The Use of Clinical Pathways in Patients with Thoracic Injuries

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Abstract

As a result of pulmonary complications, thoracic trauma is associated with high morbidity and mortality rates. Uncontrolled pain, poor inspiratory effort, and nonproductive cough contribute to pulmonary complications without early intervention. Pulmonary complications are responsible for high hospital and intensive care unit (ICU) readmission rates and lengths of stay (LOS). The implementation of a clinical pathway can reduce these variables through standardization of care. A study was conducted over six months to measure the effects of implementing a rib fracture management clinical pathway in a rural Level II trauma hospital on incidence rates of acute respiratory failure, ICU readmission, and total hospital and ICU length of stay. Results were compared six months pre- and post-clinical pathway. Patient data were obtained from TQIP (Trauma Quality Improvement Program) reports prior to the clinical pathway intervention in 2017 (n = 40) and after the intervention in 2018 (n = 53). Patients were predominantly White (92.5%, 86.6%) males (67.5%, 69.8%) ranging in age from 18 to 88 (mean age = 56). The ICU LOS was also statistically comparable across the categories, $t(91)=.11$, $p=.92$. The mean LOS in the hospital was slightly higher among the 2017 ($M=6.8$ $SD=6.0$) sample than among the 2018 sample ($M=6.3$ $SD=5.1$), the difference did not reach statistical significance, $t(91)=.12$, $p=.25$. Similarly, there were no significant differences between the samples in terms of readmission to ICU rates, $\chi^2(1)=1.46$, $p=.23$, or respiratory failure rates, $\chi^2(1)=1.64$, $p=.20$. This project identified significant gaps in rib fracture management, in addition to a need to achieve organization-wide goal alignment in order to promote positive patient outcomes.

Keywords: clinical pathways, rib fracture management, pain management, chest physiotherapy, ICU readmissions, ICU costs

The Use of Clinical Pathways in Patients with Thoracic Injuries

Thoracic trauma is the second most unintentional injury in the United States associated with significant morbidity and mortality (Galvagno et al., 2016; Unsworth, Curtis, & Asha, 2015). Rib fractures are indicators of severe bodily injury and can be a sign of underlying organ injury (Galvagno et al., 2016). Common pulmonary complications of thoracic injury can include pulmonary effusion, pneumonia, aspiration, acute respiratory distress syndrome (ARDS), and atelectasis or lobar collapse. Uncontrolled pain, poor inspiratory effort, and inadequate cough can contribute to pulmonary complications if treatment is not optimized early (Todd et al., 2006).

Some studies indicate early, aggressive intervention (Rotter et al., 2010; Todd et al., 2006) with multidisciplinary clinical pathways, chest physiotherapy (Brown & Walters, 2012; Rotter et al., 2010), and appropriate analgesia contribute to an overall decrease in complications and healthcare costs (Fakhry, Martin, Al Harakeh, Norcross & Ferguson, 2013). The use of inpatient clinical pathways allows the care team to identify complications early, decrease Intensive Care Unit (ICU) readmissions, and decrease hospital length of stay (LOS) (Elliott, Worrall-Carter, & Page, 2014; Fakhry et al., 2013). Clinical pathways provide a critical link between the best available evidence, clinical practice, and quality of care.

Background

The Trauma Services annual report (2018) at an American College of Surgeons (ACS) certified rural western Level II trauma hospital, indicated an increase in patient readmissions to the ICU and the average LOS from the previous years. Upon further examination, it was determined that most of these patients had blunt thoracic injuries with three or more rib fractures. According to the Trauma Services annual report (2018), most readmissions to the ICU were due to respiratory complications, failure, or distress.

The current standard of care for rib fracture management (RFM) at the hospital consists of managing pain and the use of incentive spirometers (IS). Management of pain using intravenous (IV) or oral medications is the responsibility of the Trauma Services provider on call. Methods of managing pain vary according to provider preference, thereby creating an opportunity for inconsistent pain management between patients. Hence, pain management represents a gap in patient care. Acute Pain Services (APS) have a designated pain pharmacist who is often consulted to assist with obtaining adequate pain control by these measures. Consulting APS is not part of the standard of care but may be done at the discretion of the trauma surgeon or Advanced Practice Provider (APP). Further, anesthesiology can be consulted for epidural or paravertebral catheter placement at the request of the trauma surgeon or APP. Placement sometimes does not occur until several days following admission or until the patient exhibits severe signs of respiratory distress.

Another area identified as a possible gap in care is the use of IS. Incentive spirometry orders are the nurse's responsibility. Standard protocols dictate that the nurse obtains the IS from the hospital inventory and then educates the patient on its use. It is the nurse's responsibility to have the patient use the IS every two hours while awake. At one time, the IS goals and patient education were the responsibility of respiratory therapists (RT). However, within the last two years that responsibility has transferred over to nurses as a result of the implementation of the electronic medical record (EMR) system. Nurses can be responsible for up to five patients during their shift resulting in some patients waiting over twenty-four hours after admission before being treated.

A western regional Level I trauma center uses a very different management strategy. The Level I trauma center implemented a RFM protocol (see Appendix A, PIC Score) that uses a

scoring system to address three areas: pain, inspiration, and cough (PIC), which if undertreated or shown to be ineffective, can lead to respiratory failure in patients with rib fractures (Brown & Walters, 2012; Galvagno et al., 2016). These areas are scored with numeric values by the patient and nurse. If a patient scores a one in any category or has an overall score of less than four, despite current interventions, then the physician is notified to initiate a more aggressive therapeutic approach such as early epidural placement.

As gaps in care were identified, it was determined the need for an aggressive therapy could be identified earlier in the hospital by developing a clinical pathway to include a multidisciplinary, standardized approach in addition to the PIC scoring system. As a Level II versus a Level I trauma facility, a RFM clinical pathway needed to be developed specifically to the facilities' requirements.

Significance to Healthcare

The management of rib fractures typically consists of effective analgesia, early effective respiratory care, and mobilization. If any of these areas are not addressed promptly, it can lead to rapid decompensation resulting in acute respiratory failure (ARF), which in turn can result in ICU admission or increased LOS in the ICU and hospital. Readmission and prolonged ICU stays increase the use of healthcare resources, total hospital costs, and rates of mortality (Agency for Healthcare Research and Quality [AHRQ], 2014). According to AHRQ (2014), on average, ICU stays were 2.5 times more costly than regular hospital stays. The AHRQ determined that there were variations in ICU utilization, with over 93% consisting of respiratory failure or distress. According to monthly expense reports from the hospital, which include salaries and supplies, the average daily ICU expense is $951.00 per patient as compared to $440.00 per patient for the

medical-surgical, orthopedic, and neurosurgical floor patients (C. Bensen, personal communication, April 19, 2018).

Purpose

The project aimed to examine the use of a clinical pathway for patients with rib fractures to decrease pulmonary complications, episodes of readmission to ICU, and average ICU and hospital LOS for patients with three or more rib fractures. The purpose of this project was twofold. The first purpose was to develop a RFM clinical pathway and educational in-service program specifically for a rural Level II trauma hospital that encompasses early analgesia, aggressive pulmonary therapies, and early mobilization. The second purpose was to decrease episodes of acute respiratory failure, ICU readmissions, and total ICU LOS using the RFM clinical pathway in patients with three or more rib fractures.

Review of Literature and Synthesis of Evidence

The primary purpose of this literature review is to answer the PICOT question: Does the use of a RFM clinical pathway for adults with blunt thoracic injuries decrease episodes of acute respiratory failure (ARF), hospital and ICU readmissions, and total hospital and ICU LOS in a six-month period compared to the current standard of care? The intent is also to examine current literature regarding best practice guidelines in the management of patients with traumatic rib fractures.

A review of the literature from 2000-2017 was conducted in the Cochran Database of Systematic Reviews, Cumulative Index to Nursing and Allied Health Literature (CINAHL), PubMed, Medline, and PsycINFO. Keywords and combinations of words used for the search included clinical pathways, blunt thoracic injury, RFM, pain control, chest physiotherapy, ICU readmissions, ICU costs. A total of 21 articles were found meeting these criteria and varied from

randomized control trials to case reports. The strength of evidence was evaluated using John Hopkins Evidence-Based Practice (EBP) Levels of Evidence. Seven primary studies were chosen based on their strength of evidence, design, and applicability to this project (see Appendix B Summary Table of Literature Appraisals). Current guidelines for RFM were included.

Clinical Pathways

A care bundle, also known as a clinical pathway, is a group of evidence-based practices targeting specific clinical problems aimed at improving the quality of patient care when used together. Research findings suggest that the implementation of clinical pathways or care bundles within the healthcare setting affords healthcare staff the tools necessary to standardize care across patient populations thereby improving health outcomes (Andres et al., 2017; Rotter et al., 2010; Sesperez, Wilson, Jalaludin, Seger, & Sugrue, 2001; Todd et al., 2006). A clinical pathway introduces an evidence-based protocol for a specific clinical problem resulting in an increase in patient care efficiency and effectiveness (Andres et al., 2017), increased communication, documentation (Andres et al., 2017; Rotter et al., 2010), protocol compliance (Damkliang, Considine, Kent, & Street, 2015), and more effective use of hospital resources (Rotter et al., 2010). Variation in patient care is reduced (Damkliang et al., 2015; Sesperez et al., 2001) resulting in fewer medical complications (Rotter et al., 2010) which decreases patients LOS (Andres et al., 2017; Rotter et al., 2010; Todd et al., 2006) and overall hospital costs (Rotter et al., 2010). As a result, these research findings suggest that the use of a clinical pathway in patients with rib fractures may reduce patient complications associated with ARF and hospital and ICU readmissions while reducing LOS and overall hospital costs.

Rib Fracture Management

Rib fracture management has been very diverse over the years. It has ranged between the use of rib belts, pain management, and ventilatory support. Complications secondary to restrictive ventilatory function, such as pneumonia, respiratory failure, and acute respiratory distress syndrome (ARDS) are often associated with multiple rib fractures (Battle, Hutchings, & Evans, 2012; Lien, Chen, & Lin, 2009; Sharma et al., 2008; Todd et al., 2006). These complications can lead to increased time in the ICU, increased hospital LOS, and increase rates of morbidity and mortality in this population. Current measures to improve ventilatory function include adequate pain management, early mobilization, in addition to chest physiotherapy.

Pain management. The effective use of IS and the ability of patients to have a productive cough are key factors in preventing complications. Hence, early and aggressive pain management is imperative for this patient population to adequately clear their airway. Analgesia is obtained with oral medication, patient-controlled intravenous medications, lidocaine patches, and epidural catheters or blocks such as paravertebral and intercostal blocks.

Oral medications and patient-controlled analgesia. Typically, RFM begins with the management of pain using Patient-Controlled Analgesia (PCA) and oral pain medications. Oral pain medications can vary between acetaminophen, non-steroidal anti-inflammatory drugs (NSAID), gabapentin, and opioid medications. The Western Trauma Association (WTA) recommended achieving adequate pain control using a multimodality approach (Brasel et al., 2017), while the Eastern Association for the Surgery of Trauma (EAST) conditionally recommended multimodal analgesia (Galvagno et al., 2016). There is limited, low-level research using a multimodal approach, specifically in trauma populations (Galvagno et al., 2016). However, other populations have exhibited the benefits of limiting opioid use (Jarzyna et al., 2011). Therefore, researchers recommend a multimodality approach to decrease the use of

narcotic medications and to help establish a balance in aggressive pain management with minimal adverse reactions (Brasel et al., 2017; Cho et al., 2011; Galvagno et al., 2016; Jarzyna et al., 2011).

Epidural and paravertebral blocks. Research findings indicated that placement of an epidural catheter can reduce rates of pneumonia, mechanical ventilation times and mortality, in addition to providing pain control to increase overall pulmonary function (Brasel et al., 2017; Bulger, Edwards, Klotz, & Jurkovich, 2004; Duch & Møller, 2015). Published guidelines by EAST indicated that a paravertebral block created equivalent pain management when compared with an epidural block, while both interventions indicated improvement of pain from the patients' baseline (Galvagno et al., 2016). The WTA reported that early use of epidural or paravertebral blocks in patients with severe pain improved patient outcomes, especially in elderly populations (Brasel et al., 2017). Although the early use of epidural and paravertebral blocks is the gold standard of care for thoracic injuries, patients with multisystem trauma may have contraindications such as traumatic brain injury (TBI) or spinal injuries (Witt & Bulger, 2016).

Chest physiotherapy. Chest physiotherapy (CPT) improves ventilation, which is a key factor in improving patient outcomes and preventing pulmonary complications such as pneumonia, respiratory failure, and ARDS (Spapen, De Regt, & Honoré, 2017). Monitoring the use of IS and vital capacity (VC) has been used to assess pulmonary function in this high-risk population (Brown & Walters, 2012; Carver, Milia, Somberg, Brasel, & Paul, 2015). In a retrospective review of 683 patients with rib fractures in a Level I Trauma Center, Carver et al. (2015) discovered that a VC less than 30% was independently associated with pulmonary complications. In contrast, higher VC's were associated with fewer pulmonary complications to

the extent that for every 10% increase in VC, there was a 36% decrease in the likelihood of developing a pulmonary complication.

Other methods of chest physiotherapy that can benefit this patient population include therapies such as IS and Continuous Positive Airway Pressure (CPAP). Research findings suggest that both therapies have decreased complications such as pneumonia and respiratory failure (Udekwu, Patel, Farrell, & Vincent, 2017). Noninvasive ventilation (NIV) is another method of chest physiotherapy that can benefit this population. Udekwu et al. (2017) found early intervention of NIV in patients with four or more rib fractures decreased the incidence of respiratory failure.

Scoring Tool

Scoring systems for rib fractures and risk assessments have been used in the past in an attempt to predict which patients would have poor outcomes (Pape et al., 2000). Ribscore is the first radiographic scoring system with prognostic value and a more recent scoring tool that is found to accurately predict pulmonary complications in patients with six or more rib fractures (Chapman et al., 2016).

Summary

Patients with multiple rib fractures have a high risk of respiratory complications and morbidity (Holcomb, McMullin, Kozar, Lygas, & Moore, 2003; Lien et al., 2009; Todd et al., 2006). Early intervention is an important factor that affects patient outcomes and LOS (Brasel et al., 2017; Galvagno et al., 2016; Holcomb et al., 2003). Existing literature indicates several areas of single modal interventions such as analgesia, IS, and NIV, which can improve patient outcomes. However, difficulties exist in ensuring patients receive this full spectrum of care. Standardized management through the use of a clinical pathway can organize care modalities in

order to decrease respiratory complications, provide consistency in efficient and effective care, and potentially decrease healthcare costs, by reducing LOS and hospital and ICU readmission (Fakry, Martin, Al Harakeh, Norcross, & Ferguson, 2013; Rotter et al., 2010; Sesperez et al., 2001; Todd et al., 2006; Wilson, Bin, Sesperez, Seger & Sugrue, 2001).

Theoretical Framework

Meleis' Experiencing Transitions theory is an emerging middle-range theory with an emphasis on transition (Meleis, Sawyer, Im, Messias, & Schumacher, 2000). This theory was developed in the 1960's by Afaf Ibrahim Meleis, a prominent nurse sociologist, educator, theorist, and researcher. Dr. Meleis continued to refine this theory over three decades. The theory has five essential properties consisting of awareness, engagement, change and difference, time span, and critical points and events (Meleis et al., 2000).

Patients with rib fractures experience multiple simultaneous and complex transitions, especially in their transfer from the ICU to the medical floor. Patients are transitioning from survival to recovery. Changes in health relating to an acute event create a process of transition wherein patients are more susceptible to risks that could negatively impact their health (Meleis et al., 2000). Establishing a clinical pathway to standardize the care of thoracic injuries will provide the necessary interventions to promote optimal respiratory status to avoid complications and prolonged transitional time to recover. By responding to specific transitions with interventions that promote health, this clinical pathway will optimize and improve patients' transition and health outcomes (Meleis et al., 2000). Trauma is an acute process that could potentially require multiple transitions through several levels of care to include the acute injury, surgery, transfers to different medical floors, disability, and possible discharge to another facility such as inpatient rehabilitation. This theory provides a framework and identifies milestones in

this process in which congruent care is needed for transition in order to promote positive outcomes.

Methodology

Objectives and Measurable Outcomes

The primary objective was to integrate and implement an evidence-based, RFM clinical pathway that will promote early intervention to decrease the incidence of ARF, ICU readmission, and prolonged hospital and ICU LOS. Measurable outcomes included the prevalence of the diagnosis of ARF (J96.0), ICU readmission, and total hospital and ICU LOS.

Setting

The project setting was a Level II, ACS certified, rural western trauma hospital. This facility is the only Level II facility within a 200-mile radius and is the primary accepting facility in the western half of the state. The closest regional Level I trauma center is over 475 miles away. Patients treated at the rural Level II trauma hospital have an average Injury Severity Score (ISS) higher than the national average ISS score of other ACS certified Level II facilities. According to the ACS (2016), ISS is a system injury score ranging from one to seventy-five. The risk of death increases with a higher score. Scores of 16-24 are considered severe, and a score greater than 24 is considered critical. This Level II trauma hospital is one of only 263 ACS certified facilities in the United States and does not have a clinical pathway or protocol for RFM.

Sample

Participants included patients admitted to the trauma hospital with a blunt thoracic injury. The inclusion criteria included adults over the age of 18 years with three or more rib fractures. The exclusion criteria included those with TBI, high spinal cord injury, Glascow Coma Scale less than 13, and those requiring ventilator support on admission.

Project Plan

The project implementation spanned over twelve months (see Appendix C, DNP Scholarly Project Timeline). The project leader submitted the applicable hospital and Kent State University forms for Institutional Review Board (IRB) Review and was found to be exempt from IRB approval since data analysis will contain no personal identifying data. This project adhered to Health Insurance Portability and Protection Act (HIPPA) regulations to protect the confidentiality and anonymity of all participants. Data extracted from the Trauma Registry did not include any patient identifiers.

Meleis' Experiencing Transitions Theory guided the project. The first two concepts in Meleis' Theory are that of *awareness* and *engagement*. *Awareness* of an increasing number of trauma patients readmitted to the ICU due to respiratory failure was noted during the presentation of the annual trauma report in March of 2017. *Engagement* occurred when this information was communicated to key stakeholders. As per facility policy, an application for change was submitted to the Change Committee for evaluation and approval to proceed with the development of the RFM clinical pathway. Following approval, a workgroup consisting of key stakeholders was formed. The group of key stakeholders included a member from the administration, nursing management, pharmacy, respiratory therapy, trauma service management, information technology, ICU management, and the Doctorate of Nursing Practice (DNP) student who served as the project leader.

The third concept in Meleis' Theory is that of *change and indifference*. The rural Level II trauma hospital had no previous pathway or protocol for RFM. *Change* involved the development of a RFM clinical pathway, which included a PIC scoring tool (see Appendix A). The RFM clinical pathway was adopted from a protocol used at a western, ACS certified, Level I

trauma center and was specifically adapted for the Level II trauma hospital. The PIC Score is a subjective scoring system, which addresses pain, inspiration, and cough. If undertreated or shown to be ineffective, these three areas can lead to respiratory failure in patients with rib fractures (Brown & Walters, 2012; Galvagno et al., 2016). Pain was scored using the standard numerical pain scale. Inspiratory capacity was scored based on IS effort, and cough was scored by the patient's ability or inability to productively cough. If a patient scored a one in any category or had an overall score of less than four, despite current interventions, then the trauma surgeon or APP was notified to initiate a more aggressive therapeutic approach.

An educational session was provided to RTs, APS, floor managers, and registered nurses (RN) after the RFM clinical pathway was created and approved by the administration. A mandatory RFM clinical pathway education module was presented to all RNs, pain pharmacists, and RTs on June 1, 2018, through the facility online educational service HealthStream. All healthcare workers were allotted four weeks to complete the module. The educational module contained a brief powerpoint presentation discussing the roles and responsibilities of the individuals and departments involved. In addition, the education module described patient education, assessment, and how to initiate the RFM clinical pathway (see Appendix D, Rib Fracture Management Pathway Responsibility). Additional education was provided during monthly meetings for RTs and RNs on the four medical floors and in the ICU. Attending monthly meetings provided an opportunity for the project leader to answer questions and address concerns and comments regarding the utilization of the RFM clinical pathway. The six trauma surgeons and two APPs on the Trauma Services team had a brief information and education session at their monthly multidisciplinary meeting. Individuals not attending the meeting were instructed individually by the project leader. Early interventions were coordinated with RNs,

RTs, and APS and included IS, cough, IPV, or Bilevel Positive Airway Pressure (BiBAP), multimodal pain management, and possible placement of an epidural or a paravertebral catheter for pain control.

The fourth component, *time span* refers to the constant flow of change across time, noting there must always be a forward motion for change to occur (Alligood &Tomey, 2010). Data for all trauma patients meeting criteria are documented in the National Trauma Registry database system. Data from the Trauma Registry was obtained from the Trauma Data Analyst for the same six-month period before the RFM clinical pathway and six months post RFM clinical pathway use.

The fifth component was that of *critical points* and *events.* Even though data was collected at the end of the project, a continuous evaluation took place throughout the project. The data collection point was one crucial part of the event. *Events* that affect transition, such as the inability to transfer to the floor due to staffing or high census, inability to place an epidural for pain control, or the need to go to the Operating Room (OR) for other injuries were identified. Identifying those *critical points* was crucial to transition.

Resources

This project was a collaborative effort with key stakeholders, including the patient, patient families, administration, nurses, RTs, APS, project leaders, and Trauma Services. The expenses associated with the implementation and development of this project were nominal (see Table 1, DNP Project Resources).

Table 1

DNP Project Resources

Resources	Cost per Item or Person	Total Cost	Cost to Project Leader
Educational in-service to nursing staff in ICU, and four medical floors	$55/hr X 30 hours	$1650	$0
Educational in-service APS, RT, and managers	$55/hr X 10 hours	$550	$0
Trauma Data Analyst will access data and pull reports	$25/hr X 4 hours	$100	$0
Supplies: 60 color (0.11 each) laminated (0.44 each) PIC score sheets	copies $6.60 laminating sheets $26.40	$33	$0
Total		$2333	$0

The Trauma Data Analyst donated time of approximately two hours to produce reports containing the required data. Since there was no money in the current budget for this project, Trauma Services donated 60 laminated, colored PIC score sheets to medical floors and the ICU. The project leader, who donated approximately 40 hours, initially conducted in-service education. Education followed a template and included a discussion of the project, PIC scoring tool, roles and responsibilities, and allowed time to answer questions. The in-service education was accomplished by the project leader who attended staff meetings for APS, RTs, department managers, and nursing staff on four different medical floors and the ICU. Education was completed during employee orientation and by nursing managers, following the initiation of the RFM clinical pathway. Other services received education during the monthly multidisciplinary trauma meeting.

Data Analysis

Data were analyzed using SPSS25.0 for Mac. The demographic characteristics of the patient's age, gender, race, ISS, and mechanism of injury (MOI) were analyzed using descriptive

statistics included ranges, means, and standard deviations or chi-squares. Patient outcomes were compared six months pre- and post-pathway implementation of the RFM clinical pathway. Outcome measurements included the rate of diagnosis of ARF, ICU readmission, and total ICU LOS. Intensive Care Unit readmission and ARF were categorical and analyzed using chi-square. A *t*-test was used to compare the number of days admitted to the ICU pre- and post-clinical pathway.

Results

The Trauma Data Analyst obtained reports from TQIP for all patients meeting inclusion and exclusion criteria from July 1, 2017 to December 31, 2017. Reports were also obtained for post-intervention patients meeting the same criteria from July 1, 2018 to December 31, 2018. The following section will describe both the descriptive statistics and outcome measures for this project.

Descriptive Statistics

Demographics. In the 2017 sample, 40 individuals comprised of 67.5% (*n*=27) were male, and 32.5% (*n*=13) were female. In the 2018 sample, there were 53 individuals comprised of 69.8% (*n*=37) males and 30.2% (*n*=16) females. Therefore, the gender distribution across both samples was comparable, χ^2 (1) = .06, *p*=.81. The youngest individual in the 2017 sample was 18 years old, and the oldest was 88, with a mean age of 56. However, the larger standard deviation (18.3) suggests a broad spread of age ranges around the mean, and the skewness statistic (-.23) suggests that these data are skewed left. For the 2018 sample, the youngest individual was 18 and the oldest 96, with the mean age of 61. Again, this data is characterized by a high standard deviation (16.7) and negative skew (-.30), suggesting that there are more

individuals in both samples who are above the mean ages of 56 and 61 than there are below (see Table 2, Patient Demographics).

The 2017 sample had 92.5% White or Caucasian and 2.5% falling into each category of American Indian, Hispanic or Latino, or unknown. Whereas in the 2018 sample, patients were 86.6% White or Caucasian with 13.2% falling into American Indian or unknown categories. The difference between the two groups was not statistically significant, χ^2 (3) =3.018, p=.39 (see Table 2, Patient Demographics).

Table 2

Patient Demographics

	2017 (n=40)	**2018** (n=53)
Characteristics	n (%)	n (%)
Age, in years		
18-49	15 (37.5)	9 (17.0)
50-69	13 (32.5)	29 (54.7)
70-89	12 (30.0)	12 (22.6)
90+		3 (5.7)
Sex		
Male	27 (67.5)	37 (69.8)
Female	13 (32.5)	16 (30.2)
Race		
White or Caucasian	37 (92.5)	46 (86.8)
American Indian	1 (2.5)	4 (7.5)
Hispanic	1 (2.5)	0
Unknown	1 (2.5)	3 (5.7)

Mechanism of injury. In 2017, motor vehicle crashes (MVC), motorcycle crashes (MCC), and all-terrain vehicle (ATV) crash accounted for the majority MOI at 47.5% in 2017 versus 35.9% in 2018 (see Table 3, Mechanism of Injury). While some differences can be observed between the samples, the differences are non-significant in chi-square analyses, χ^2 (9) =8.0, p=.53.

Table 3

Comparing Mechanism of Injury

	2017 (*n*=40)	**2018** (*n*=53)
Mechanism of Injury	*n* (%)	*n* (%)
MVC	12 (30)	8 (15.1)
MCC/ATV	7 (17.5)	11 (20.8)
Bicycle	1 (2.5)	3 (5.6)
Fall from height	9 (22.5)	11 (20.8)
Ground level fall	6 (15.0)	10 (18.9)
Industrial	1 (2.5)	0 (0)
Sporting Activities	0 (0)	1 (1.9)
Horse or Animal	3 (7.5)	3 (5.6)
Penetrating	0 (0)	2 (3.8)
Other	1 (2.5)	4 (7.5)

Outcome Measures

The independent *t*-test was used to evaluate ISS, ICU, and hospital LOS before and after the intervention. The sample population in 2017 had a higher (M=13.9, SD=8.0) ISS than the 2018 population (M=11.9, SD=7.6), but the difference was not statistically significant in independent *t*-tests, $t(91)=.40$, $p=.69$. The ICU LOS was also statistically comparable across the categories, $t(91)=.11$, $p=.92$. Finally, while the mean LOS in the hospital was slightly higher among the 2017 (M=6.8 SD=6.0) sample than among the 2018 sample (M=6.3 SD=5.1), the difference did not reach statistical significance, $t(91)=.12$, $p=.25$ (see Table 4, Comparison of LOS and ISS).

Table 4

Comparison of Length of Stay and ISS

	Data Collection			
	2017 (*n*=40)	2018 (*n*=53)		
	Mean (*SD*)	Mean (*SD*)	*t*(91)	*p*
ISS	13.9 (8.0)	11.9 (7.6)	.40	.69
ICU LOS	2.0 (2.8)	1.9 (2.3)	.11	.92

Hospital LOS	6.8 (6.0)	6.3 (5.1)	.12	.25

Similarly, there were no significant differences between the samples in terms of readmission to ICU rates, χ^2 (1) =1.46, p=.23, or respiratory failure rates, χ^2 (1) =1.64, p=.20 (see Table 5, Comparison of Readmission to ICU and Respiratory Failure Rates).

Table 5

Comparison of Readmission to ICU and Respiratory Failure Rates

	Data Collection			
	2017 (n=40)	2018 (n=53)		
	n (%)	n (%)	χ^2 (1)	p
Readmissions to ICU	4 (10.0)	2 (3.8)	1.46	.23
Respiratory Failure (J96.0)	13 (32.5)	11 (20.8)	1.64	.20

Impact of Results on Practice

The purpose of this project was twofold. The first purpose was to develop an evidence-based RFM clinical pathway and educational in-service protocol specific for a rural Level II trauma hospital, which encompassed early analgesia, aggressive pulmonary therapies, and early mobilization. The second purpose was to decrease episodes of acute respiratory failure (J96.0), ICU readmissions LOS, and total ICU and hospital LOS using the RFM clinical pathway in patients with three or more rib fractures. The literature is very limited for clinical pathways or bundled care in trauma patients due to the variety of concurrent injuries in this specific population. Few studies have been performed addressing the use of clinical pathways in the trauma population. Existing literature for RFM suggested several areas of single modal interventions such as analgesia, epidural placement, IS, and NIV can improve patient outcomes (Brasel et al., 2017; Bulger, Edwards, Klotz, & Jurukovich, 2004; Carver et al., 2015; Duch &

Møller, 2015; Unsworth, Curtis, & Asha, 2015). However, difficulties exist in ensuring patients receive a full spectrum of care.

In this quality improvement project, there were gaps identified in the delivery of consistent, evidence-based care. There were delays in epidural placement and IS use in addition to a lack of patient education regarding their injuries and the need to maintain good pulmonary hygiene. The results of this project did not indicate any statistical difference in readmission rates to the ICU or rates of ARF. At first glance, there appear to be fewer readmissions to the ICU following the intervention. There were four readmissions to the ICU in 2017 (n=40) and two readmissions to the ICU in 2018 (n=53). In 2017, three of the four readmissions were for ARF and one for a decreased level of consciousness, secondary to pain medications. In the 2018 readmissions, one patient was readmitted for respiratory failure and the other for alcohol withdrawal syndrome. The difference between pre- and post-intervention samples were not significant, which may be in part due to the small sample size. The patient requiring readmission to the ICU for alcohol withdrawal had a total ICU LOS of 10 days. As a result of the small sample size, this may have skewed the data to the extent that it inhibited a measurable difference following the RFM clinical pathway intervention.

Finally, even with the induction of a clinical pathway, objectives may be unattainable as a result of an organization's pre-existing standard operating procedure (SOP) or predefined job descriptions preventing full compliance to the clinical pathway protocol. For example, an order placed by the trauma surgeon or APP was required to initiate the RFM clinical pathway. Two patients met the inclusion criteria but were excluded because the trauma surgeon or APP did not initiate the RFM clinical pathway for unknown reasons. Another example was regarding the initial assessment and education of patients. According to the RFM clinical pathway, following

order placement, the RT had up to 2 hours to assess the patient and educate them on the use of IS and the PIC scoring system. The previous responsibility of assessment and patient education was delegated to RNs due to a new EHR system that was introduced 2 years prior. There were delays in patients receiving education and instruction. This project discovered some RTs did not feel it was related to their job duties and should be a nursing duty, which was most likely a mindset from the previous predefined job descriptions. Though not to the extent noted previously, this mindset was noted to cause some delays in initial treatment at the start of the project. As previously mentioned, research findings suggested that prompt assessment and intervention significantly decreased the frequency and rate of respiratory failure (Battle, Hutchings, & Evans, 2012; Galvangno et al., 2016; Lien, Chen, & Lin, 2009; Sharma et al., 2008). Additionally, it was discovered that newly employed RTs were not receiving the mandatory education regarding the RFM clinical pathway. Therefore, considering and addressing current practices that may hinder the success of an implemented clinical pathway is imperative to its success.

Strengths and Limitations of the Project

This project had strengths as well as limitations. This quality improvement project involved using a multidisciplinary team approach to care, which will not only improve patient outcomes but use resources more efficiently. The project also increased staff awareness of the need for early intervention in this population in order to improve outcomes and prevent complications.

There were a few limitations identified in this quality improvement project. The results were from a single facility in a rural western state. It has been noted that even though the facility is a Level II Trauma facility, the average ISS is higher than the national average of other Level II

facilities. Another limitation of this project was the short, six-month time frame, which resulted in a smaller than predicted sample size. Smaller samples make it difficult to evaluate the translation of evidence into practice and increase the risk of errors.

The electronic health record (EHR) system called Epic has different windows and views depending on the user. What a RN has access to does not appear to be the same as an NP or doctor's view. For the Trauma Data Analyst, Epic does not show a clear indication that transfer orders were placed. Transfer orders can be placed, and if there is not an available bed on the receiving unit, the ICU nurse will release the floor orders and continue to manage the patient in ICU until a bed becomes available. When the Trauma Data Analyst is entering data into TQIP regarding ICU LOS, the patient may still appear to be in ICU.

This project was also limited by new staff in nursing and respiratory therapy not receiving required education regarding the RFM clinical pathway. The protocol includes notifying the trauma provider of any PIC score of one or a total score of four or less, and on two separate occasions, it was noted there was a patient that scored within these notification parameters, and no notification was made by the RT or RN respectively. It was determined these were new staff members who did not receive the required education.

Dissemination Plan and Rationale

Evaluation of this quality improvement project has been continuous and resulted in increased awareness and interest. During the project, the RFM clinical pathway was discussed at the Western Regional Trauma Advisory Committee (WRTAC) meeting, and then Trauma Services was asked to share the RFM clinical pathway and current findings at both the Central and Eastern Regional Trauma Advisory Committee meetings as well as the State Trauma Advisory Committee meeting. Currently, information regarding the RFM clinical pathway is

being adopted by two other Level II trauma facilities in the state and several smaller facilities who plan on adopting and implementing a similar project. In addition, cardiac services were educated on the findings and started using the RFM clinical pathway for the patient sustaining rib fractures following cardiopulmonary resuscitation.

The plan is to continue to expand on the current project and re-evaluate the data in one full year. The ultimate goal is to publish the findings of this project in a peer-reviewed trauma journal.

Future Implications for Practice and Sustainability

Due to the variety of concurrent injuries within trauma patient populations, the current research literature exploring the implementation of clinical pathways is limited. However, the existing literature on RFM is robust and suggested several single modal interventions to improve patient outcomes. As a result of the variation in suggested interventions and hospital protocols, patients do not receive consistent care across institutions and often do not receive the full spectrum of care necessary to reduce the risk of complications that lead to more severe health issues. Research findings suggest that the development of a RFM clinical pathway could potentially promote early intervention, facilitating a reduction in patient complications with ARF, hospital and ICU readmission, and reduce LOS and hospital costs.

An important outcome of this project was increased awareness at both the hospital and state level. The need for early interventions in patients with thoracic injuries is essential to improving outcomes. A RFM clinical pathway provides cost savings, multidisciplinary approach, with consistent use of interventions. Prior to the initiation of this project, orders for IS were placed and sometimes not instituted for over 24 hours. It was also noted the patient was not properly educated on the necessity of IS and pain management. The project increased staff

awareness on the need for IS and proper education. Also, patients received education and IS within a few hours of admission. The development of an RFM clinical pathway can decrease gaps in care, improve patient education, and positively impact quality, not only in the trauma population but across the entire healthcare system.

The cost of implementing this project was minimal for the hospital. However, several factors need to be thoroughly considered and addressed to ensure the sustainability of this project. Namely, achieving organization-wide goal alignment, ensuring proper education of the clinical pathway protocol to all stakeholders across shifts, and ensuring protocol requirements can be aligned with both pre-standing hospital protocols and pre-determined job descriptions.

During the implementation of the RFM clinical pathway, there were inconsistencies identified in the delivery of care. A possible cause of these inconsistencies could be the lack of an organization-wide alignment with the goals of the RFM clinical pathway in addition to a lack of procedural clarity and inconsistent understanding and education of healthcare stakeholders across all shifts. Although a great effort was taken to ensure individuals were educated on the RFM clinical pathway, various stakeholders may not have understood or acknowledged the value and potential benefits of its implementation. Respiratory therapy initially felt pulmonary hygiene was a nursing responsibility until more education was provided. In addition, RT management felt the six hour assessment outlined in the clinical pathway may strain RT resources.

The major resources necessary to ensure the sustainability of this project include a concerted effort across multidisciplinary stakeholders toward a unified goal of the intervention. Sustainability can be accomplished by securing dedicated funding for the RFM clinical pathway, incorporating mentors or champions of the intervention, addressing staffing challenges, and

making the necessary system changes for the RFM clinical pathway to succeed. Ensuring visible performance measures are in place, such as publicizing and sharing patient health outcomes as a result of the intervention, are also suggested to instill value in the project.

Conclusion

As noted in Meleis' Experiencing Transitions theory, providing the necessary interventions to promote health can improve patient transitional time to recovery and improve patient outcomes. The rib fracture management clinical pathway provides a standardized approach to care of patients with thoracic injuries. The need for a standardized approach to managing trauma patients with thoracic injuries is essential to improve patient outcomes and quality of care. Patients that present with multiple rib fractures are at high risk for respiratory complications and morbidity (Holcomb, McMullin, Kozar, Lygas, & Moore, 2003; Lien et al., 2009; Todd et al., 2006). Research findings on RFM suggest that early intervention is a key factor in minimizing respiratory complications and reducing hospital and ICU LOS (Brasel et al., 2017; Galvagno et al., 2016; Holcomb et al., 2003). The evidence supports individual interventions that improve patient health outcomes and quality of care in this patient population, which serves as a solid foundation for the development of a RFM clinical pathway.

This current evidence-based project aimed to implement a RFM clinical pathway into a rural Level II trauma hospital with the intent of decreasing the rate of the diagnosis of ARF, ICU readmission, and hospital and ICU LOS. The findings from this project were not significant for the measurable outcomes, which included diagnosis of ARF, ICU readmission rates, and total hospital and ICU LOS within the participating rural Level II trauma hospital. Limitations of the current study included the small sample size and limited duration of time in which the RFM clinical pathway was conducted. Although the analytics did not reveal a statistical significance,

several important factors that could affect the implementation of a clinical pathway were revealed. Specifically, gaps in the consistency of care were identified prior to and following the implementation of the RFM clinical pathway. These gaps could be caused by a need to achieve organization-wide goal alignment, effective education of the clinical pathway protocol to all stakeholders across shifts, and to ensure protocol requirements can be aligned with both pre-standing hospital protocols and pre-determined job descriptions. The RFM clinical pathway project should move forward into a larger study of longer duration to theoretically produce more robust evidence.

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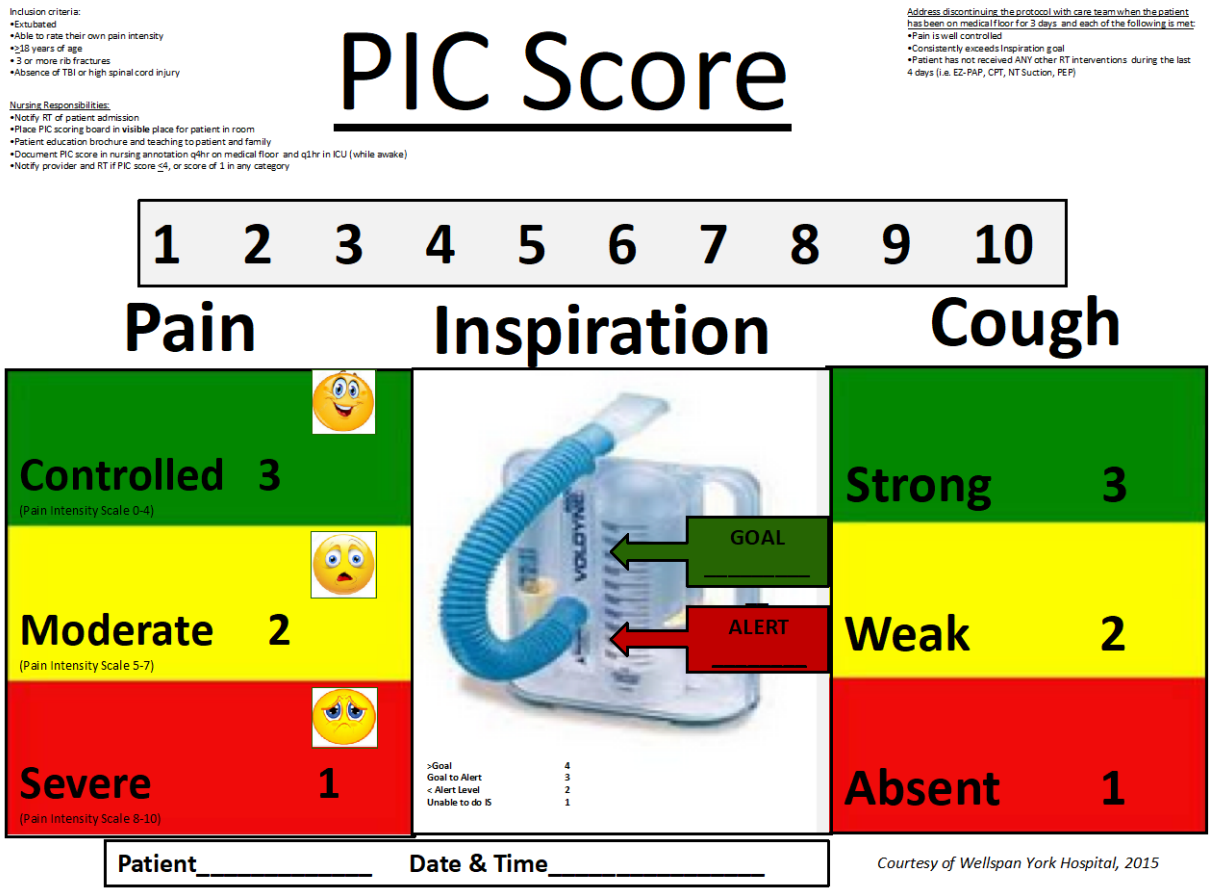
Appendix A



Notes: PIC Scoring originally developed by Wellspan York Hospital, and with written permission was adopted for use by Harborview Medical Center. Written permission was obtained for its use by C.Witt and E. Bulger (personal communication, April 10, 2018).

Appendix B

Summary Table of Literature Appraisals

Synopsis				**Credibility**		**Applicability**
Authors, (Year), country	Study Design and Sample	IV and DV Measurement	Outcomes/Findings	Appraisal Strength-Weakness		Valuable to practice Y/N/Maybe LOE
Wong, E. M., Chan, S. W., & Chair, S. (2010) China	• Quasi-experimental • N=125 pts, • 62 to EG and 63 CG • 6 hospital wards randomized into experimental and control	• IV: usual care plus educational intervention vs usual care only • DV: pain by VAS • DV: Anxiety by STAI • DV: self-efficacy by C-SES	• EG Reported significant lower pain and anxiety during hospitalization only (T0-T3) as compared to CG($p<.001$). • EC consistently increased SE across all time periods, CG decreased SE. • No statistical significance Regarding LOS.	• Adequate sample size to detect education intervention w/ stat. significance • Multiple measurements different time intervals, long and short-term effects • Randomly selected hospital wards	• Did not randomize participants, randomized 6 hospital wards. There may have been differences in hospital wards regarding noise level, temperature, etc.	• Maybe • Good info regarding pain control. The EG had less pain which is essential to pts. with rib fractures. Less pain means less chance of resp. complications. Pts with rib fractures were excluded from this study • LOE: Level II
Rotter, T., et al (2012) USA	• Systematic Review of RCT • Inpatients managed w/clinical pathway	• 27 studies containing intervention of clinical pathway	• Reduction of inpatient complications. • Improved documentation • Reduced use of hospital resources • Reduced LOS/cost	• Results relevant to a variety of settings • Adequate number of studies/participants	• No clear definition of clinical pathways has been widely accepted. • Unable to assess the individual designs of the	• Yes • Valuable to practice indicates clinical pathways can reduce resources, cost, LOS and

					pathways in each study	improve outcomes • LOE: Level I
Todd, S., et al., (2006) USA	• Quantitative prospective cohort • N=150 pts prospective cohort post pathway and CG N=150 pts pre-pathway	• IV: clinical pathway vs usual care • DV: pain cont. • DV: pneumonia rate & mortality • DV: ICU, hospital & vent days	• EG increase PCA and epidural use vs CG (p< .0001). • EG decrease ICU & hospital LOS • EG decrease pneumonia (p<.001) & mortality (p=.06) • EG increase in ventilator days	• EG compared to CG with similar gender and ISS scores • Reliable measures with adjustments for age, ISS and number of rib fractures	• EG possible cofounder to detect intervention effect: pts younger with more rib fractures than CG • EG increase in vent time, lower pneumonia rate • Many options for respiratory therapy	• Yes: This study is shows clinical pathways can decrease LOS, pneumonia and mortality. Is >10 yrs but very few done, and this is used as a foundation in other studies. • LOE: Level III
Carver, T. W., Milia, D. J., Somberg, C., Brasel, K., & Jasmeet, P. (2015) USA	• Quantitative retrospective chart review • N=683 pts over 4-year period	• IV: vital capacity • DV discharge disposition • DV pulmonary complication	• With every increase in VC of 10%, from 30-50, there was decrease likelihood of PC and d/c to ECF • Each 10% increase in VC correlated with 36% decrease PC	• Adequate sample size. • Used the same VC tool for measurement all 4 years • Clear definitions of variables	• No standardized performance of VC, used average of daily measurements • Confounding factors affecting VC such as pain control methods not look at, except epidural	• Yes: article identifies objective physiological data, use of VC Including VC in protocol may alert to potential respiratory decline • LOE: Level III
Bulger, E. M., Edwards, T., Klotz, P., &	• Quantitative prospective randomized trial • N=46 pts	• IV: epidural analgesia vs opioid PCA • DV: pneumonia	• Epidural group more chest trauma but rate of pneumonia 18% vs 36% in PCA group	• Randomization of participants b/w epidural and PCA	• May have been variability in meds administered	• Yes: over 10 years old but first to demonstrate epidural

Jurkovich, G. J. (2005) USA		• DV: LOS hosp/ICU • DV: vent time • DV: mortality	• Epidural group had less vent days than PCA group • No difference in mortality or LOS	• Well defined variable criteria	• Article over 10 years old • Small sample size • Unable to blind participants/researcher to CG or EG • Allowed crossover to another group for treatment failure	analgesia can improve outcomes and remains realistic to current clinical practice. It has been a foundation for several recent smaller studies. • LOE: Level II
Unsworth, A., Curtis, K., & Asha, S. E. (2015) Australia	• Systematic Review variety RCT, case studies • Treatment of rib fractures	• 40 studies from several different countries	• Clinical pathways decrease hospital and ICU LOS, mortality and improve outcomes in pts >65 yrs • Epidural analgesia most effective pain control method with fewer complications • Surgical fixation decreases need for mechanical ventilation and decreases ICU cost	• 10 of the 40 RCTs • Provided comprehensive exam of different treatment modalities	• Some trials limited by small sample size • No articles regarding noninvasive ventilation or paravertebral blocks included	• Yes • Found single treatment not as effective as multiple interventions using clinical pathways • LOE: III

Notes: Abbreviations. IV: Independent variable; DV: Dependent variable; VAS: visual analog scale; LOE: level of evidence C-SES: Chinese version of Self-Efficacy Scale; STAI: State-Trait Anxiety Inventory; EG: experimental group; CG: control group T1: Time 1 T2: Time 2 T3: Time 3, ISS: Injury Severity Score, VC: vital capacity, ECF: extended care facility, PC: pulmonary complications PCA: patient-controlled analgesia

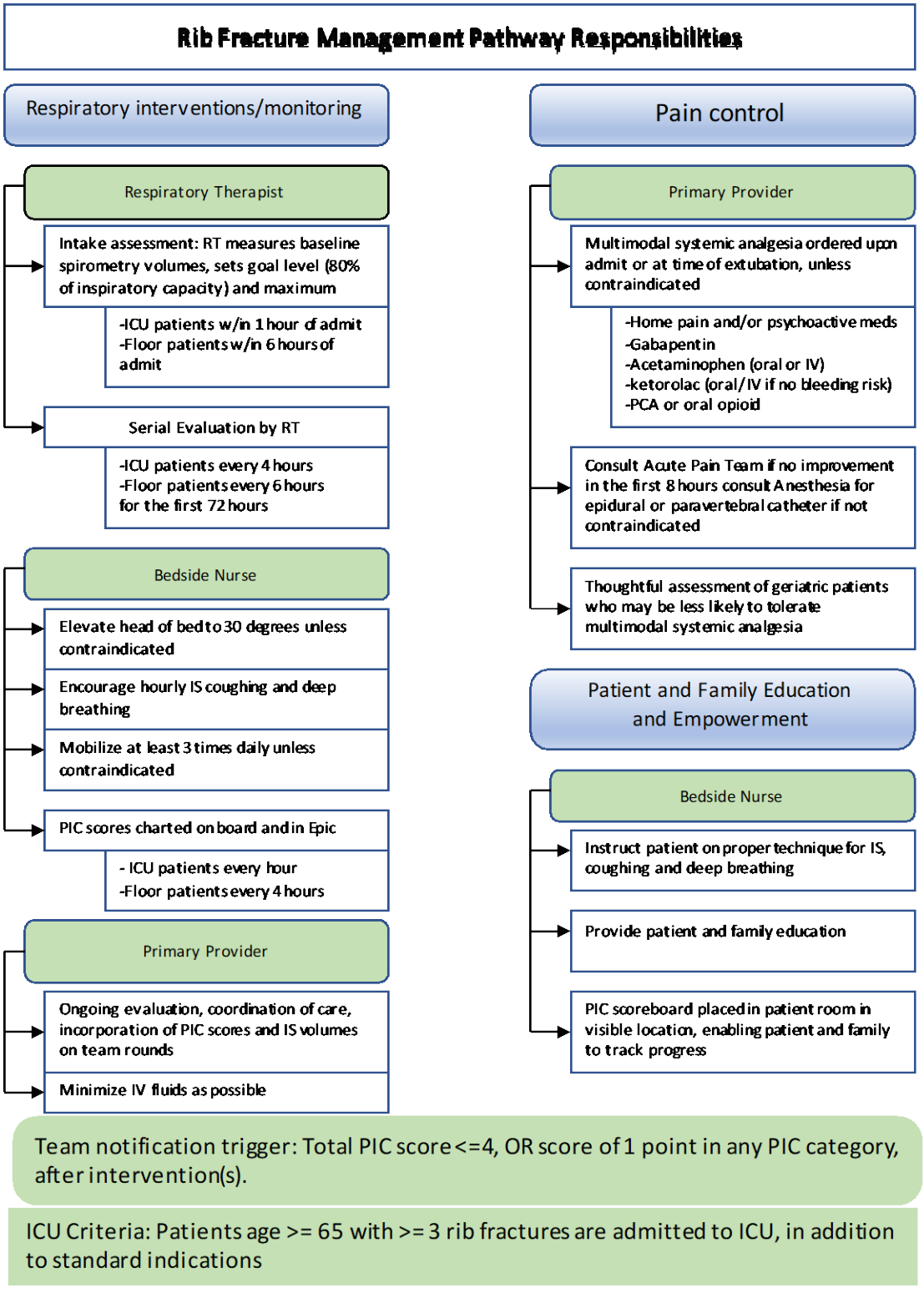
Appendix C

DNP Scholarly Project Timeline

	November 2017	December 2017	January 2018	February 2018	March 2018	April 2018	May 2018	June 2018	July 2018	September 2018	December 2018	March 2019	April 2019	May 2019	October 2019	November 2019
PICO question, literature review search and synthesis to chair.	X	X														
Formulate problem and purpose of the study.	X															
Identify committee members.	X															
Request and complete hospital change form required for project implementation.		X	X	X												
Meet with key stake holders, (administration, nursing floor and trauma managers, RT, pharmacy, IT).	X	X	X	X	X	X	X									
Attend meeting with pharmacy, RT, and nursing to present project proposal/answer questions/address concerns.							X									

Finalize EMR and charting requirements with IT.							X	X								
Meet with Trauma data analysist to obtain data.					X	X						X				
Provide PowerPoint presentation for HealthStream education.							X	X								
Proposal defense with first draft paper completions to chair then to committee for approval.							X									
Apply for IRB approval.								X								
Project implementation phase.									X	X	X					
Collect and analyze data.												X				
Begin final paper write up, limitations, implications, recommendation, and evaluation.													X	X		
Submit final paper to chair then to committee.															X	
Schedule final defense.																X
Present final defense.																X

Appendix D


Rib Fracture Management Pathway Responsibilities
Respiratory interventions/monitoring
Respiratory Therapist
Intake assessment: RT measures baseline spirometry volumes, sets goal level (80% of inspiratory capacity) and maximum
-ICU patients w/in 1 hour of admit
-Floor patients w/in 6 hours of admit
Serial Evaluation by RT
-ICU patients every 4 hours
-Floor patients every 6 hours for the first 72 hours
Bedside Nurse
Elevate head of bed to 30 degrees unless contraindicated
Encourage hourly IS coughing and deep breathing
Mobilize at least 3 times daily unless contraindicated
PIC scores charted on board and in Epic
- ICU patients every hour
-Floor patients every 4 hours
Primary Provider
Ongoing evaluation, coordination of care, incorporation of PIC scores and IS volumes on team rounds
Minimize IV fluids as possible
Pain control
Primary Provider
Multimodal systemic analgesia ordered upon admit or at time of extubation, unless contraindicated
-Home pain and/or psychoactive meds
-Gabapentin
-Acetaminophen (oral or IV)
-ketorolac (oral/IV if no bleeding risk)
-PCA or oral opioid
Consult Acute Pain Team if no improvement in the first 8 hours consult Anesthesia for epidural or paravertebral catheter if not contraindicated
Thoughtful assessment of geriatric patients who may be less likely to tolerate multimodal systemic analgesia
Patient and Family Education and Empowerment
Bedside Nurse
Instruct patient on proper technique for IS, coughing and deep breathing
Provide patient and family education
PIC scoreboard placed in patient room in visible location, enabling patient and family to track progress
Team notification trigger: Total PIC score <=4, OR score of 1 point in any PIC category, after intervention(s).
ICU Criteria: Patients age >= 65 with >= 3 rib fractures are admitted to ICU, in addition to standard indications