellitus, 23 (21%) were current smokers, 20 (18%) had a functionally dependent health status, and 20 (18%) were prescribed and on anticoagulation)

Table 6

Advanced Directive and Comorbidities

Comorbidities	N = 109 (%)
Advanced directive limiting care (DNR)	16 (14.7%)
Alcohol use disorder	12 (11%)
Anticoagulant therapy	20 (18.3%)
CVA/residual neurological deficit	3 (2.8%)
Chronic Obstructive Pulmonary Disease	17 (15.6%)
Chronic renal failure	6 (5.5%)
Cirrhosis	10 (9.2%)
Congenital Anomalies	1 (0.9%)
Congestive heart failure	14 (12.8%)
Current smoker	23 (21.1%)
Dementia	8 (7.3%)
Diabetes mellitus	30 (27.5%)
Disseminated cancer	2 (1.8%)
Functionally dependent health status	20 (18.3%)
Hypertension	55 (50.5%)
Mental/personality disorder	17 (15.6%)
None (NA)	17 (15.6%)
Peripheral Artery Disease	7 (6.4%)
Steroid use	4 (3.7%)
Substance Abuse Disorder	4 (3.7%)

Table 7

Summary of Descriptive Statistics

Trauma Activation	N = 109 (%)
Green	2 (1.83%)
Yellow	55 (50.5%)
Red	38 (34.9%)
Other	12 (11%)
Consults	2 (1.8%)

Table 7 – *Continued*

ED Disposition	**N = 109 (%)**
OR	16 (14.6%)
Floor	50 (45%)
ICU	39 (35.7%)
Observation Unit	1 (0.9%)
Progressive Care Unit	3 (2.7%)
Age	**N = 109 (%)**
18-29	11 (10.1%)
30-39	8 (7.3)
40-49	6 (5.5%)
50-59	12 (11%)
60-69	21 (19.3%)
Trauma Activation	**N = 109 (%)**
70-79	27 (24%)
80-89	19 (17.4%)
>89	7 (6.4%)
ED GCS	**N = 107 (%)**
3	3 (2.7%)
7	2 (1.8%)
9	2 (1.8%)
12	3 (2.8%)
14	15 (14%)
15	82 (76.6%)
ISS	**Mean (SD) (95% CI)**
ISS on admission	14.5 (10.5) 95% CI (12.45- 16.48)
Delirium	**N = 109**
Yes	4 (3.6%)
No	105 (96.3%)
Total Ventilator Days	**Mean (SD) (95% CI)**
Number of days ventilated	4.3 (7.1) (2.8 – 5.6)
ICU LOS	**Mean (SD) (95% CI)**
Number of days in ICU	18.5 (9.5) (15-22)

Table 7 – *Continued*

Mortality	N = 109 (%)
Lived	85 (77.9%)
Died	24 (22.92%)
Hospital LOS	**Mean (SD) (95% CI)**
Number of days admitted to the hospital	18.5 (18.4) (15- 22)

DISCUSSION

There was a greater incidence of unplanned ICU admissions among geriatrics with a median age of 68 years among patients with unplanned ICU admissions. This is consistent with the current literature identifying and describing the increased risk of adverse outcomes among geriatric trauma patients (Morgan et al., 2020; Mulvey et al., 2020; Prin & Li, 2016). In addition, among patients with unplanned ICU admissions, there were more unplanned transfers to the ICU (n=50, 51%) when compared to patients with ICU readmissions (n = 39, 35%). Further analyses aiming to identify whether unplanned transfers to ICU are associated with under triage vs hospital-acquired events may provide meaningful data to inform quality improvement.

The findings from this DNP project also showed that 80 % of unplanned ICU admissions occurred among patients with one or multiple comorbidities. This represents a potentially significant characteristic among adult trauma patients warranting further studies to identify whether the unplanned indication for ICU was related to exacerbations of pre-existing diseases vs. development of patient safety indicators. Moreover, this also further supports the need for studies analyzing the etiologies of unplanned ICU admissions. This is because there are often confounding variables such as hospital capacity, resource allocation, and adverse safety events that can concomitantly exist preceding an unplanned ICU admission. These findings are potentially significant and can inform further studies identifying characteristics predictive of unplanned transfers to ICU. This has the potential to provide meaningful implications in clinical practice for preventing adverse outcomes such as unplanned ICU admissions among adult trauma patients.

Characteristics of patients with adverse outcomes are essential to consider when triaging and managing trauma patients with complex and health conditions. Age, ISS, and Comorbidities are widely discussed across the literature regarding the development of adverse outcomes including unplanned ICU admissions, increased risk of in-hospital mortality, and greater LOS. The findings of this analysis suggest there is a significant opportunity to prevent hospital-acquired events and reduce exacerbations of chronic diseases to improve patient outcomes and quality of care. Age, ISS, and pre-existing conditions are important characteristics to evaluate and consider collectively when triaging and managing adult trauma patients to ensure the highest quality of patient-centered, safe, and effective evidence-based care. In summary, there exists a significant opportunity to improve outcomes among geriatric trauma patients by identifying characteristics that may increase the risk for complications, including hospital-acquired events or exacerbations of chronic diseases.

Trauma Activation

Trauma Activation is not intended or currently used to determine the ED Disposition. This is because it is based on pre-hospital data, which, although is important, does not accurately correlate with the level of care a patient may require. However, there was a greater number of trauma yellow activations among patients with unplanned ICU admissions when compared to reds. This analysis can only describe this trend as a control group would be needed to determine if this is statistically significant or occurring by chance alone. Further studies powered and designed to identify a statistically significant association among patients based upon meaningful characteristics including age, frailty index, and ISS collectively can provide meaningful data for improving triage processes.

ED Disposition

ED disposition provides important information regarding the level of care a patient receives when admitted to the hospital. The ED disposition is determined upon anticipated needs, measures of acuity, and influenced by individual, organizational resource constraints. Trauma patients with life-threatening injuries who are hemodynamically unstable often are dispositioned from the ED to the operating room or ICU. In contrast, hemodynamically stable trauma patients requiring less intensive therapies or monitoring are often dispositioned to the general floor or step-down unit. Among patients with unplanned ICU admissions, there was a greater number of ED dispositions to the floor (n=50) when compared to the ICU (n = 39). This equates to a greater number of unplanned ICU transfers vs. ICU readmissions. Since unplanned ICU admissions measure unplanned transfers to the ICU and ICU bounce backs, there is value in identifying whether a greater incidence of unplanned ICU admissions is patients with or without previous ICU admissions during their hospitalization.

Age

In this analysis, there was a significantly greater proportion of unplanned ICU admissions among older adults. This is consistent with larger studies describing an increased risk of unplanned ICU admissions among geriatric adults (Mulvey et al., 2020). Regarding patient characteristics to inform predictive models, age is consistently associated with higher incidences of adverse outcomes and in-hospital mortality (Lopes et al., 2020; Morgan et al., 2020; Mulvey et al., 2020; Prin et al., 2016; Rosa et al., 2015). This analysis is consistent with larger studies as a majority of patients with unplanned ICU admissions were geriatric (Morgan et al., 2020; Mulvey et al., 2020; Prin et al., 2016). In summary, most patients with unplanned ICU admissions were geriatric, suggesting there is an opportunity to reduce adverse events among this vulnerable and ever-growing population. Further analyses are needed to identify whether this risk factor alone or collectively with other characteristics is sensitive and specific enough to predict unplanned ICU admissions.

ED GCS

GCS is an ordinal scale used to measure an individual's level of consciousness with a minimum of 3 and a maximum score of 15. A significant body of evidence demonstrates statistically significant associations in adverse outcomes and increased mortality among trauma patients with low GCS scores on ED arrival (Khan et al., 2017; Morgan et al., 2020). An ED GCS (<8) is associated among patients with unplanned ICU admissions. In this analysis, the median ED GCS was 15. There may be several reasons the average GCS was higher in this analysis when compared to other studies. First, there may have been disproportionately fewer patients with traumatic brain injuries or altered mental status on admission. Secondly, many studies report the most recent GCS when analyzing an association between GCS and risk of adverse events such as unplanned ICU admission. In prospective analyses, the review of the most recent GCS or GCS upon admission to ICU may be more closely associated with unplanned ICU admissions.

ISS

An ISS greater than 15 is significant for severe and potentially life-threatening injuries. The ISS is used as an assessment tool to identify patients at greater risk of mortality and is widely used in trauma (Hagiwara et al., 2014; Morgan et al., 2020; Mulvey et al., 2020). The median ISS was 15, which is significant and consistent with potentially life-threatening injuries. It is interpreted that the higher ISS represents a higher acuity among patients with unplanned ICU admissions. This may represent a significant finding as more patients were triaged from the ED to the general floor (n = 50) compared to a progressive care unit (n = 3). There was a statistically significant difference in mean ISS among patients with ED dispositions. This supports the accuracy of using the ISS to help objectively report acuity, which is important when triaging patients.

Comorbidities

In addition to age, 84.4% of patients with an unplanned ICU admission had the presence of at least one pre-existing condition. Comorbidities and health-related conditions can increase the risk for adverse outcomes among trauma patients and lead to a greater length of stay (Mulvey et al., 2020). Thus, preventing exacerbation of chronic diseases is essential among geriatric trauma patients to prevent unplanned transfers to ICU. Further studies identifying whether these adverse outcomes are related to exacerbations of their chronic health conditions or secondary to the development of unintended complications such as VTE/DVT can be meaningful. Additionally, further studies are needed to analyze whether specific comorbidities are predictive of adverse outcomes. This can improve the quality of care and patient outcomes among trauma patients with multiple chronic diseases to reduce the length of stay, excess health care costs, and in-hospital mortality.

Delirium

Although discussed across the literature to be associated with unplanned ICU admissions, delirium was only reported in 4 out of 109 patients (3.6%). This could be due to under-reporting or insufficient documentation indicating a patient had or was being treated for delirium. However, the incidence of delirium could also be low due to the current measures to prevent delirium. These include early mobility, minimizing benzodiazepines, and geriatrics consult to eliminate polypharmacy.

In summary, this retrospective analysis identified important characteristics, including age, ED deposition, and comorbidities (pre-existing conditions) among adult trauma patients with unplanned ICU admissions. The findings of this analysis provide essential data that will lead to further studies aiming to optimize triage and discharge practices to prevent unplanned ICU admissions. Additionally, the opportunity to analyze the efficacy of collectively using age, ISS, comorbidities, and frailty to predict unplanned ICU admissions can potentially have significant implications for clinical practice. To conclude, essential characteristics should be considered when triaging and preventing adverse outcomes among adult trauma patients. However, further analyses are necessary to identify characteristics predictive of unplanned ICU admissions.

Limitation of this DNP Project

There are several limitations of this retrospective analysis. The methodology and design limit this analysis to describing characteristics among patients with unplanned ICU admissions. There remains a further need to identify statistically significant associations to better identify and predict adverse events such as unplanned ICU admissions. In addition, and beyond this project's scope was the inability to control for confounding variables that can precipitate unplanned ICU admissions, such as patient safety indicators, quality and safety events, critical staffing limitations, increased hospital capacity, and resource constraints. Furthermore, the variable frailty was unable to be analyzed due to insufficient data and time limiting the possibility of chart review. The potential to analyze frailty in addition to age, ISS, and comorbidities can provide meaningful data to inform improvements in triaging and managing geriatric trauma patients.

The COVID-19 pandemic has significantly influenced the number of hospital beds available and has stretched ancillary staffing ratios. The time a patient waits to be admitted to the appropriate level of care based on trauma acuity can influence the length of stay and unplanned ICU admissions; however, it is not captured in this retrospective analysis. The COVID-19 pandemic also creates a historical bias and influences standard procedures and processes available for trauma care; thus, it is a significant limitation of this analysis.

DNP Essentials Addressed

The DNP essentials outlined by the AACN are essential competencies distinguishing the skills of doctoral nurse practitioners and are foundational to their practice and role (American Association of Colleges of Nursing [AACN], 2006). This DNP project addresses several of the DNP essentials. First, this project incorporates Lewin's change theory to identify opportunities as well as navigate possible barriers in which can influence health outcomes and delivery of health care. This addresses DNP Essential I, Scientific Underpinnings for Practice. Secondly, this project discusses organizational and systems leadership and promotes quality improvement by reducing adverse events while fostering clinical excellence. For example, the cultural shift discussed is an example of the active commitment needed to identify and implement sustainable and continuous improvement (AACN, 2006). Additionally, as the aging population continues to increase there are increasing demands for critical care services. This project recognizes the value in and identifies the need to improve patient outcomes and quality of care among geriatric trauma patients.

DNP essential III, clinical scholarship, and analytical methods for evidence-based practice align with the purpose of this DNP project (AACN, 2006). This qualification is foundational to the success of all DNP advanced practice nurses regardless of subspeciality and is important for improving health outcomes, patient safety, and quality of care. The opportunity to reduce unplanned ICU admissions was identified based on knowledge gaps discussed and synthesized from existing literature. A retrospective descriptive analysis was performed to identify characteristics among patients with unplanned ICU admissions. The findings of this analysis Have identified possible opportunities to improve triage and discharge practices for adult trauma patients. The findings have been turned over to the trauma quality improvement team, and a study designed and powered to identify if under triaging is associated with unplanned ICU transfers.

DNP essential VI, improving interprofessional for improving patient and population health outcomes is a qualification demonstrated by the collaborations required for this project to occur. As healthcare becomes more complex multidisciplinary collaboration is essential for reducing adverse events and promoting quality healthcare that is patient-centered, safe, effective, timely, and equitable. This project demonstrates the importance of collaboration for improving health outcomes and facilitating a just culture that cultivates continuous improvement. Finally, this analysis describes characteristics among adults with unplanned ICU admissions addressing the knowledge gaps relative to reducing this adverse event. The overall aim of this analysis is to reduce adverse outcomes associated with unplanned ICU admissions which proportionally affect geriatrics.

Implications for Clinical Practice

This retrospective analysis describes important characteristics of patients with unplanned ICU admissions among adult trauma patients. The findings of this analysis are key for planning prospective quality improvement projects and needed to inform further analyses to identify feasible and effective practice considerations to prevent unplanned ICU admissions, reduce LOS and in-hospital mortality. The results of this analysis are limited to describing characteristics among adult trauma patients with unplanned ICU admissions. This analysis found a greater number of the patients with unplanned ICU admissions were geriatric adults and adults with multiple comorbidities. The opportunity to reduce adverse outcomes among this population can optimize patient outcomes and reduce LOS. Additionally, further retrospective analyses improving the strength of evidence and the ability to predict specific characteristics predictive of unplanned ICU admissions can lead to reduced adverse outcomes.

In trauma, prevention is the single most effective way to reduce mortality, and the same applies to preventing hospital-acquired events such as unplanned ICU admissions. Identifying and analyzing the characteristics representative of patients with unplanned ICU admissions has identified the opportunity to improve patient outcomes and quality of care among geriatric trauma patients. Furthermore, the prioritization of an interdisciplinary team engaged in optimizing geriatric trauma care can improve quality of care, patient outcomes, and throughput, which is key for preventing hospital-acquired events and complications. There will need to support from all stakeholders as discussed previously with a commitment for ensuring effective staffing models, resource allocation, and continued trending of quality metrics to evaluate for improvement.

CONCLUSION

The opportunity to reduce adverse outcomes among geriatric adult trauma patients can optimize patient outcomes and reduce LOS. Additionally, further retrospective analyses improving the strength of evidence and our ability to predict specific characteristics predictive of unplanned ICU admissions can lead to reduced adverse outcomes. Thus, considering important characteristics that can increase a patient's risk for adverse outcomes may help to prevent adverse outcomes including unanticipated ICU admissions and reduce LOS. In trauma, prevention is the single most effective way to reduce mortality, and this is the same for preventing hospital-acquired events such as unplanned ICU admissions. Thus, ensuring care is evidenced based, patient-centered, safe, effective, and timely will help to prevent complications, improve throughput, and reduce the number of days hospitalized.

APPENDIX A:

LITERATURE GRID

Author (Year)	Title	Purpose	Major Findings	
Al-Jaghbeer et al., 2016	Incidence and Etiology of Potentially Preventable ICU Redamissions	Identify if the majority of ICU readmissions are preventable or nonpreventable	There were more non-preventable ICU readmissions when compared to preventable. 11.8% were preventable whereas 88.2% were non-preventable. K statisitc to assess concordance.	There remains opportunitiy to prevent ICU readmissions. Findings suggest that ICU readmissions may not be an accurate measure of quality or hospital performance.
Alarhayem et al., 2019	Application of electronic medical record-derived analytics in critical care: Rothman Index predicts mortality and readmissions in surgical intensive care unit patients	Asses the the validity of using the Rothman Index to predict Surgical ICU readmissions and mortality.	A lower RI score was predictive of SICU readmission within 48 hours of transfer and these patients also exhibited greater LOS.	Increased mortality and LOS were associated with SICU readmissions. Lower RI scores were associated with SICU readmission. Further multicenter studies are needed to improve the strength of evidence informing clinical practice recommendations.
Bradburn et al., 2020	An analysis of outcomes and predictors of intensive care unit bouncebacks in a mature trauma system	Determine the effect of unplanned ICU admission/readmission on mortality. Identify variables predictive of this population.	Increased mortality (70%) was associated among patients with unplanned ICU admissions (ICU BB). Respiratory compromise is the primary ICU indication Predictive variables reported were sepsis, unplanned intubation, and pulmonary embolus.	Trauma patients with unplanned ICU admission/ICU BB are associated with adverse outcomes including increased mortality risk.

Author (Year)	Title	Purpose	Major Findings	
Fakhry et al., 2014	ICU BB in Trauma Patients	Review ICU BB and identify variables that may predict an unplanned return to ICU.	4.5 % BB Mean Age 52.9 ISS 23 Mortality rate 19.3%	Predictors of ICU BB were GCS <9, presence of comorbidity, or multiple. Supports analyzing GCS and comorbidities.
Gajic et al., 2008	Stability and Workload Index for Transfer score predicts unplanned intensive care unit patient readmission: initial development and validation	Develop and validate a numerical index predicting ICU readmission	SWIFT score with AURC of 0.70 when compared to APACHE Score 0.62 Calculates a risk index score based upon ED Disposition, GCS day of discharge from ICU, respiratory requirements	SWIFT score outperformed APACHE in a medical ICU and mixed medical-surgical ICU. Further studies are needed to validate the utility and efficacy of this risk assessment index.
Gotur et al., 2020	Analysis of Rothman Index Data to Predict Post discharge Adverse Events in a Medical Intensive Care Unit	Analyze whether the RI could predict adverse outcomes among patients within 72 hours of ICU discharge	Among medical ICU patients a RI >50 was associated with lower odds of adverse event (72%; (OR = 0.2887, 95% CI = 0.1278-0.6517 and $P = .003$)	There may be utility in using RI or characteristics of RI to assess risk for adverse outcomes.
Hamidi et al., 2019	Prospective evaluation and comparison of the predictive ability of different frailty scores to predict outcomes in geriatric trauma patients	Compare predictability of the frailty scores to predict adverse events, mortality, discharge disposition, and 30-day readmissions among trauma patients.	TSFI and RFS out performed the mFI and FS for predicting outcomes. TSFI and RFS an unadjusted C-statistic indicated strong predictability among all outcomes	A universal Frailty index score can help to predict adverse outcomes among geriatric trauma patients. Supports the evidence for using frailty scores in clinical practice. There remains further opportunity to prevent adverse outcomes by using frailty scores among geriatric trauma patients.
Hammer, et al., 2020	A Tool to Predict readmission to the Intensive Care Unit in Surgical Critical Care Patients—The RISC Score			

Author (Year)	Title	Purpose	Major Findings	
Hosein, et al., 2014	A meta-analysis to derive literature-based benchmarks for readmission and hospital mortality after patient discharge from intensive care	Identify literature-based estimates of ICU readmission and mortality incidence	58 articles reviewed 46 reporting ICU readmission 49 reporting hospital mortality 4 -6 patients out of every 100 patients discharged from ICU will be readmitted to the ICU 3- 7 out of 100 patients discharged will die before hospital discharge.	There remains an unacceptable incidence of adverse outcomes post ICU discharge. These findings help to inform benchmarks for preventing and reducing mortality post ICU discharge and ICU readmissions.
Kramer et al., 2012, 2013	Intensive care unit readmissions in U.S. hospitals: Patient characteristics, risk factors, and outcomes The association between ICU readmission rate and patient outcomes.	Assess patient characteristics associated with increased risk for unplanned ICU admission and in-hospital mortality. Analyze outcomes of patients with the unplanned return to ICU	Multicenter retrospective analysis (97 ICU's, 35 hospitals) There was an increased risk of mortality among patients with ICU readmissions. Statistically significant risk factors included location before ICU admission, Age, comorbidities, diagnosis, ICU LOS, physiologic abnormalities 6.3% incidence of ICU readmission ~ 20% in-hospital mortality Greater LOS	Increased severity of illness is associated with a greater risk of adverse outcomes including ICU readmission, in-hospital mortality, and greater LOS. The severity of illness and risk factors should be collectively considered when training and discharging patients. There remains a significant opportunity to prevent adverse outcomes among all sub-specialty ICU patients with unplanned ICU admissions.
Khan et al., 2017	The impact of Glasgow Coma Scale-age prognosis score on geriatric traumatic brain injury outcomes	Predicting the prognosis of TBI among geriatric trauma patients	8750 geriatric trauma patients mean age of 77.8 (±7.1y). A linear correlation was seen between the GAP score and adverse outcomes. As the GAP score increased the mortality rate and unfavorable discharge disposition increased (SNF).	GAP score greater than 12 was associated with in-hospital mortality anand unfavorable discharge disposition. Predicting prognosis helps providers anticipate and prevent adverse outcomes among geriatric trauma patients. This is significant as this can

Author (Year)	Title	Purpose	Major Findings	
				help providers start early goals of care discussions with families related to prognosis.
Lee et al., 2015	Efficacy of the APACHE II scores at ICU discharge in predicting post-ICU mortality and ICU readmission in critically ill surgical patients	Evaluated the efficacy of predicting adverse outcomes -post-ICU discharge from an SICU.	APACHE II score was more accurate in predicting mortality than unplanned ICU readmission (AURC 0.63 and 0.60 respectively).	There remains further studies are needed to identify and evaluate predictive risk factors associated with adverse outcomes post ICU discharge.
Lin et al., 2018	The outcomes and prognostic factors of the patients with unplanned intensive care unit readmissions	Retrospective analysis of outcomes among patients with unplanned ICU admissions.	Increased mortality was associated among patients with unplanned ICU admissions and increased APACHE II scores.	Supports the increased mortality risk among patients with unplanned ICU admissions. Further studies are needed to evaluate predictive factors associated with adverse outcomes.
Markazi-Moghaddam et al., 2020	Risk prediction models for intensive care unit readmission: A systematic review of methodology and applicability.	Systematic Review of risk prediction models for ICU readmission	Significant heterogeneity among the models and articles limits the recommendation and efficiency in clinical practice. None of the reported prediction models are externally validated.	The recommendations for using predictive models are limited due to significant heterogeneity and lack of external validity. Further investigation for preventing adverse outcomes among populations at risk for unplanned ICU admissions remains important.
Martin et al., 2019	Predicting ICU readmission among surgical ICU patients: Development and validation of a clinical nomogram	Analyze risk factors predictive of adverse outcomes among surgical, trauma, transplant, and vascular patients.	Variables predictive of unplanned return to ICU were age BUN, serum chloride, glucose, atrial fibrillation, renal insufficiency, and respiratory rate. AURC reported was 0.71.	There may be utility and efficacy in identifying risk factors predictive of adverse outcomes. Further studies are needed to validate the predictability among larger populations.

Author (Year)	Title	Purpose	Major Findings	
Morgan et al., 2020	A Comprehensive Review of the Outcome for Patients Readmitted to the ICU Following Trauma and Strategies to Decrease Readmission Rates.	highlight the outcomes of patients readmitted to the ICU and provide an overview of possible strategies to aid in decreasing ICU readmission rates	Increased in-hospital mortality, greater LOS, and increased healthcare costs (17 billion) are associated with unplanned ICU admissions. Variables increasing the risk of unplanned ICU admission include GCS<9, >ICU LOS, hemorrhage, TBI, rib fractures, pulmonary contusions. Age and respiratory complications are the primary indications for ICU readmission.	Extreme variability in readmission and mortality ranges is secondary to a lack of a universal definition of ICU readmission. This limits the ability to recommend one single evidence-based approach for preventing this adverse outcome.
Mulvey et al., 2020	Unplanned ICU Admission Is Associated With Worse Clinical Outcomes in Geriatric Trauma Patients	Identify the rate, impact, and predictive factors of patients with unplanned ICU admissions.	Unplanned ICU admission primarily seocndary to respiratory (34.7%) and cardiovascular (22.1%) indications. Patients were older, had higher ISS, and comorbidities. Age and ISS were predictive of unplanned ICU admission.	Patient characteristics including Age and ISS are predictive of unplanned ICU admission among geriatric trauma patients.
Nates et al., 2016	ICU Admission, Discharge, and Triage Guidelines: A Framework to Enhance Clinical Operations, Development of Institutional Policies, and Further Research	Update to the SCCM guidelines for ICU admission, discharge, and triage providing a framework for clinical practice and further research.	Some undertraining is more acceptable than under triaging (grade 2C). Deciding to admit elderly (>80 yr) to the ICU based on comorbidities, the severity of illness, and not chronicle chronological age (grade 2C).	Support the need for further research to prevent adverse outcomes during the admission and discharge process of ICU patients. Further studies are needed to inform clinical practice recommendations for informing admission, triage, and discharge to and post ICU.

Author (Year)	Title	Purpose	Major Findings	
			Reduce ED boarding and housing patients in non-specialty ICU (grade 2C). Patients with a high risk for mortality and readmission (high severity of illness, multiple comorbidities, physiologic instability, and ongoing organ support) should discharge to a step-down unit or LTACH as opposed to the regular ward (grade 2C). Further research is needed to develop and validate predictive models (e.g., mortality and ICU readmission). Further studies for reducing rates of readmission to the ICU, evaluating staffing models, and optimizing handoff processes.	
Niven et al., 2014	Critical care transition programs and the risk of readmission or death after discharge from an ICU: a systematic review and meta-analysis.	Evaluate if critical care transition programs reduce the risk of ICU readmission or in-hospital mortality	SR and Meta-Analysis Face validity of critical care transition programs appear to decrease adverse outcomes post ICU discharge Limited clinical practice recommendations given level of evidence informing SR (methodology).	Further research analyzing cost-effectiveness and efficacy of critical care transition programs is needed. Additionally, the efficacy of preventing unplanned ICU admission is needed.

Author (Year)	Title	Purpose	Major Findings	
Prin et al., 2016	Complications and in-hospital mortality in trauma patients treated in intensive care units in the United States, 2013	Describes the annual incidence of trauma patients requiring ICU admission and analyzes risk factors of hospital complications and mortality.	In 2013 there 1.3 million trauma patients were admitted to ICU among Level 1 and Level 2 trauma centers. Nearly 25% of these patients developed hospital-acquired complications including pneumonia, UTI, ARDS.	Preventing hospital-acquired events can prevent unplanned ICU admissions. There also remains a significant opportunity to reduce in hospital mortality associated with hospital-acquired infections and events.
Rosa et al., 2015	Comparison of Unplanned Intensive Care Unit Readmission Scores: A Prospective Cohort Study	Compared SWIFT, TISS-28, and SOFA in predicting unplanned ICU readmission and in-hospital mortality.	SWIFT, TISS-28, and SOFA only demonstrated moderate efficacy in predicting a return to ICU or in-hospital mortality.	There remains a further need for research to improve the efficacy and recommending the utility of predictive models in clinical practice. The characteristics that compromise these predictive models are widely discussed to be associated with increased risk for adverse outcomes. Analyses of patient characteristics that are predictive of unplanned ICU admission or mortality are also warranted.
Wong et al., 2016	Association of the severity of illness and intensive care unit readmission: A systematic review	Evaluate whether the severity of illness is associated with unplanned ICU readmissions	Unplanned ICU admissions are associated with increased severity of illness, increased mortality, and greater LOS.	The severity of illness is a risk factor associated with adverse outcomes among adults.

APPENDIX B:

THE UNIVERSITY OF ARIZONA INSTITUTIONAL REVIEW BOARD DECISION LETTER

THE UNIVERSITY OF ARIZONA
Research, Discovery & Innovation

Human Subjects Protection Program

1618 E. Helen St.
P.O.Box 245137
Tucson, AZ 85724-5137
Tel: (520) 626-6721
http://rgw.arizona.edu/compliance/home

Date:	August 22, 2021
Principal Investigator:	Amanda K Zeagler
Protocol Number:	2108123662
Protocol Title:	A Descriptive Analysis of the Incidence of Unplanned Trauma ICU Admissions
Determination:	Human Subjects Review not Required

Documents Reviewed Concurrently:

Data Collection Tools: *DNP Project Variables .xlsx*
Data Collection Tools: *List of Variables.docx*
HSPP Forms/Correspondence: *Advisor Confirmation Email.pdf*
HSPP Forms/Correspondence: *Zeagler_Determination_of_Human_Research.pdf*
Other: *nrduc_supplemental_questionnaire (3).docx*
Other Approvals and Authorizations: *Zeagler Letter of Support (AutoRecovered).docx*

Regulatory Determinations/Comments:

- Not Research as defined by 45 CFR 46.102(l): As presented, the activities described above do not meet the definition of research cited in the regulations issued by U.S. Department of Health and Human Services which state that "Research means a systematic investigation, including research development, testing, and evaluation, designed to develop or contribute to generalizable knowledge. Activities that meet this definition constitute research for purposes of this policy, whether or not they are conducted or supported under a program that is considered research for other purposes. For example, some demonstration and service programs may include research activities. For purposes of this part, the following activities are deemed not to be research."

The project listed above does not require oversight by the University of Arizona.

If the nature of the project changes, submit a new determination form to the Human Subjects Protection Program (HSPP) for reassessment. Changes include addition of research with children, specimen collection, participant observation, prospective collection of data when the study was previously retrospective in nature, and broadening the scope or nature of the study activity. Please contact the HSPP to consult on whether the proposed changes need further review.

The University of Arizona maintains a Federalwide Assurance with the Office for Human Research Protections (FWA #00004218).

APPENDIX C:

NRDUC APPROVAL LETTER

Banner Health®

September 1, 2021

Amanda K. Zeagler, RN

RE: NRDUC Project:
Protocol Number: 2108123662: A Descriptive Analysis of the Incidence of Unplanned Trauma ICU Admissions
New Project: UA Determination of Human Research Application Version (August 2019); forwarded to Non-Research Data Use Committee on 08/23/2021
Non-Research Data Use Committee Evaluation: Approved on 09/01/2021

Dear Amanda K. Zeagler:

Thank you for your submission of the UA Determination of Human Research Form which outlined the above noted project. On 08/23/2021, UA IRB concluded that this project was not research and subsequently forwarded it to the Banner Health Non-Research Data Use Committee (NRDUC) for oversight and review.

The project information you provided was reviewed and approved on 09/01/2021, by the BH NRDUC. Should you have any questions or concerns please feel free to reach out to the NRDUC chair at any time.

PLEASE NOTE:
The NRDUC determination is based on the information you provided to the committee on your application version (August 2019) and supporting documents forwarded to the NRDUC on 08/23/2021. If the project is modified in any way, including re-analysis of data, the determination is no longer valid. You must resubmit the project to the NRDUC for review and approval.

A copy of this letter will be placed in the NRDUC project file.

Sincerely,

Kristen Eversole, BS, RHIA, CHPC
Banner Health Privacy Sr. Director/Chief Privacy Officer, NRDUC Chair

APPENDIX D:

STATA DO FILE

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