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Determining a discernable pattern in intensive care unit and coronary care unit readmissions: a quality improvement project

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Determining a discernable pattern in intensive care unit and coronary care unit readmissions: a quality improvement project

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By

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Abstract

Background: Unplanned readmissions to the intensive care unit (ICU) are a significant clinical concern associated with more severe illnesses, longer lengths of stay, higher costs, and higher risk for hospital and overall mortality (Boots, 2013; Brown, Ratcliffe, Kahn, & Halpern, 2012; Elliot, Crookes, Worrall-Carter, & Page, 2011; Kramer, Higgins, & Zimmerman, 2013; Rosenberg, Hofer, Hayward, Strachan, & Watts, 2001; & Schorr, 2012).

Objective: This quality improvement project was intended to identify a discernable pattern or characteristic associated with unplanned readmissions to the intensive care unit/coronary care unit.

Methods: This retrospective cohort study used all patients discharged and subsequently readmitted to the critical care units in the same hospital stay at a Northwest Arkansas hospital were included in the cohort.

Results: The most frequent readmission diagnoses were respiratory (33.3%) and cardiac (31.1%) related. The most common reasons for readmission were respiratory decompensation (28.9%), post-operation complications (20.0%), and post-cardiac catheterization complications (15.6%). The majority of patients readmitted were male (80%), over the age of 65 (73.3%) and originally came from the emergency department (51.1%). Discharge and readmission times were not found to be significant in this particular study. Vitals at readmission to ICU/CCU were more unstable than at discharge from ICU/CCU.

Conclusions: Identifying the patient characteristics and risk factors associated with readmission can provide a path to improving patient outcomes and implementing interventions to reduce the

number of readmissions into the ICU; in turn reducing costs, mortality, and length of stay. Several patient and admission characteristics were associated with readmission.

Background

In the United States, intensive care unit care accounted for 13.4 per cent of all hospital costs and 4.1 per cent of all national health care spending in 2005 (Lissauer, Diaz, Narayan, Shah, & Hanna, 2013). Being able to predict and subsequently prevent ICU readmissions would help improve use and costs. Unplanned readmissions to the intensive care unit (ICU) are a significant clinical concern associated with more severe illnesses, longer lengths of stay, higher costs, and higher risk for hospital and overall mortality (Boots, 2013; Brown, Ratcliffe et al., 2012; Elliot et al., 2011; Kramer et al., 2013; Rosenberg et al., 2012). Timmers et al. (2012) defined readmission as "a second readmission to ICU during the same hospitalization." Identifying the patient characteristics and risk factors associated with readmission can help physicians improve patient safety by assessing cautiously before making intensive care discharge decisions to prevent readmission occurrences (Kramer et al., 2012; Lai et al.,, 2012; Rosenberg et al., 2001). ICU readmission rates have been estimated from 4% to 14% in previous studies (Brown et al., 2013; Chalmers & Black, 2014; Kramer et al., 2013; Lai et al., 2012; Rosenberg et al., 2001 ; Russell, 2012; Timmers et al., 2012). Patients who are readmitted within the same hospital stay experience poorer outcomes than those not readmitted, which is expected. A noteworthy aspect of these patients is that they have an overall mortality rate up to 6 times higher, lengths of stay twice as long, and are 11 times more likely to die in the hospital than patients who are not readmitted (Elliot et al., 2011).

Many studies focus on ICU readmission rates as indicators for quality of care (Brown et al., 2013), but identifying risk factors associated with readmissions could allow for adoptive measures to reduce these events (Moreira, Cardoso, Padilha, & Grillo, 2011). Adoptive measures could include improved discharge planning, increasing availability of skilled staff, and decreased workloads. A qualitative analysis study completed in a 500-bed tertiary referral hospital found that delayed medical care for acutely ill patients on the general ward was a major contributing factor to ICU readmissions (Elliot et al., 2011). The delay could occur because although ward staff may possess knowledge and skills relevant to their own specialty, they may not be experienced in critical care (Elliot et al., 2011). Hospital managers should consistently be looking for ways to increase the knowledge and skills of ward staff to decrease the problem of critical care incompetence.

Discharge "out of hours" as a risk factor for readmission is a common finding in many studies and is associated with increased mortality (Pilcher, Duke, George, Bailey, & Hart, 2006). A study in Australia found the strongest risk factors to be chronic comorbidities and "out of hours" discharge, which is considered from 6PM to 6AM (Renton et al., 2011). Another study in a metropolitan hospital replicated these findings in that discharge that occurred on night shift between 2200-0730 resulted in higher crude mortality (Duke, Green, Briedis, 2004). Night time discharge is associated with increased mortality, but this may be the consequence of premature discharge and not necessarily linked to the time of day (Duke et al., 2004). Intensive care unit discharge planning should seek ensuring a safe and efficient transition to the general ward. With poor discharge planning, it is likely discontinuity of care, delayed recovery, and ICU readmission can result.

Many studies have been completed to determine specific risk factors for readmission patients, though, agreement on common risk factors or high-risk patient profiles has not been achieved (Lai et al., 2012; Metnitz et al., 2003; & Rosenberg et al., 2001). Studies have proclaimed that a significant number of readmission cases were potentially preventable and that specific treatments targeted towards high-risk patients could decrease readmission rates (Lai et al., 2012). For that reason, it is of clinical interest to further identify patients who are at greater risk for readmission to the ICU/CCU. There are several studies that found readmissions are more common among patients who respond poorly to treatment, especially those patients transferred to a different unit (Elliot et al., 2011 & Russell, 2012). Transfer to the ICU from another hospital or from a general medicine ward should be noted as a high risk factor for ICU readmission. Patients originally transferred from another hospital or admitted to the ICU from a general medical floor were more likely to be readmitted than patients directly admitted from the emergency department or ambulatory clinics (Rosenberg et al., 2001). It has also been found that readmitted patients received longer durations of treatment before their first ICU admission (Rosenberg et al., 2001), which could allude to the possibility that these patients were much sicker. The literature proves that readmitted patients were in greater need of organ support on the day of a patient's first ICU discharge, with more patients still requiring ventilator, cardiovascular, and renal support than non-readmitted patients (Metnitz et al., 2003). Physiologic risk factors vary throughout studies, but there are several that are predominant consistently. Cardiac and respiratory conditions are common denominators when discussing associated risk factors for readmission to the ICU (Boots, 2013; Joskowiak, Wilbring, Szlapka, Georgi, Kappert, Matschke, & Tugtekin, 2012; Lai et al., 2012; Renton, Pilcher, Santamaria, Stow, Bailey, Hart, & Duke, 2011; & Timmers et al., 2012). More specifically, most frequent risk factors identified

in the literature include ischemic heart disease, congestive heart failure, respiratory failure, hospital acquired and aspiration pneumonia and chronic obstructive pulmonary disease (Joskowiak et al., 2012 & Lai et al., 2012). Other factors such as sepsis, hemorrhage, dialysis and hepatic failure have also been found to be significant (Brown, Ratcliffe, Kahn, & Halpern, 2012; Brown et al., 2013; Cook, 2013; & Rosenberg et al., 2001). Lai et al (2001) led a multivariate analysis of data from the Taiwan National Health Insurance Research Database that found, age > 39 years old, female gender, ischemic heart disease, lung related disorders, pneumonia, cerebrovascular disease, sepsis, heart failure, chronic liver failure, diabetes mellitus, and chronic obstructive pulmonary disease to be significant risk factors for readmission to the ICU. The most frequent etiologic organ systems in the study by Lai et al (2001) were cardiovascular (35.38%), respiratory (26.96%), and digestive system (8.51%). A prospective observational cohort study by Timmers et al (2012) found the main causes of readmission were respiratory decompensation (48%) and cardiac conditions (16%).

A secondary analysis of a prospective cohort study by Rosenberg et al. (2001) studied the reasons for original ICU admission and subsequent readmission. They found that upper gastrointestinal bleeding, pneumonias (including infectious and aspiration), respiratory failure, and sepsis syndromes accounted for >50% of admissions in both groups, although readmitted patients were more likely to be originally admitted with sepsis and hepatic failure (Rosenberg et al., 2001). Another recent study by Brown et al (2012) looked at original diagnoses and readmission diagnoses finding that, the most common readmission diagnoses were respiratory (42.3%) and cardiac arrest or failure (24.4%).

The purpose of this project was to determine if there is a discernable pattern or characteristics in patients that are readmitted to the critical care units at a Northwest Arkansas hospital.

Intended Improvement

This quality improvement project was intended to identify a discernable pattern or characteristic associated with unplanned readmissions to critical care units. Discernable variables can be physiological or non-physiological. Physiological variables included the patient's illnesses, injuries, or conditions. Non-physiological variables related to the efficiency of the hospital, such as discharge timing or length of stay. With the expensive cost and increased occurrence of older, more acutely ill patients in ICUs, efforts are being made to improve the intensive care unit's clinical effectiveness and cost efficiency (Rosenberg et al., 2001). Being able to identify factors that may be preventable could drastically lower costs, mortality rates, and length of stay. There have been a number of studies done to investigate variables that might be associated with readmission outside of the United States. Because of this, it is challenging to pinpoint consistent risk factors for patients in the United States. This study's goal was to determine if there is an identifiable pattern in patients in Northwest Arkansas who are discharged from the ICU/CCU, and subsequently readmitted. Outcomes of this study have hopefully helped provide a path to improving patient outcomes and point to the specific interventions that need to be implemented to reduce the number of readmissions into the ICU/CCU.

Study Aims

The aim of this study was to determine if there is a discernable pattern in patients readmitted to critical care units. The question that guided this quality improvement study was:

- Do patients who are discharged from, and subsequently readmitted to an intensive care unit/coronary care unit have discernable patterns and/or characteristic(s)?

Methodology

This quality improvement project was conducted at a hospital in Northwest Arkansas following approval of the University of Arkansas Institutional Review Board and the hospital's Quality Improvement Department. It was conducted in compliance with the Health Insurance Portability and Accountability Act (HIPAA) guidelines ("HIPAA Privacy Rule", 2003).

Design

The study design for this quality improvement project was a retrospective medical record review using 200 charts from the critical care units at one Northwest Arkansas hospital.

Setting

This study took place in the critical care units of one Northwest Arkansas hospital. The intensive care unit is a place for critically ill patients whom require closer monitoring and more frequent medical attention. The coronary care unit is staffed with cardiac nurses and trained personnel that monitor a patient's heart and overall condition 24 hours a day. The units incorporate specialized equipment and educated interdisciplinary teams to meet the needs of these patients. The interdisciplinary team primarily includes, but is not limited to, physicians, nurses, and respiratory therapists.

Intervention

This quality improvement project was conducted using a retrospective medical record review. All patients admitted to the ICU/CCU between August 2013 and August 2014 were

included. Patients under the age of 18 and pregnant women were excluded. Non-physiologic variables were examined to determine if there was a discernable pattern and included age, gender, where the patient was before ICU/CCU admission (i.e. long term care facility, home, emergency department, etc.) length of ICU/CCU stay, time of discharge from ICU/CCU, time of readmission to ICU/CCU, and where the patient was transferred after discharge from ICU/CCU. Physiologic variables that were examined included primary diagnosis and comorbidities at first admission to ICU/CCU, the reason for readmission, the primary diagnosis at readmission, and vital signs at discharge and readmission. Specific physiologic variables assessed included cardiac, respiratory, hypertension, gastrointestinal, neurological, type 2 diabetes, fluid and electrolyte imbalance, lymphatic, genitourinary, sepsis, oncological, musculoskeletal, hemodynamics, integumentary and psychosocial.

All patient information was de-identified as per the Health Insurance Portability and Accountability Act (HIPAA) guidelines ("HIPAA Privacy Rule", 2003). Patients of 65 years of age and older were aggregated into a single category of 65 and older. Patients were assigned a random number for case log purposes. Once the medical record review is completed, there will be no method of re-entry into the medical record.

Analysis

A descriptive data analysis was performed for the patients in the study and was described as median and 25^{th} and 75^{th} quartile. The continuous variables were tested on normal distribution with the Lilliefors test. A univariate analysis was performed to identify risk factors associated with readmission using a Mann-Whitney *U* test for the continuous variables and the chi-square

test for the categorical variables. Risk factors with a *p* less than 0.05 on univariate analysis were entered in a multivariate analysis to identify independent risk factors.

RESULTS

Characteristics of Readmitted Patients. There were 45 ICU/CCU re-admissions to two critical care units at a Northwest Arkansas hospital from August 2013 to August 2014. Out of 45 patients analyzed, 8.9% (n=4) died during their ICU/CCU stay.

Table 1 – Age of Readmitted ICU/CCU Patients

Age	Frequency	Percent	Cumulative Percent
≥ 65	33	73.3	73.3
40-64	8	17.8	91.1
20-39	4	8.9	100.0
Total	45	100.0	

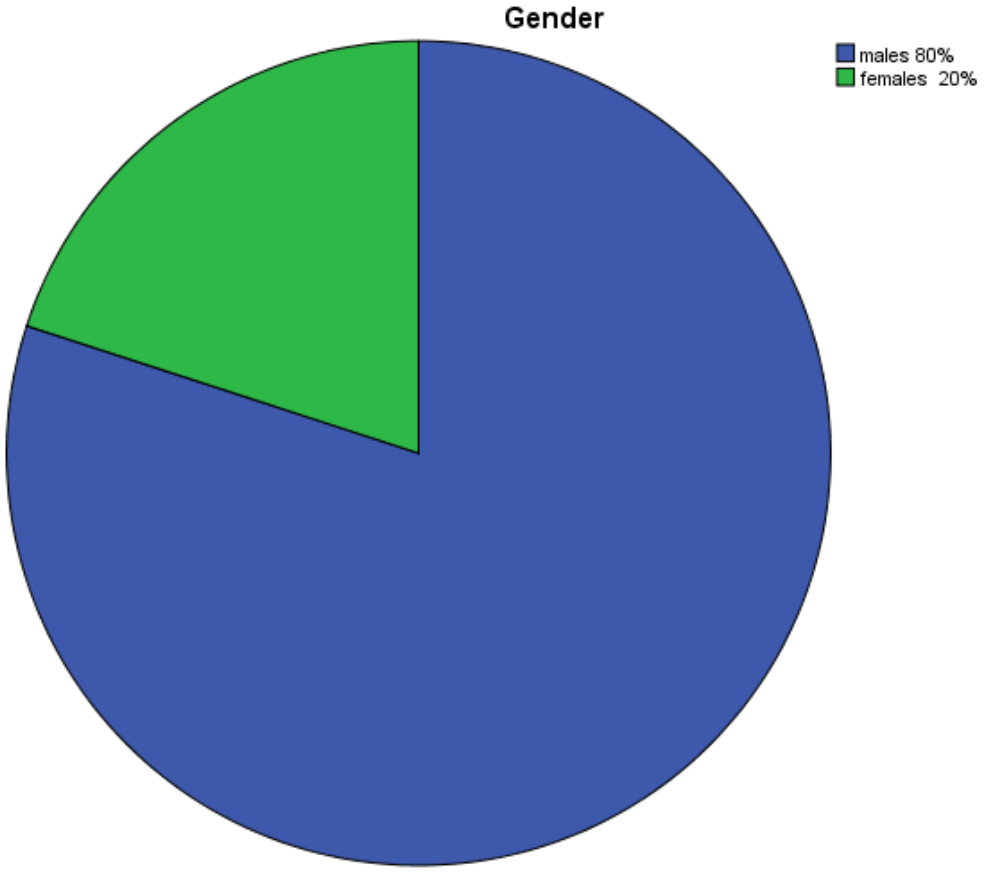
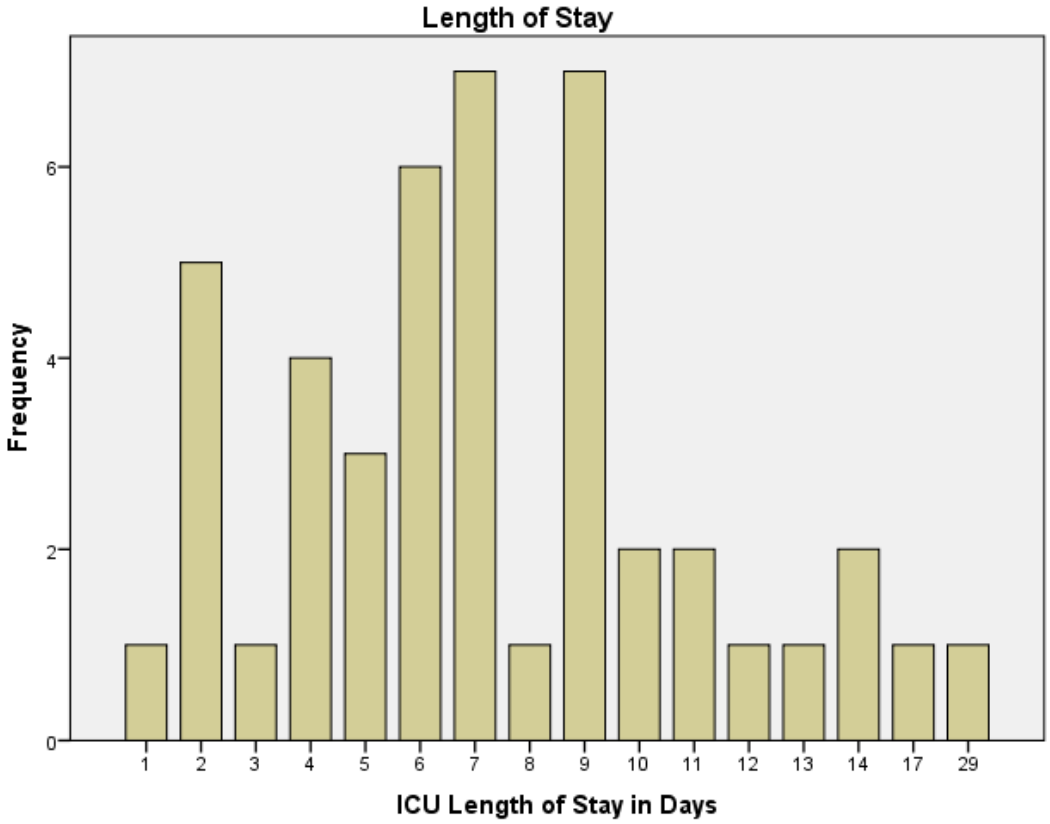


Figure 1 – Gender of Readmitted ICU/CCU Patients

Table 1 organizes the age of the study population. The majority of patients ranged from 65 years of age and older, making up for 73.3% (n=33) of the study population, while patients ages 20 to 39 years old accounted for the minority of the study population at 8.9% (n=4). Figure 1 shows the majority of the study population were males, 80% (n=36), with only a fifth of the study population females at 20% (n=9).

Figure 2 – ICU Length of Stay in Days for Readmitted ICU/CCU



According to Figure 2, the mean time of ICU/CCU length of stay was 7.6 days with a standard deviation of 4.854, although it was observed that 40.0% (n=18) of patients stayed 8 days or longer, 11.1% (n=5) of those remained in the unit for more than 12 days.

Table 2 - Location Before Admission Into ICU/CCU

Location	Frequency	Percent
Emergency Department	23	51.1
Long Term Care Facility	2	4.4
Home	3	6.7
Rehab Hospital	1	2.2
Another Hospital	12	26.7
Clinic	4	8.9
Total	45	100.0

Table 2 provides the frequency of the patient's location before initial admission into ICU/CCU. The majority of patients at 51.1% (n=23) were admitted into the ICU/CCU through the emergency department (ED). Following the ED, 26.7% (n=12) of patients transferred from another hospital was the most frequent location before original admission into ICU/CCU. Being referred to the hospital via clinic was the third most frequent, although it represented a small percentage at 8.9% (n=4).

Table 3 – Primary Diagnosis at Original ICU/CCU Admission

Primary Diagnosis	Frequency	Percent	Cumulative Percent
Cardiac	15	33.3	33.3
Respiratory	9	20.0	53.3
Gastrointestinal	3	6.7	60.0
Neurologic	4	8.9	68.9
Fluid/Electrolyte Imbalance	2	4.4	73.3
Lymphatic	1	2.2	75.6
Sepsis	3	6.7	82.2
Oncological	4	8.9	91.1
Hemodynamics	2	4.4	95.6
Psychosocial	1	2.2	97.8
Immunological	1	2.2	100.0
Total	45	100.0	

Diagnoses for Original ICU/CCU Admission. As demonstrated in Table 3, the highest frequency of primary diagnosis upon admission was cardiac-related at 33.3% (n=15), which included ventricular tachycardia, ischemic cardiomyopathy, deep vein thrombosis, congestive heart failure, coronary artery disease, atrial fibrillation, hypotension, aortic stenosis, carotid

artery disease, hyperlipidemia, NSTEMI, STEMI, atherosclerosis, mitral valve disease, portal hypertension, and ischemic enteritis. Following, the second highest frequency of primary diagnosis was respiratory related at 20.0% (n=9), which mostly included chronic obstructive pulmonary disease, asthma, pulmonary embolism, respiratory failure, pneumonia, pulmonary edema, pneumothorax, hemothorax, hypoxemia, and hypercapnia. The cardiopulmonary system makes up 53% (n=24) cumulative of primary diagnoses of patients readmitted into the ICU/CCU, followed by neurologic (8.9%), oncological (8.9%), gastrointestinal (6.7%), sepsis (6.7%), fluid and electrolyte imbalance (4.4%), hemodynamics(4.4%), lymphatic (2.2%), psychosocial (2.2%), and immunological (2.2%).

Table 4 – Intensive Care Unit/Critical Care Unit Discharge Destination

Discharge Destination	Frequency	Percent	Valid Percent	Cumulative Percent
ICU/CCU	2	4.4	4.4	4.4
Medical-Surgical	4	8.9	8.9	13.3
Cardiac	8	17.8	17.8	31.1
Cardiac	9	20.0	20.0	51.1
Medical-Surgical	4	8.9	8.9	60.0
Medical-Surgical	2	4.4	4.4	64.4
Emergency Department	1	2.2	2.2	66.7
Cardiac	6	13.3	13.3	80.0
Emergency Department	3	6.7	6.7	86.7
Medical-Surgical	4	8.9	8.9	95.6
Medical-Surgical	1	2.2	2.2	97.8
Medical-Surgical	1	2.2	2.2	100.0
Total	45	100.0	100.0	

Discharge Characteristics. Table 4 shows the percentage of patients that were discharged to each unit of the hospital. The findings were significant in that over half of readmissions,

51.1% (n=23) accounted for patients discharged from the ICU/CCU to cardiac wards. Medical-surgical units followed with the second highest readmissions at 35.5% (n=16). It should be noted that 4.4% (n=2) of patients were discharged from one ICU/CCU unit to another ICU/CCU, and subsequently readmitted to the original ICU/CCU.

Table 5 – Time of Discharge from ICU/CCU

Time	Frequency	Percent	Cumulative Percent
Time not indicated	36	80.0	83.7
0601-1200	1	2.2	86.0
1201-1800	4	8.9	95.3
1801- 2359	2	4.4	100.0
Total	43	95.6	
Missing	2	4.4	
Total	45	100.0	

Table 5 shows the frequency and times of discharge from ICU/CCU. The discharge time from ICU/CCU was recorded using the documented time of transportation, if documentation was available. The time intervals used were 0000 to 0600, 0601 to 1200, 1201 to 1800, and 1801 to 2359. Discharge that occurred between 1801 and 0600 were considered after-hours. 80.0% (n=36) of patients did not have a time documented for time of discharge from the ICU/CCU. 11% (n=5) of patients were discharged between 0600 and 1800. The data showed that 4.4% (n=2) of patients were discharged after-hours (between 1801 and 0600).

Vital Signs for Discharge from ICU/CCU and Readmission to ICU/CCU. Vital signs for discharge and readmission were evaluated upon the criteria used for diagnosis of systemic inflammatory disease syndrome (SIRS), which can lead to septic shock. Discharge vital signs were recorded from the patient's last charted assessment in the ICU/CCU. Vitals at readmission

to the ICU/CCU were recorded using the first charted assessment in the unit, or from nurses' notes documenting reason for readmission. Vital signs for discharge from the ICU/CCU and readmission to the ICU/CCU were both categorized into the same ranges.

Temperature

Temperature was categorized as either a fever of more than 38°C (100.4°F), within range from 96.8 to 100.4, or less than 36°C (96.8°F). At time of discharge, almost all patients (97.8%) had a body temperature within normal range. A small percent (2.2%) of patients had a body temperature greater than 100.4°F at discharge from ICU/CCU. At readmission into the ICU/CCU, there was a slight increase in the number of patients with a temperature greater than 100.4°F than at time of discharge, with 6.7% of patients presenting with a fever. This left 93.3% of patients to be within normal range for temperature at readmission.

Heart Rate

Table 6 – Heart Rate at Time of Discharge from ICU/CCU

Heart Rate	Frequency	Percent	Cumulative Percent
>100	4	8.9	8.9
70-99	39	86.7	95.6
<70	2	4.4	100.0
Total	45	100.0	

Table 7 – Heart Rate at Time of Readmission to ICU/CCU

Heart Rate	Frequency	Percent	Cumulative Percent
>100	15	33.3	33.3
70-99	27	60.0	93.3
<70	3	6.7	100.0
Total	45	100.0	

Table 6 shows the heart rates at the time of discharge from ICU/CCU. Heart rate was categorized as either more than 100 bpm, in range from 70-99 bpm, or less than 70 beats per minute. At time of discharge, over three quarters of patients (86.7) had a heart rate between 70-99 bpm. Only 13.2% of patients had a heart rate outside of range, 8.9% of those of which were tachycardic.

Table 7 presents the patients' heart rates at time of readmission to the ICU/CCU. There was a 24.4% increase in patients who had a heart rate greater than 100 beats per minute at readmission than discharge, which totals to 33.3% presenting with tachycardia at time of readmission. Also at readmission, 60.0% of patients were within range, and 6.7% had a heart rate less than 70.

Respiration Rate

Table 8 – Respiratory Rates at Discharge from ICU/CCU

Respiration Rate	Frequency	Percent	Cumulative Percent
>20	7	15.6	15.6
12-20	37	82.2	97.8
<12	1	2.2	100.0
Total	45	100.0	

Table 9 – Respiratory Rates at Readmission to ICU/CCU

Respiration Rate	Frequency	Percent	Cumulative Percent
>20	13	28.9	28.9
12-20	30	66.7	95.6
<12	2	4.4	100.0
Total	45	100.0	

Table 8 shows the respiratory rates at discharge from the ICU/CCU. Respiratory rate was recorded as one of the following, greater than 20 breaths per minute, within range for 12-20 breaths

per minute, or less than 12 breaths per minute. Exactly 15.6% (n=7) of patients presented with tachypnea, greater than 20 breaths per minute, at discharge. The vast majority of patients at 82.2%s showed a normal respiratory rate in between 12-20 breaths per minute.

Respiration rates at time of readmission are shown in Table 9. It was found that the number of patients with a respiratory rate greater than 20 breaths per minute at readmission nearly doubled the number of patients at discharge. 28.9% of patients at readmission fell in the category of greater than 20 breaths per minute. 66.7% remained within normal limits, between 12 and 20 breaths per minute, and 4.4% had respirations of less than 12 per minute.

Systolic Blood Pressure

Figure 3 – Discharge Systolic Blood Pressure of Readmitted ICU/CCU Patients

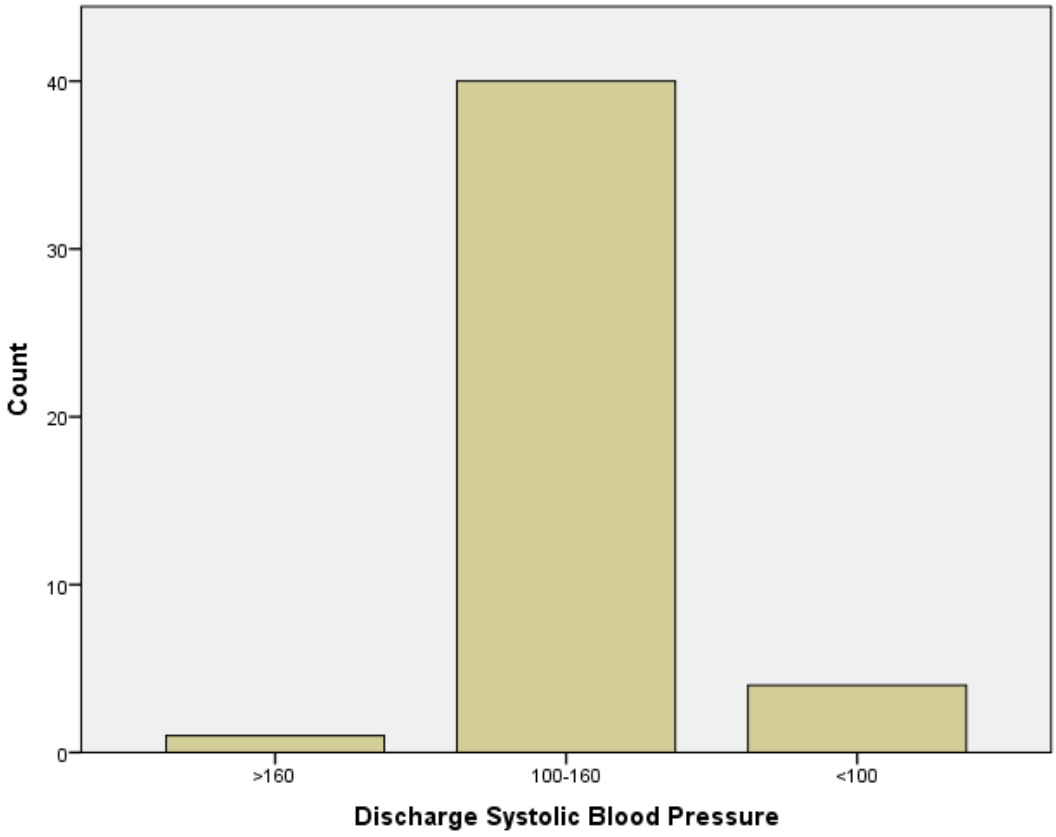


Figure 3 represents the systolic blood pressure at time of discharge from ICU/CCU. Systolic blood pressure (SBP) was categorized as greater than 160 mm Hg, within range at 100 to 160 mm Hg, or less than 100 mm Hg. The study population consisted of 88.9% of patients whose systolic blood pressure was within range at discharge. However, 8.9% of patients had a SBP less than 100 mm Hg.

Figure 4 – Readmission Systolic Blood Pressure for Readmitted ICU/CCU Patients

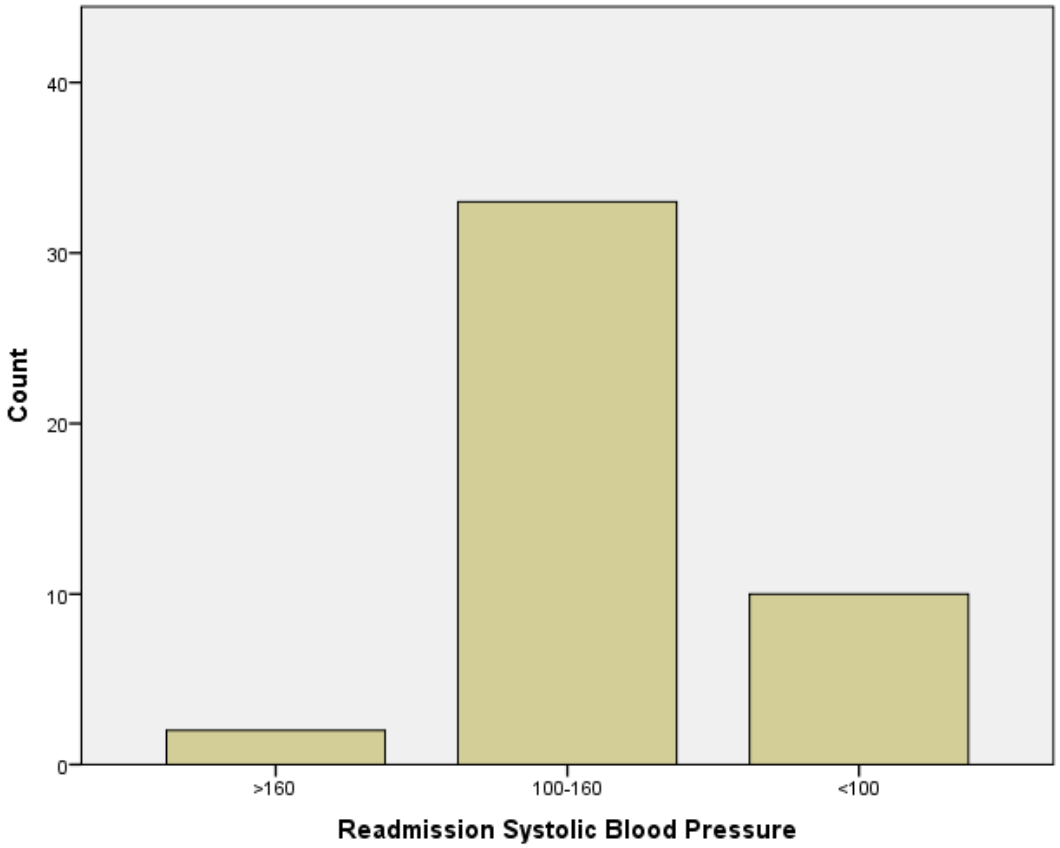


Figure 4 depicts the systolic blood pressure readings at time of readmission to the ICU/CCU. A systolic blood pressure less than 100 mm Hg presented over two times the amount at readmission than at discharge. The number of patients with a SBP less than 100 mm Hg went from 8.9% at discharge, as previously noted, to 22.2% at time of readmission. 73.3% of patients remained within range at 100 to 160 mm Hg, and 4.4% with a SBP greater than 160 mm Hg.

Table 10 - Readmission Time to ICU/CCU

Time	Frequency	Percent	Cumulative Percent
No time noted	28	62.2	62.2
0001-0600	2	4.4	66.7
0601-1200	6	13.3	80.0
1201-1800	6	13.3	93.3
1801- 1359	3	6.7	
Total	45	100.0	100.0

Characteristics of Readmission. The readmission time to the ICU/CCU, depicted in Table 10, was recorded using the documented time of transportation, if documentation was available. The time intervals used for readmission were the same as the time intervals used for discharge, 0000 to 0600, 0601 to 1200, 1201 to 1800, and 1801 to 2359. 62.2% (n=28) of patients did not have a time documented for time of readmission to the ICU/CCU. 4.4% of patients were readmitted between 0001 and 0600 and 6.7% of patients were readmitted between 1801 and 1359, concluding that 11% of patients were readmitted during what is considered after-hours (between 1801 and 0600). The remaining patients (26.6%) were readmitted between 0601 and 1800, half of those of which were readmitted in the earlier part of the day (between 0601 and 1200) and the other half of those which were readmitted between 1201 and 1800.

Table 11 - Reason for Readmission to ICU/CCU

Reason	Frequency	Percent	Cumulative Percent
Respiratory	13	28.9	28.9
Post-operation Complications	9	20.0	48.9
Cardiac/Catheterization Complications	7	15.6	64.5
Cardiac	4	8.9	73.4
Neurological	4	8.9	82.3
Hemodynamics	2	4.4	86.7
TREX/Code	2	4.4	91.1
Fluid/Electrolyte Imbalance	1	2.2	93.3
Psychosocial	1	2.2	95.5
Integumentary	1	2.2	97.8
Hemorrhage	1	2.2	100.0
Total	45	100.0	

Reasons for Subsequent Readmission. As demonstrated in Table 11, the highest frequency of reason for readmissions resulted from respiratory complications at 28.9%. Reasons included, but not limited to, respiratory distress, pleural effusion, collapsing of the lung, hypoxemia, pneumothorax from unsuccessful chest tube placement, pulmonary embolism, retained hemothorax, pneumonia, and respiratory failure. Post-operation complications, not including cardiac-related procedures, followed with the second most common reason for readmission at 20.0%. Post-cardiac operations and catheterizations complications were a separate classification and made up 15.6% of reasons for readmission for the study population. Cardiac-related reasons for readmission accounted for 8.9% and included cardiac diagnoses such

as ventricular tachycardia, rather than complications. Neurologic reasons also accounted for 8.9% of patients. 4.4% of patients were readmitted due to a code or a call to Team Response to Extremes (TREX), which is the hospital's rapid response team. Hemodynamics was a reason for 4.4%, followed in no particular order by fluid/electrolyte imbalances (2.2%), psychosocial (2.2%), integumentary (2.2%), and hemorrhage at 2.2%.

Table 12 – Primary Diagnosis at Readmission to ICU/CCU

Primary Diagnosis	Frequency	Percent	Cumulative Percent
Cardiac	14	31.1	31.1
Respiratory	15	33.3	64.4
Gastrointestinal	4	8.9	73.3
Neurological	4	8.9	82.2
Fluid/Electrolyte Imbalance	1	2.2	84.4
Genitourinary	1	2.2	86.7
Sepsis	2	4.4	91.1
Oncological	1	2.2	93.3
Hemodynamic	1	2.2	95.6
Psychosocial	1	2.2	97.8
Integumentary	1	2.2	100.0
Total	45	100.0	

The primary diagnoses for readmission (Table 12) have frequencies similar to the original diagnosis at the first admission to the ICU/CCU, yet still different. Respiratory diagnoses had the highest frequency at readmission at 33.3% (n=15), contrary to first admission primary diagnoses which had the highest frequency of cardiac. Although, cardiac followed closely with the second highest frequency of 31.1% (n=14). At readmission, the cardiopulmonary system made up 64.4% (n=29) cumulative of primary diagnoses, compared to the 53% of cardiopulmonary diagnoses at original admission. Gastrointestinal and neurological were equal in their frequency

with 8.9% (n=4) each, followed by sepsis at 4.4% (n=2). Fluid and electrolyte imbalance, genitourinary, oncological, hemodynamics, psychosocial, and integumentary each represented 2.2% (n=1), for a combined percentage of 13.2.

It was reviewed that 91.1% (n=41) of patients did not have a nosocomial infection throughout there hospital stay. However, 6.7% (n=3) did contract Methicillin-resistant Staphylococcus aureus (MRSA). 2.2% (n=1) contracted hospital-acquired pneumonia.

DISCUSSION

The literature consisted of multiple studies that were done as initial ICU readmissions, discharged home, and then readmitted to the ICU for another hospital stay. The literature was comparable, but it is important to keep in mind this study focused on initial ICU/CCU admissions, discharged from the ICU/CCU to a different general ward, and readmitted to the ICU/CCU within the same hospital stay. By only looking at readmissions during the same hospital stay, we believe this can portray a more specific measure of hospital readmissions without environmental factors of home playing a part.

The analysis of the demographic characteristics found that the study population's age was predominantly patients over the age of 65, and male gender. These findings are similar to those of some studies (Kramer et al., 2012; Rosenberg et al., 2001; & Timmers et al., 2012) , but differ from the results of a recent study led by Lai et al (2012) that proved female gender to be the majority, and in turn a more significant predictive factor. Our study is comparable to the literature (Moreira et al., 2011) as we also found male gender, elderly, and a location in the ED before admission into ICU/CCU to be most common of the patients readmitted into the ICU/CCU.

The mean time of ICU/CCU length of stay for our study was 7.6 days with a standard deviation of 4.854, as mentioned earlier. This was comparable to the literature, in which there were findings such as 8.9 days with a standard deviation of 10.90 (Moreira et al., 2011).

Cardiac conditions, followed by respiratory related diagnoses made up the most frequent primary diagnoses for original admission. The frequency of diagnoses changed for original ICU/CCU admissions and ICU/CCU readmissions, from cardiac to respiratory. The cardiopulmonary diagnoses increased to 60% for readmissions.

It was found in the literature that studies that categorized readmission events by primary diagnoses or etiologic organ systems were limited. Therefore, a ranking of which primary diagnoses were most frequent in ICU readmissions, specifically within the same hospital stay, were not fully consistent.

Our study regarding the most frequent etiologic organ systems in readmission episodes was comparable to what was found in the literature (Brown et al., 2012; Lai et al., 2012; Timmers et al., 2012) with cardiovascular and respiratory ranking as the two highest frequencies interchangeably. Our study found gastrointestinal related diagnoses as the third highest frequency, which was found in some literature (Lai et al., 2012), but other literature found cardiovascular to be third (Chan et al., 2009). Respiratory ranked number one as the leading readmission diagnosis in our study, which was also found in a study by Chan et al (2009). This could be due to respiratory complications being difficult to completely heal and lead to the need for readmission.

In our study, the top five primary diagnoses of readmitted patients were cardiovascular, respiratory, gastrointestinal, neurological, and fluid and electrolyte imbalances. These top five

correlated closely enough with the literature (Chan et al., 2009), as respiratory, cardiovascular and neurological were all leading etiologies for readmission. However, the study that correlated with our data, which presented respiratory diagnoses were followed by neurological, and cardiovascular, was completed in a surgical ICU which could skew the data.

Primary diagnoses were recorded at readmission, but also the specific reason for readmission. Respiratory issues continue to be a number one frequency through readmission, as they were found to be the number one reason for readmissions. Reasons for readmission and primary diagnosis for readmissions were both recorded because the reason gives more specificity for the readmission, such as a post-operation complication or a code being called.

The literature presents that pulmonary complications are among the most frequently reported complications after coronary artery bypass graft (CABG) surgery (Hulzebos, Meeteren, De Bie, Dangelie, & Helders, 2003). This could be why respiratory had the highest primary readmission diagnosis and cardiac and catheterization complications were also high. A study by Hulzebos et al (2003), created a bedside risk assessment form to predict the preoperative risks of postoperative pulmonary complications in patients who had undergone CABG surgery. The study concluded they believed that, by assessing the risk, clinicians could provide more tailored care to patients who are at high risk for developing a pulmonary complication. We believe this also to be true, which could lead to helping reduce readmission rates to the ICU/CCU. Data was not collected on the specific risk assessment the critical care units at this Northwest hospital used, if any.

With over three-quarters of the discharge times not documented, it was not possible through this study to prove discharge after-hours affected readmission rates or mortality. A small

proportion was discharged after-hours, but we do not believe that to be representative of the amount of patients discharged from the ICU/CCU between 1801 and 0600. The literature proves our hypothesis of after-hour discharges to increase the risk for readmission, but our study does not confirm this (Duke et al., 2004; Pilcher et al., 2006; & Renton et al., 2011). Studies have also demonstrated no increase in mortality after night discharges and have suggested that these outcome differences might be related to insufficient intensive care unit bed availability (Goldfrad & Rowan, 2000; & Kramer et al., 2012). While there are multiple prior studies regarding discharge times, readmission times are not generally studied. Our study found that there were double the readmissions during after-hours than discharges during this time.

There were 51.1% readmissions that came from the cardiac units. This could be because staffing needs are being impacted due to the acuity of the patients. The majority of coronary care unit patients are also sent to the cardiac units; therefore they are more likely to be re-admitted from there. A qualitative analysis of nurses' perceptions and experiences found that discharging patients early from the ICU when they are clinically unstable creates issues around workload and significantly challenges the ward staff (Elliot et al., 2011). The study had participants indicate that some patients on general wards were too sick to be there because of the severity of their condition and the high level and intensity of their care needs (Elliot et al., 2011). They also had participants that described many patients being clinically unstable, such as having fluctuating blood pressure (Elliot et al., 2011). The staff may not be doing anything drastically wrong, but it is because the acuity of the patient that is bringing them back to the ICU/CCU. It could be helpful if hospital managers looked at ways of identifying more appropriate environments to manage acutely ill patients or lowering the nurse-patient ratio.

In this study, we chose to categorize vital signs as related to the criteria for SIRS. Progression to severe sepsis is associated with mortality and morbidity (Gultepe et al., 2014). This led us to believe that sepsis could have a significant impact on ICU/CCU readmissions within the same hospital stay. By providing appropriate treatment early in the development of sepsis, patient outcomes improve (Gultepe et al., 2014) which could allude to readmissions to the ICU/CCU being reduced. The guidelines for vital signs for SIRS include: fever of more than 38°C (100.4°F) or less than 36°C (96.8°F), heart rate of more than 90 beats per minute, and respiratory rate of more than 20 breaths per minute (Kaplan & Pinksy, 2014). Septic shock occurs when there is sepsis-induced hypotension (where either the systolic blood pressure is <90mm Hg, a reduction of >40 mm Hg below baseline, or the mean arterial pressure (MAP) is <70 mm Hg) that persists despite adequate fluid resuscitation (Gultepe et al., 2014). This is why systolic blood pressure was measured into the categories chosen. We did not measure MAP in this study.

The amount of patients who presented with sepsis at discharge from the ICU/CCU and readmission to the ICU/CCU was not found to be significant. The prevalence of sepsis actually decreased from 6.7% (n=3) at discharge to 4.4% (n=2) at readmission. Therefore, the vital signs may not be correlated to a patient with a diagnosis of sepsis. However, the increase in frequency of vital signs that make up SIRS criteria did increase from discharge to readmission for each studied vital sign - temperature, heart rate, respiration rate, and systolic blood pressure.

Temperature increased from one patient at discharge to three patients at readmission with an elevated temperature above 100.4F. This does not match up with the percent of patients presenting with sepsis at discharge and readmission, therefore is found to be insignificant in relation to sepsis.

A heart rate above 100 beats per minute was recorded for only four patients at discharge, and increased to an alarming 15 patients (33.3%) at readmission. This could be because of the amount of readmissions related to cardiac conditions and post- cardiac catheterization complications, and not because of sepsis.

Respiration rates over 20 breaths per minute were recorded nearly double at readmission than at discharge, with 28.9% of patients presenting tachypneic at readmission. It is hypothesized this is because respiratory diagnoses were the most frequent primary diagnosis at readmission.

A large difference was found for systolic blood pressure of <100 mm Hg between discharge and readmission. It was found to increase from 8.9% at discharge to 22.2% at readmission, thus staying true to the trend of increasing prevalence for vital signs meeting SIRS criteria at readmission. The drop in systolic blood pressure for more patients at readmission can be related to the frequency of cardiac diagnoses and complications at readmission, because many heart conditions prevent your body from being able to circulate enough blood. The drop in systolic pressure could also stem from the medications that are generally prescribed for many heart conditions, such as diuretics and beta blockers which have a common side effect of hypotension.

Our study did not find there to be a link between SIRS criteria, sepsis, and increased readmissions. However, it is significant that each vital sign presented in one way or another to be out of normal limits. The instability of vital signs can be correlated with the increase for readmission.

Conclusion

In conclusion, we performed a descriptive data analysis of the study patients to identify independent risk factors. Of patients readmitted, most patients were men and over the age of 65, coming from the emergency department before original ICU/CCU admission. Patients with respiratory and cardiovascular diseases are at greatest risk for ICU/CCU readmission. The main reasons for readmission were deteriorating respiratory conditions, post-operation complications, and post-cardiac catheterization complications. Instability of vital signs increased significantly at readmission.

Recommendations for new research include comparing readmitted patients with non-readmitted patients to determine if there is a difference in risk factors between ICU/CCU readmissions within the same hospital stay and ICU/CCU readmissions after being discharged home.

Limitations

It is acknowledged that this study has several limitations. First, the findings in this study are not representative of any other ICU/CCUs because our analysis only included data collected from one intensive care unit and one coronary care unit in Northwest Arkansas. Second, there were variables in the study that data were unavailable due to documentation not being made by appropriate personnel. Times for discharge from the ICU/CCU and readmission into the ICU/CCU, as well as vital signs at time of transportation of patient during discharge and readmission to ICU/CCU were also rarely documented.

Another limitation lies in that data was collected for original diagnoses and readmission diagnoses to the ICU/CCU, but data was not analyzed to determine if readmitted patients were readmitted for a similar diagnosis as their original admission diagnoses. This would have been

helpful to know if there was a recurrence of the original problem, rather than a new problem arising.

In our study, we did not research when a patient contracted a nosocomial infection. Consequently, we do not know if the reason for readmission was related to the infection. Also, we were unable to tell if a patient presenting with SIRS criteria through vitals was indeed to the patient with sepsis. This was because of the random numbers assigned to patients that were necessary to comply with HIPAA.

When recording vitals for discharge and readmission, the SIRS criteria, as stated above, is a heart rate greater than 90. Our heart rate was categorized as greater than 100, which could have a lowered the amount of patients who were identified as presenting with SIRS criteria.

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