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Improving Trauma Activation Guideline Adherence in a Level III Emergency Department

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IMPROVING TRAUMA ACTIVATION GUIDELINE ADHERENCE IN A LEVEL III
EMERGENCY DEPARTMENT

by

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APPROVED BY DNP PROJECT ADVISOR / CLINICAL MENTOR

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Jesus Valdez

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Abstract

The purpose of this quality improvement project was to increase appropriate use of trauma activation guidelines by nurses in a Level III emergency department. Care provided by a multidisciplinary trauma team is paramount for the severely injured patient, as this may facilitate rapid diagnosis and treatment. Trauma-related mortality can be significantly decreased through the care provided. Trauma patients require specialized care at a precise time often called the “golden hour” to help prevent death or disability. Almost 30 Texans die every day from trauma-related injuries that averages to 10,000 people each year. Trauma is the leading cause of death in persons aged 1 to 44. In 2016, Hospital A had 21 (9.6%) missed cases (undertriage) surpassing the American College of Surgeons’ benchmark of achieving fewer than 5% undertriage. This project used an educational intervention for nurses based on hospital trauma activation guidelines and American College of Surgeons’ guidelines. Participants completed a pretest and posttest to measure efficacy of the educational intervention on the improvement of adherence to the trauma activation guideline. The nurse’s knowledge improved following the educational session as measured utilizing a pretest/posttest/post-posttest. The number of missed activations dramatically reduced when compared to the same time period last year. The utilization of an educational teaching session for the identification and management of trauma patients requiring higher level of care through the activation of the trauma team can be an effective viable option. Emergency department nurses play an integral role in the triage process, and must be held accountable for their role.

Keywords: trauma team activation, trauma activation guidelines, undertriage, missed activation

Overview of the Problem

Each year there is an estimated 136 million visits to the emergency room, and out of those visits, 41 million are related to trauma (Centers for Disease Control and Prevention [CDC], 2016). Trauma or traumatic injury is a term that refers to “physical injuries of sudden onset and severity which necessitates immediate medical attention, which if severe enough may cause system shock trauma and may require immediate resuscitation and intervention to save life and limbs” (University of Florida Health, 2017, para. 1). Traumatic injuries are a result of a variety of mechanisms: (a) motor vehicle collisions, (b) sports injuries, (c) falls, (d) natural disasters, and (e) a number of other physical injuries that can occur at home, work, and on-the-street that may require immediate medical care (UF Health, 2017). Trauma is something that can affect everyone of all ages and may have a considerable impact on life years lost, which is equal to the life lost from cancer, heart disease, and HIV combined (National Trauma Institute, 2014). Trauma not only impacts morbidity and mortality, but also has a financial burden of approximately \$671 billion a year, including healthcare costs and lost productivity (National Trauma Institute, 2014). Nearly 192,900 people die each year from violence and injuries, such as motor vehicle crashes, falls, or homicides (CDC, 2016). Many of the survivors are left with lifelong mental, physical, and financial problems.

For people between 1 to 44 years of age, trauma is the number one cause of death, surpassing the number of those succumbing individually to cancer, HIV, or flu in each category (CDC, 2016). Trauma is the third leading cause of death overall, across all age groups (CDC, 2016). When an individual with life-limiting illnesses enters the emergency department (ED) in a crisis, the often complex and multifaceted needs can be best managed by a multidisciplinary trauma team. The trauma team’s main objective is to rapidly (a) resuscitate and stabilize patients,

(b) prioritize and determine the nature and extent of the injuries, and (c) prepare the patient for transfer to the site where the patient will receive care, whether it be within the hospital or to an outside receiving hospital (Georgiou & Lockey, 2010). Studies have also shown that those patients who meet established trauma activation guidelines, but are not treated by a trauma team (trauma team activation was not called), have a higher mortality (Barsi et al., 2016; Gerardo et al., 2011; Rogers et al., 2012; Vickers et al., 2015). In clinical practice, the undertriage rate approached approximately 35% in the United States (Xiang, Wheeler, Groner, Shi, & Haley, 2014). By properly initiating the trauma activation, providers, including nurses, can do their best to assure that trauma patients receive all the available resources required to meet their needs (Georgiou & Lockey, 2010; Rados et al., 2013; Yoo & Mun, 2014; Xiang et al., 2014).

Problem

The main emphasis of this quality improvement project was to identify a patient-related health need within the department and to develop, implement, and evaluate a plan to rectify the problem. The following objectives were formulated based on the Doctor of Nursing Practice (DNP) student's needs assessment:

1. Evaluate the current standards of care that guide the care of the trauma patient in the ED at Hospital A.
2. Identify the ED nurses' and provider's knowledge pertaining to trauma team activation.
3. Identify the current use of protocols and clinical guidelines for trauma care and trauma team activations in the ED.
4. Identify potential barriers and facilitators that may aid or impede the completion and implementation of the quality improvement project.

5. Identify the process by which the nurses and providers will be educated about the trauma activation protocol.
6. Identify the number of trauma patients who are seen in the department each year.

Background

As trauma continues to be the leading cause of death for those 1 to 44 years old (CDC, 2016), it is imperative that trauma facilities formulate new methodologies in addressing undertriaging of patient traumas (Jelinek, Fahje, Immermann, & Elsbernd, 2014). The utilization of trauma teams provides much needed services in an efficient and expedient manner. Trauma teams have shown that to reduce the time taken for resuscitation, as well as time to perform computed tomography (CT) scans, to ED discharge, and the time it takes to get the patient to the operating room, have all been proven to improve survival rates (Georgiou & Lockey, 2010; Gerardo et al., 2011; Rados et al., 2013; Rogers et al., 2013; Yoo & Mun, 2014; Wang, Hsia, Shih, Tsai & Chen, 2014).

Hospitals' EDs have designated trauma levels that define what level of trauma can be managed and the type and timing of trauma resources that must be available (American Trauma Society, n.d.). Hospital A's ED is designated as a Level III trauma center. Level I trauma centers are capable of providing total care for every aspect of injury from prevention through rehabilitation and are the comprehensive regional resource to the community (American Trauma Society, n.d.). Level II trauma centers are able to initiate definitive care for all trauma patients by having multiple specialties on call 24 hours, such as general surgeons, orthopedic surgeons, neurosurgery, anesthesiology, emergency medicine, radiology, and critical care (American Trauma Society n.d.). Level III trauma centers have the ability to provide prompt assessment, resuscitation, surgery, intensive care, emergency operations, and the stabilization of trauma

patients (American Trauma Society n.d.). They differ in the available specialties they have available. Level III trauma centers have 24-hour coverage by emergency physicians and prompt availability of general surgeons, orthopedic surgeons, and anesthesiologists; however, severely injured patients' treatment consists of rapid identification, stabilization, and transfer to a Level I or Level II hospital. That is why it is paramount for nurses and staff to be able to identify those severely injured patients who require a higher level of care so they may receive the resources they need when they need them.

The trauma team in the ED at Hospital A is composed of multiple disciplines including radiology, respiratory, and laboratory services. Trauma activation is defined by Hospital A as the activation of the multidisciplinary hospital team. For the purpose of this project, a "correct call" or appropriate triage activation is defined as correctly activating a trauma activation when indicated according to the hospital's established trauma activation guidelines. Missed activation or undertriage occurs when a call was indicated according to the trauma activation guidelines, but was not activated.

In the current ED, there is a two-tiered trauma activation guideline system that triggers the trauma team to be assembled (Appendix A). A Level I trauma activation involves immediate response by a full trauma team that includes a trauma surgeon for patients with physiological or anatomical abnormalities that indicate serious, life-threatening injury or mechanism of injury that is associated with a high probability of sustaining life- or limb-threatening injury. Level I trauma activations are generally recognizable because the patients are typically gravely injured, and there is little doubt that those patients need extra immediate attention. A Level II trauma activation entails a core trauma team that does not include the trauma surgeon. Its purpose is to expedite care and evaluate patients with significant risk of severe injury based on the emergency

physician's or nurse's judgment, mechanism of injury, or anatomical findings. Level II trauma activations can pose a problem because their presentation is often obscured by other variables, such as patient's age, comorbidities, polypharmacy, mechanism of injury, presenting complaint, and method of arrival versus a Level I where often there is no ambiguity whether it merits a Level I activation. Level II trauma activation can easily be upgraded if the findings on the assessment warrant it.

For benchmarking purposes, Hospital A utilizes the triage recommendations by the American College of Surgeons' benchmark of achieving fewer than 5% undertriage rate (Barsi et al., 2016). Table 1 depicts the number of trauma patients seen in the hospital ED from 2013-2016 and the number of missed trauma activations. This information was utilized to ascertain the extent of the problem and establish a baseline for comparison after implementation of the quality improvement project. Additionally, the information collected provided the DNP student with insight into possible causes of the identified problem.

The data for the trauma activations and number of patients seen were obtained by the DNP student using pre-existing data from the hospital's trauma database and personal conversations with the ED trauma coordinator (A. Ganz, personal communication, July 20, 2017). Additionally, a root cause analysis case involving a small child was reviewed. That case occurred in 2016 and involved a gravely injured child in which a trauma activation was not initiated, which may have resulted in delay of care. The data demonstrate that the rate of undertriage has been steadily increasing over the past 4 years.

Table 1

Hospital A's ED Number of Trauma Patients and Missed Trauma Activations

Year	No. Patients Seen in ED	Number Level I Traumas	Number/% Missed Activation Level I Traumas	Number Level II traumas	Number/% Missed activation Level II traumas
2013	10,019	36	0 (0%)	152	8 (5.2%)
2014	10,182	48	1 (2%)	205	15 (7.3%)
2015	10,438	36	0 (0%)	181	13 (7.2%)
2016	10,501	52	0 (0%)	219	21 (9.6%)

The number of patients seen in the ED has steadily increased over the years as depicted in Table 1. For the year 2013, the ED evaluated 10,019 trauma patients, and it had 36 Level I trauma activations with no missed activations/undertriage along with 152 Level II and 8 (5.2%) cases in which the patient was undertriaged and had one missed activation (see Appendices B & C). In 2014, the total number of trauma patients increased by a small fraction, and there were 48 Level I trauma activations with only one missed/undertriaged case (see Appendices A & B). For 2014, there were 205 Level II trauma activations and 15 (7.3%) missed activations/undertriage (see Appendices B & C).

In the year 2015, there were a total of 10,438 patients seen and evaluated in the ED (see Appendix B). Among those patients, there were 36 Level I trauma activations (see Appendix B). Based on the data obtained through the department's trauma database for 2015, no Level I traumas were missed. In 2015, the department had 181 Level II activations and, most importantly, 13 (7.2%) missed opportunities to initiate a trauma II activation. This number is

well above the American College of Surgeons' recommendation to achieve an undertriage rate of less than 5% (Rotondo, Cribari, & Smith, 2014).

As of December 2016, there were 10,501 total trauma patients evaluated in the ED (see Appendix B), of which there were 52 Level I trauma activations. In 2016, there were 219 Level II traumas. During that year, the facility had 21 (9.6%) missed cases in which a Level II trauma could have been activated. It should be noted that the rate of missed trauma activations had gone up in 2016 instead of decreasing. Based on this number, there was a 2.6% increase from 2015 in the number of Level II traumas that had been missed. Among these 219 patients, 31 were admitted to in-patient units, 167 were discharged, and 20 patients were transferred to other facilities for a higher level of care.

While reviewing the trauma data at Hospital A, the DNP student noted that there were a number of cases that merited a trauma activation; however, there was a lapse in the process, and no trauma activation was initiated by the staff or providers (A. Ganz, personal communication, February 28, 2017). Contributing factors cited included a newer nursing staff including recent nursing graduate nurses, newly hired physicians, lack of experience with high acuity patients, high patient turnover, and the fast pace of the department. One key problem in the department seems to be the failure by the nurses to recognize patients who fall into the Level II criteria. The emphasis on the number of patients seen in the facility each year and the increasing rate of undertriage at Hospital A reiterates the need to improve the method in which care is prioritized and delivered to the trauma patient.

A thorough evaluation of current use of protocols was important to determine if any deficiencies in the care being provided for trauma patients existed. The providers and nursing staff were questioned on their knowledge and understanding of protocols for the care of trauma

patients. Understanding of the degree of current nurse and provider knowledge pertaining to the trauma activation protocol was essential to identify any knowledge deficits and to formulate a plan, intervention, and evaluation strategy to address any deficits.

The identification of any barriers or facilitators in the development and implementation of the project was crucial for the project to take root in the department. One of the strategies that is widely used is the strengths, weaknesses, opportunities, and threats (SWOT) analysis. Conducting a SWOT analysis of the environment can give rise to the development of relationships with the key stakeholders in order to understand the inner workings of the department, which later assisted the DNP student to develop action plans that either removed or altered any barriers in the early phases of the project (Moran, Burson, & Conrad, 2014). The SWOT analysis identified strengths that aided in the promotion and support of the planned teaching/intervention project.

In order to obtain the process that is best suited to convey the desired information, one must determine the learning needs of the target audience. Through the needs assessment, information on educational attainment on the staff was collected. This was an important aspect of the teaching/intervention project because it related to how best to target the audience (nurses) and what teaching methods to utilize.

Throughout the needs assessment, vast amounts of information were gathered that when analyzed, identified a serious issue in the care of the trauma patients and the initiating of the trauma activation guideline/protocol. The DNP student implemented various forms of data collection, such as observation, surveys, questionnaires, and interviews (see Appendices D, E, F, & G) that garnered a wealth of information. The student utilized direct observations to observe

the current state of trauma patient care, including the many influences on the processes of the trauma care.

The observation phase was primarily conducted in areas where triage of patients took place. These areas predominantly consisted of the triage area and the front or main pod. The observation process included how the patients were triaged, the flow of patients, and factors that may have determined the placement of patients throughout the department. The staff was observed in an attempt to identify any patterns, interdisciplinary communication, teamwork as well as the method in which triage was conducted. The main observation made was that when patients came into the ED from the ambulance bay, many patients were not given a hands-on assessment or triage by the nursing staff. The nursing staff would take the report from the EMS from behind a desk and did not get up and perform an assessment. This practice is detrimental to the assessment process and one's ability to properly identify a trauma patient that merits a trauma activation.

To gather further data about nursing and other staff's comprehension of their role in trauma situations, a questionnaire was devised to distribute among nurses who were the largest stakeholders in the department and were the main focus group in the project (see Appendix D). The purpose of the nursing questionnaire was to obtain a better understanding of the nurses' knowledge of initiating a trauma activation, following the trauma activation protocol, and to determine if there was any uniformity or discordance in the activation process. The questionnaire was used to obtain information and generate data regarding the staff's perception of the utilization or underutilization of the trauma activation protocol.

Twenty-seven RNs out of 56 employed nurses responded to the employee questionnaire (see Appendix D) and their responses varied. There were no licensed vocational nurses included

as a result of the department's hiring practice of not allowing licensed vocational nurses to work in the department. When asked if they felt confident calling a trauma team activation, 24% of the nurses strongly disagreed and 20% somewhat disagreed. When asked if they felt they had the necessary knowledge to initiate a trauma activation, 20% of the nurses who participated strongly disagreed, and another 32% reported that they somewhat disagreed. The nursing staff was also asked if they felt confident that their coworkers would assist them in the trauma activation; a resounding 68% strongly agreed and another 24% somewhat agreed, while 4% disagreed and another 4% somewhat disagreed or neither agreed or disagreed. When asked if they feared activating a trauma activation because it would reflect negatively on their abilities as a nurse, only 8% of the nurses felt that they would be seen in a negative light if they mistakenly did or did not activate the trauma team.

In addition to employee questionnaires, personal interviews (see Appendix E) were conducted by the DNP student with the providers: (a) medical doctors, (b) advanced practice nurses, (c) nurses, and (d) other auxiliary staff such as nurse technicians and radiology department personnel. The student conducted 20 interviews including 3 advanced practice nurses, 3 physicians, 11 nurses, 1 radiology technician, and 2 nursing technicians. The stakeholders were asked a series of 10 questions to gain insight into what they perceived were barriers and facilitators that may inhibit or aid in the activation of the trauma team and the use of the trauma activation protocol (see Appendix E). They were also questioned regarding their past experiences when activating the trauma protocol and what factors they deemed made the trauma activation process a positive or negative experience. It was, again, concluded that some nurses lacked the necessary knowledge to accurately and confidently initiate the trauma activation. One nurse who had two and a half years' experience, when asked if there was anything she would like

to see changed to improve the trauma activation process responded, “I do not know because I have not participated in one (trauma).” Another nurse, who recently had graduated from nursing school and had been in the department for four months, was asked if in general she felt that the nursing staff was trained to initiate an activation. She alarmingly responded, “I personally have not had any training here at all; I am not aware of any criteria to call an activation.” One advanced practice nurse commented, “Let me put it this way, depending on who is working will dictate what kind of day I will have because some of the nurses are not very knowledgeable (about trauma activation).” These interviews further supported the need for targeted nursing education regarding the trauma activation guidelines.

The assessment brought to light that there was a substantial segment of trauma patients who merited trauma team activation and were being undertriaged and, therefore, not receiving immediate benefits of the trauma service team. The data showed some barriers including the knowledge gap among staff as to the appropriate designation of trauma patients and the proper utilization of trauma activation protocol. Many of the nurses had less than three years of experience working in the ED and may contribute to a lack of exposure to adequately triage and identify subtle changes that might prompt a more experienced nurse to activate the trauma team. The lack of experience by the newer nurse graduates is further compounded by their lack of knowledge of the existing trauma protocol for the treatment of the acutely injured patient who may merit trauma team activation. One particular nurse who participated in the assessment phase of the project had been employed in the ED for 2 years and had never participated in a trauma activation, much less activated one herself.

Strengths identified included the willingness of staff and providers to work together in order to bring about improved care. Another strength that was recognized among the staff was

their willingness and desire to learn, improve their knowledge and, by doing so, improve the care they provided to the trauma patients.

Problem Statement

Based on the assessment data, the problem identified in the Hospital A ED consisted of the undertriage of patients, most notably Level II traumas at a rate of 9.6% in 2016 and represented a 2.6% increase from 2015 to 2016 exceeding the American College of Surgeons' recommendations (Rotondo et al., 2014). The problem in the department seems to be the failure by the nurses to recognize patients who fall into the Level II trauma criteria and activate the trauma team that appears to be related to insufficient knowledge regarding the existing trauma activation protocol.

Review of the Literature/Evidence

PICOT Question

The following PICOT question was utilized as a guide for the quality improvement project: Will providing an educational in-service to nurses improve their adherence to the established trauma activation guidelines in the ED from June 22, 2017 through August 30, 2017?

Critique of Research Findings

A literature review was conducted to evaluate the evidence as it pertains to the utilization of trauma activation protocols and its effect on resource utilization and allocation, length of stay (LOS) in the department and, ultimately, and most importantly, on mortality. An additional objective of this literature review was to determine successful methods of applying clinical-based guidelines and tools within the realms of emergency care to aid healthcare personnel, including

nurses, to identify and address the highly important issue of diminished adherence of trauma protocol guidelines.

The core function of nursing is to provide effective, efficient clinical care to individuals, families, and the communities based on scientific underpinnings and, above all, accepted by those for whom they care (Institute of Medicine [IOM], 2004). Hospital-based EDs have gone through an evolution over the past decades; no longer do they solely provide acute emergency care. Rather the ED has become part primary care, social services, and the last source of medical care for many Americans (IOM, 2007; Quattrini & Swan, 2011). The annual number of emergency room visits in the United States was 90.3 million in 1996, and that number volume has increased to 129.8 million in 2010 (Murphy, Barth, Carlton, Gleason, & Cannon, 2014). As a result, there has been continuing pressure to see an increasing number of patients, safely and efficiently and which has prompted many healthcare disciplines to develop innovative new approaches concerning treating and triaging patients in the ED (Quattrini & Swan, 2011).

Nurses in the ED are faced with work environments full of stress, constraints in time, high acuity patients, and yet, they must deliver emergency care that requires rapid decision-making and effective coordination of groups of caregivers, often from various disciplines (IOM, 2007). These relationships with members of the multidisciplinary team can have a tremendous impact on patient outcomes (IOM, 2007). The ED staff may have little or no training in teamwork skills; however, emergency care is a place where rapid assessment making and efficient coordination of groups of caregivers, often from multiple disciplines with immensely different training, professional missions, and cultural identities, is essential. This assembly of coworkers leads to an environment of groups such as nurses, providers, pharmacy, social

workers, and radiology providing care to those patients who present to the emergency room (IOM, 2007).

The IOM, in a review of malpractice claims from several EDs, found that 43% of errors were due to problems with team coordination, and 79% of those errors could have been mitigated or prevented if there had been team structure in the ED and if ED personnel had received team behavior training (IOM, 2007). It is through this pursuit of improved healthcare and measurable improved outcomes that the aim to improve the proper identification of trauma patients through education may enable the right personnel (multidisciplinary team) and resources to treat the patients' needs in an efficient and expedient manner (Barsi et al., 2016; Clements, Curtis, Horvat & Shaban, 2015; Grossman et al., 2014; Jelinek et al., 2014; Xiang et al., 2014).

As healthcare science and providers actively seek new methodologies to improve trauma patient care, the literature is replete with data that support the idea that trauma-related mortality can be reduced significantly through early targeted care that is delivered by a multidisciplinary approach (Gerardo et al., 2011, Rogers et al., 2013, Wang et al., 2014). It is paramount that these patients are properly and expeditiously identified so that proper personnel, equipment, and other resources can be allocated to meet their needs in order to mitigate complications and decrease mortality (Barsi et al., 2016; Rados et al., 2013; Rogers et al., 2013). It is vital that staff, including nurses and providers, are offered the most up-to-date methodologies in order to perform their roles on the emergency triage team (Georgiou & Lockey, 2010; IOM, 2007; Rogers et al., 2012).

The studies that form part of the literature review can be grouped into several themes: (a) efficacy of trauma protocols on overall mortality; (b) effects on the elderly patient; (c) expedient use of resources, such as x-ray and CT scans; (d) impact on LOS and length of time to surgery if

required; and (e) impact of nursing knowledge on trauma activation. One theme that permeated through many of the studies was the central task of early identification of trauma patients in order for them to get the needed resources and treatment on a timely basis (Clements et al. 2015; Grossmann et al., 2014; Gerardo et al., 2011; Rehn et al., 2012; Rogers et al., 2013; Wang et al., 2014; Xiang et al., 2014). Trauma care methodologies, especially those related to trauma activations, are necessary to treat trauma patients, reduce mortality, and mitigate overall burden of injury (Barsi et al., 2016; Grossmann et al., 2014; Rogers et al., 2012). Integral to trauma care is the ability to measure performance of the institution's ability to provide care to trauma patients and to have a mechanism of feedback for continued improvement (Jelinek et al., 2014). The impetus of the development of current trauma systems was the realization of undue death related to subpar trauma care (IOM, 2007). Mortality has become the preferred method of measurement of trauma care performance. Although many may agree that this unit of measure may not be the perfect outcome measure, it can be easily tracked and collected within a hospital setting (Gruen, Gabbe, Stelfox, & Cameron, 2012).

Rogers et al. (2012) conducted a retrospective study to determine if the level of undertriage was acceptable within a mature Level II trauma center as a measure of the adequacy of its trauma activation. Like most of the trauma activation system and protocols across the country, the protocol incorporates anatomical aspects, physiological measures, and mechanisms of injury (such as a fall, motor vehicle crash, etc.) as part of the criteria. The authors defined undertriage as an Injury Severity Score (ISS) score of greater than 15 and no trauma activation. The ISS is a system for numerically stratifying injury severity. The ISS system has a range of 1 to 75 with higher scores indicating more severe injuries. The ISS scores are categorized as follows: ISS score 1 to 8 minor, 9 to 15 moderate, and 16 to 24 severe; anything greater than 24

is deemed very severe (Rogers et al., 2012). The undertriaged patients were compared to appropriately triaged patients over a time period from 2000 to 2010. The researchers examined the following variables: (a) mortality, (b) ED LOS, (c) hospital LOS, (d) complications, (e) coumadin use, and (f) age 65 and above. In a sample of 4,534 elderly patients, 15.1% were undertriaged and over 90% had sustained a fall prior to presentation to the ED (Rogers et al., 2012). The finding from this study supports results from a study conducted by Rehn et al. (2012) that found that increased age was associated with increased the risk of undertriage.

Another study conducted by Rogers et al. (2013), using the Pennsylvania Trauma Systems Registry, was evaluated for the timeframe of 2000 to 2010, and more than 18,576 patients were reviewed. Two hundred fifty-two were excluded related to missing data. Among the 18,576 patients, 1,156 (6.3%) were undertriaged. Notably, 84.3% of the undertriaged persons had a head injury compared to 45.4% of those correctly triaged. The investigators concluded that undertriage was a significant predictor of increased mortality (odds ratio [OR] = 3.0, $p < .001$, 95% confidence interval (CI [2.4, 3.8]), longer ED LOS (OR = 54.5, $p < .001$, 95% CI [45.5, 63.5]), and hospital LOS (OR = 1.7, $p < .001$, 95% CI [1.4, 2.1]). Patients 65 years of age and older who had one or more comorbidity had 2.18 times higher odds of mortality than their correctly triaged counterparts (Rogers et al. 2013). Factors related to undertriage included patients receiving coumadin and those who were older than 64 years of age. A study conducted by Xiang et al. (2014) concluded that elderly patients were more likely to be undertriaged and that more than 40% of undertriaged patients had a diagnosis of traumatic brain injury. A study by Rehn et al. (2012) showed that increasing age also appeared to increase the risk for undertriage.

Rogers et al. (2013) arrived at congruent findings as many other investigators (Rehn et al., 2012; Xiang et al., 2014) in that trauma activation, when used correctly, can have a positive

impact on decreasing mortality. The findings illustrated that no one plan or protocol is ideal for all hospitals and that trauma activation protocols must be refined based on institutional needs, along with the needs of the population served (Rogers et al., 2013). The limitations of the study include (a) lack of a uniform trauma protocol among hospitals, (b) diversity of the trauma registry population, and (c) different criteria on what constitutes serious trauma. Therefore, this study is not generalizable to all institutions, but provides valuable evidence regarding the predictors of mortality and LOS. The authors of the study also did not account for patients with advanced directives that could have had an impact on mortality rates on the correctly triaged and undertriaged groups (Rogers et al., 2013).

In another study that also utilized mortality rate as a measure to assess the efficacy of the utilization of trauma team activation, Gerardo et al. (2011) conducted a prospective secondary analysis and utilized only emergency medicine, board certified, or board-eligible emergency physicians as part of the team. The utilization of board certified or board-eligible emergency physicians has been shown to improve patient outcomes (Rogers et al., 2012); however, there is not much known regarding how the composition of the trauma team itself affects trauma team care and its outcomes. The objective of the study was to evaluate the outcomes before and after the implementation of a trauma team that had a full-time emergency-trained board-certified physician with a trauma specialist in an academic institution. Patients were divided into a pre-intervention period (1999 to 2000, $n = 2,714$ patients) and post-intervention period (2002 to 2003, $n = 3,089$ patients). Patients treated in 2001 ($n = 1,282$ patients) were not included in the study because implementation of ED physician board-certified providers took place during that year. Gerardo et al. (2011) defined mortality as death from any cause during the patient's care in the hospital. The study concluded that there was an overall mortality rate reduction of 6.0% to

4.1% that was associated with “the use of an integrated trauma team with EM-trained BC/BE physicians” (95% CI [0.7%, 3.0%]) (Gerardo et al., p. 588). Additionally, among patients with an ISS greater than 25, mortality rates decreased from 30.2% to 22.0% from the pre to post-intervention periods (95% CI [2.1%, 14.4%]) (Gerardo et al., 2011).

Dehli, Fredriksen, Osbakk, and Bartnes (2011) evaluated the use of trauma protocol in order to optimize resource allocation, diminish waste, and to identify criteria that might be changed in order to improve the protocol. Trauma team activation was evaluated according to the occurrence of severe injury and the incidence of emergency procedures (Dehli et al., 2011). In this observational retrospective study conducted at the University Hospital of North Norway Tromsø, a total of 441 patients were included. The researchers viewed overtriage as a resource misallocation problem because it required a multidisciplinary team to assemble that subsequently, diverted resources and personnel from other responsibilities (Dehli et al. 2011). They found that at this particular institution, when using the ISS greater than 15 as the reference point to measure, the overtriage rate was 71% and undertriage rate was 32%, and when using emergency procedures such as endotracheal intubation or chest tube insertion for the standard of reference, the overtriage rate was 71% and undertriage rate was 21% (Dehli et al., 2011). The authors noted that utilizing mechanism of injury, for example being ejected from the vehicle or a death on scene, as part of the criteria for trauma activation leads to overtriage. Despite the American College of Surgeons’ (Rotondo et al., 2014) suggestion that 50% overtriage is acceptable in order to reduce undertriage, their findings were still high (Dehli et al., 2011). Based on this study, the importance of implementing a precise trauma protocol cannot be overemphasized to ensure both safety and improved outcomes, while reducing misallocation of

resources that might have negative consequences to the overall department and, consequently, to the patient (Dehli et al., 2011).

In a similar study, Rehn et al. (2012) focused on a two-tiered trauma team activation protocol that was introduced to evaluate the impact of triage precision and resource utilization. The patient sample was 1,812 rural and urban patients at a 630-bed Norwegian trauma center that treats a population of 330,000 people, plus an additional 120,000 from surrounding areas (Rehn et al., 2012). This prospective interventional study divided the sample into a before period that subjected the patients to the informal one-tiered practice (January 1, 2004 to December 31, 2008) and an analysis of the after period that consisted of the patients who were treated with the two-tiered trauma team activation (TTA). The investigators sought to evaluate a comparison of overtriage rates before and after the implementation of the TTA policy and to evaluate the TTA in contrast to overtriage skilled hours' expenditure per major trauma victim (Rehn et al., 2012). Findings indicated that the undertriage percentage was reduced from 28.4% to 19.1% ($p < .001$) after the implementation, while overtriage percentage increased from 61.5% to 71.6% ($p < .001$). The authors noted a reduction of the mean number of skilled hours spent per overtriaged patient from 6.5 to 3.5 hours, and the number of skilled hours spent per major trauma patient was reduced from 7.4 to 7.1 hours ($p < .001$). They also noted what many other studies have found that age increased the risk of undertriage (Rogers et al., 2012, 2013; Xiang et al., 2014). Similar to other studies, falls in this segment of the population were an indication of increased risk for undertriage and a decreased risk for overtriage (Rainer et al., 2007; Rehn et al., 2012). Ultimately, the study was able to show the benefits of a two-tiered trauma protocol by illustrating reduction in undetriage and increased overtriage, while reducing trauma team resource usage (Rehn et al. 2012). This study showed the need for additional focus regarding the elderly

population in an attempt to reduce undertriage. The limitation of the study was that there was a difference in time between the two groups (after group = 18 months versus before group = 60 months) and could have skewed the data.

In a retrospective study by Wang et al. (2014) that was conducted in a Level I trauma center in Taiwan, the study objective was to evaluate the role of TTA on outcomes in trauma patients with an ISS greater than 15. A total sample of 231 patients was used in this study. The study demonstrated that there was an association between the use of TTA and shorter time to the operating room (170 minutes vs. 534 minutes, $p = 0.02$). This study added to the vast knowledge base on the utilization of TTA (Barsi et al., 2016; Grossman et al., 2014; Roger et al., 2013; Xiang et al., 2014) and provided another exemplar regarding how TTA can aid in expediting resource allocation and treatments to severely injured patients, patients for whom the difference of minutes can make a difference of life or death. The study had some limitations such as the use of a small sample size, the location, and that it was conducted at a Level I trauma center that for the most part, possesses valuable resources that many hospitals may not possess.

Another theme encountered in the literature was the relationship of nursing to the trauma process. Encouraging nursing staff to collaborate with other multidisciplinary teams in identifying high-risk and inefficient work processes and redesigning them for efficiency and safety is of paramount importance. In 2014, there were 11.8 million workers employed in healthcare practitioner, technical, and support occupations with 2.7 million registered nurses, making nurses the largest specialty of all healthcare workers (Bureau of Labor Statistics, 2015). Nurses are involved in all facets of care, whether it be in hospitals, nursing homes, schools, community clinics, or other places of employment (Bureau of Labor Statistics, 2015). Therefore, nurses are on the frontlines and contribute to the quality of care the people receive, and the

quality of nursing care rendered can often mean the difference between life and death (Bureau of Labor Statistics, 2015). For this reason, efforts should be focused on ongoing nursing staff education and a provision of appropriate training/teaching in order to improve their abilities to perform their job and, in doing so, improving the quality of care they are providing their patients.

Related to this endeavor, Jelinek et al. (2014) implemented a quality improvement initiative aimed at improving trauma triage accuracy. The authors developed a role called the “trauma report nurse,” and this person became the trauma nurse expert who was responsible for assigning a trauma triage level to all trauma patients who presented to the ED. In addition to the development of this new nurse’s role, Jelinek et al. (2014) made improvements to the pre-hospital report format, allowing for standardization and clarification of the verbiage utilized for the patient handoffs. After conducting a review of the process in the care of the trauma patients, they identified several communication issues that arose from the field to the arrival of the patient to the facility. Namely, the report that the ED staff from the emergency medical field responders was being communicated to a person in a different building from the ED than being relayed to nursing staff and physicians via telephone or text. This posed a problem since the ED staff did not receive a first-hand report from those in the field.

The second problem Jelinek et al. (2014) identified was that once trauma patients arrived, they were being triaged by emergency medical services personnel physicians, or sometimes the patient was not triaged. Due to the already heavy burden placed on physicians with having to oversee a high and varied number of patients, triage done by physicians was deemed unwelcomed because of their availability and the prolonged period of time before the physician was able to conduct a triage. This discrepancy of information between all those who were able to triage regarding the trauma activation protocol led to a high level of undertriage.

The project objective was to reduce the rate of undertriage and improve employee satisfaction (Jelinek et al., 2014). They selected 28 nurses to undergo a one-hour course that utilized several methodologies that covered roles, responsibilities, leveling criteria, policies, procedures, and radio etiquette that they had developed. Three months after the initiative was implemented, the two objectives were met. The department's undertriage rates dropped from 14% to 10%, and 3 years later, it decreased to 4.8% ($p < .001$). The data demonstrated that the trauma RN role garnered support from the department staff.

A study conducted by Vatnøy, Fossum, and Slettebø (2012) involved ED nurses as the target audience in order to improve the efficacy of assessment strategies performed by nurses. The importance of triage accuracy and the pivotal role it plays in the prioritization of limited medical resources among patients who are acutely ill was emphasized (Vatnøy et al., 2012). The aim was to evaluate the decision-making in the triage setting before and after the implementation of the "Medical Emergency Triage and Treatment System" in the hospital's ED. This descriptive study utilized a sample of 655 patients before the intervention and 413 patients after the intervention. A questionnaire was utilized to evaluate how the RNs assessed the patient before intervention, while the emergency patient records were used for data collection after the intervention was deployed. Prior to the intervention, the nurses based their assessments on signs and symptoms and medical diagnoses. Vital parameters such as respiratory rate, pulse oximetry, heart rate, or level of consciousness were rarely used. After the implementation, nearly two-thirds of the patients were assessed following a triage system with vital parameters and standardized algorithms for symptoms and signs in the assessment procedure (Vatnøy et al., 2012). Through education about and utilization of a standardized triage system much like the

trauma activation protocol, the nursing staff increased their reliance on vital parameters and signs and symptoms to guide them with the triage of acutely ill patients.

Clements et al. (2015) stated that nurses are an integral to trauma and resuscitation in the ED, and their contribution through the care they provide and their effective communication, leadership, and teamwork permit quality patient care. They hypothesized that by allocating the most senior nurses as scribes and augmenting their duties to include (a) nursing leadership, (b) improved nursing documentation, (c) awareness of patients' clinical conditions, and (d) improved prioritization of nursing strategies and communication between members of the team would be improved (Clements et al., 2015). This correlational study used a pretest and posttest survey of emergency nurses working in resuscitation rooms and assessed their perceptions of leadership, communication, and documentation before and after the implementation of the new nursing role. The study concluded that 100% of the respondents' posttests stated they had a good-to-excellent understanding of their role, compared to 93% pre-study (Clements et al., 2015). A decrease (58.1% to 12.5%) in intimidating personality as a negative aspect of communication and the nursing leadership had a 6.7% increase in the proportion of those who reported nursing leadership to be good-to-excellent (Clements et al., 2015). The accuracy of clinical documentation improved ($p = 0.025$). These findings are important because adopting a structured team-based approach to trauma care based on a nursing education intervention allowed nurses to have ongoing input into stabilization of and the ability to address the needs of the resuscitation patient. This study added to the body of knowledge that nurses contribute to the effective communication and functioning of the trauma team and must be supported in this activity (Clements et al., 2015).

Although many of the studies reviewed have been conducted using different designs, populations sizes, and with varying objectives, what many of the studies have concluded is that there is a need to implement some type of universal or evidence-based protocol in conjunction with the institution's needs and the population served in order to maximize the adherence of TTA in the care of the trauma patients (Dehli et al., 2011; Rogers et al., 2012; Yoo & Munn, 2014) and that nurses are essential in this process (Clements et al., 2015; Jelinek et al., 2014) . Based on the evidence reviewed, an educational quality improvement project aimed at Hospital A's ED nurses was supported.

Project Aim

The intervention's purpose was to provide essential information to the nurses regarding trauma team activation using valid and evidence-based information that was intended to expand their knowledge of how to appropriately identify patients who merit a trauma team activation, thereby improving adherence to the department's trauma activation guidelines and, in doing so, securing the necessary resources to improve patient outcomes.

Methodology

Design and Sample

This study utilized a quality improvement design. The DNP student developed an educational intervention aimed at RNs in the hospital's ED and addressed the following: (a) degree of undertriage in trauma patients and (b) the use of the existing trauma activation guideline in congruence with the department's policies and procedures. The student developed the educational materials because no teaching toolkits were available that addressed the teaching of trauma activation guidelines within the institution. The sample included 56 out of 65 registered nurses who were employed by Hospital A's ED at the time of the project. The 56

nurses had a varied educational background: (a) 39 nurses possessed an associate's degree, (b) 24 nurses had a bachelor's degree, and (c) 2 nurses had a master's degree in other fields. The sample included day and night shift nurses in order to give a better insight of the nursing staff. The teaching intervention was developed with input from the trauma coordinator and presented solely by the DNP student. It consisted of a teaching session delivered onsite during the nurses' regular shifts and covered the department's trauma activation protocol along with departmental policies regarding the evaluation of trauma patients.

Setting

The quality improvement project was conducted at a Level III trauma hospital ED located in a major metropolitan area in Texas. The department serves a diverse number of surrounding communities in respect to race, ethnicity, age, educational attainment, and language. The quality improvement project/teaching intervention was carried out in the designated ED conference room. The conference room was ideal due to its size and ability to be private and free from interruptions. The allocated conference room seated 15 to 20 people without compromising comfort and was equipped with multimedia equipment.

Population

The target population for the teaching intervention was the ED's RNs, who are ideally positioned to be the first ones to initiate trauma activations. Ultimately, the population to be reached was the patients who are treated in the hospital's ED, specifically those patients meriting a trauma activation.

Procedure Plan

The DNP student created the educational materials for the planned intervention. Although the material for the teaching session was developed in close partnership with the trauma

coordinator who had ultimate final approval prior regarding the information provided, the DNP student was the sole presenter in the sessions. The trauma coordinator, being an expert in the field, was consulted throughout the development and implementation of the quality improvement project, and modifications were made based on her input. For example, the coordinator suggested including information regarding trauma activation as it related to women who were greater than 20 weeks pregnant and presented to the ED.

A questionnaire was developed by the student with the trauma coordinator's input to measure the nursing staff's knowledge regarding the trauma activation process at Hospital A. This same questionnaire was administered prior to the educational session, immediately after the session, and again in 2 to 4 weeks. The purpose of the questionnaire was to identify baseline knowledge and track any change in knowledge. A power analysis was conducted, and it was determined that for a population of 65 available participants (number of nurses employed in the ED department), a minimum sample size of 56 participants would allow detection of statistical significance at a 95% confidence interval, with a margin of error of 5%.

Data Collection Plan and Data Analysis

The process for the nursing educational sessions was planned as follows:

1. Utilizing a key, each participant was assigned a number with the student principal investigator (PI) as the sole person with access to the key. The participant was asked to write his or her study number and email on all questionnaires. The study number was used by the DNP student to group the three study questionnaires for data analysis. No individually identifiable information was collected from the project participants.
2. The educational intervention was preceded by a pretest administered immediately prior to the teaching session to obtain the nurse's baseline knowledge.

3. A 20- to 25-minute educational session was implemented.
4. The first posttest was administered immediately after the educational intervention.
5. All questionnaires were to be collected and graded privately by the student.

Analysis of the questionnaires was achieved by summation of the total number of questions correct on each exam divided by the total number of questions. A percentage correct was assigned to each questionnaire and a mean score was calculated for each set of tests. Notes were kept about the most and least missed questions. Although this type of educational project does not have the validity or reliability of other teaching toolkits that might be used for other subject matter, the student ensured that the subject matter was tailored to the specific needs of the staff nurses in the ED and had expert input from the nurse trauma coordinator. A *t*-test was run between the means of the questionnaires to determine if there was a statistically significant change in knowledge level.

Additionally, the student conducted medical record audits on charts from patients seen in the hospital's ED from August 1-31, 2017 (approximately four weeks after the educational sessions were completed). The purpose of the chart audit was to evaluate if trauma activation was indicated, and if indicated, what level was activated (see Appendix H). These outcome data were obtained utilizing a purposive sample from the retrospective chart and data reviews. The patient records reviewed consisted of all trauma patients seen in the department. Patient census was obtained every 24 hours. Once the printout of the department's census was achieved, the following steps were taken by the student:

1. Quick overview of all the patients on a list observing for trauma cues to select a chart for further review.

2. Cues that were used to isolate chart for further review were: (a) falls, (b) motor vehicle collisions, (c) extremity pain, (d) facial pain, (e) assault, (f) gunshots, (g) stabbings, (h) abrasions, (i) lacerations, (j) ankle pain, (k) leg pain, (l) head injuries, and (m) trauma.
3. Once the chart was isolated for review, the chart was audited for possible candidates for trauma activation using the trauma guideline criteria (see Appendix A).
4. If a patient's chart was identified as a case that merited trauma activation and the nurses initiated the correct level of trauma activation, it was documented as a correctly triaged patient.
5. If a patient chart was identified as a case in which a trauma activation was warranted and the staff failed to activate a trauma, it was noted as an undertriage (missed activation).
6. All missed activation cases were reviewed using the trauma review form (Appendix H).
7. A daily account of trauma patients, total number of trauma activations, level of trauma activation I or II and missed activations were documented without using any identifiable markers.

The data collection pertaining to trauma activation outcomes was conducted from August 1 through August 31, 2017. These data were compared to the data for the corresponding month from the previous year to measure any change. The DNP student conducted post-education observation along with continued review of data from the hospital's trauma database (see Appendix I).

Evaluation Model

The model selected to evaluate the implementation of the teaching plan was Kirkpatrick's Four Level Training Model (Kirkpatrick Partners, 2015). The model utilized 4 levels to evaluate training programs effectiveness: (a) reaction, (b) learning, (c) behavior, and (d) results. Levels 1 and 2 provided information on effective training by measuring the quality of the training and the degree to which it resulted in knowledge and skills that could be applied to perform work duties (Kirkpatrick Partners, 2015). These measurements were pivotal in the training function to measure the quality of the program's designs and delivery (Kirkpatrick Partners, 2015). The proceeding levels 3 and 4 provided much needed data related to the effectiveness of the training. These levels measured on-the-job performance and the result of the training, which could vary based on the desired outcome (Kirkpatrick Partners, 2015). The effectiveness of the training was of the utmost importance when attempting to demonstrate the impact that training had to the organization (Kirkpatrick Partners, 2015).

The utilization of the Kirkpatrick's evaluation model allowed the measure of effectiveness of the training in an objective manner (Mind Tools, 2015). Since the development of the model in the 1950s and its subsequent changes, the model has been widely used to evaluate training programs. It is the intention that by utilizing this model, the student could obtain evidence-based information that could be used to evaluate training and provide information on the project's future applications. Concepts from the Kirkpatrick Model were used to evaluate (a) the staff's knowledge of the current trauma activation protocol, (b) the staff's utilization of the information gained from the teaching intervention regarding trauma activation, and (c) the staff's identification of any improved trauma patient identification that merited trauma activation.

Objectives and Timeline for Project Completion

By implementing the quality improvement project, the providers and nursing staff can anticipate the following benefits:

- I. By the end of week 4 in July 2017, 80% of the nurses will increase their knowledge in regard to the proper identification of trauma patients that may merit trauma team activation through a 20- to 25-minute evidence-based educational session provided by the DNP student. This objective will be evaluated based on results of the pretest, posttest, and post-posttest.
- II. By August 31, 2017, after the implementation of the teaching session, the nurses will improve the delivery of care to the trauma patients and the subsegment of that population that may require a higher level of care by initiating trauma activations as warranted and will be evaluated by the student through intermittent observation.
- III. By August 31, 2017, the rate of undertriage will be fewer than 7% in the ED. The proper utilization of the trauma activation guideline by the nurses will be evaluated by patient record review of August 2017 data and compared to August 2016 data. This record review will be completed by September 30, 2017.

IRB-Ethical Considerations

Institutional Review Board approval was received from the student's university and Hospital A prior to implementation of the project. No patient intervention was conducted. All nursing participants who voluntarily agreed to participate in the study signed a consent form (Appendix J) prior to attending the educational session and completing the study questionnaire, and they were given the option of not participating or withdrawing from the project at any time in the process. Regarding chart audits, no identifiable information such as name, date of birth,

social security number, address, or medical record number was collected. The respective timeline for the implementation of the project was from June 22, 2017 through August 31, 2017.

Involvement of Agency Stakeholders

The quality improvement project required buy-in from all stakeholders including management (department director, day and night managers, trauma coordinator, and chief nursing officer), advanced practice RNs, physicians, and nurses in order to be successful. This was taken into account while conducting the needs assessment of the department and when formulating the SWOT analysis (Appendix K). Specifically, the SWOT analysis identified the barriers and potential facilitators among the stakeholders that needed to be addressed before moving forward with the project.

After careful consideration, a consensus was obtained that the department needed a quality improvement measure to address the nurse's role in the trauma activation process and in doing so, might potentially mitigate the number of patients who were undertriaged. A letter of support was obtained from the nurse manager as evidence of their support and commitment to the student's project and ultimately, the improvement of patient care.

Results

A total of 11 educational sessions were conducted from June 22 to June 30 to ensure the desired sample and proper mix of day and night shift nurses and PRN staff, including those who worked weekends, could be reached. The staff in attendance was asked to sign in and provide an email address that was to be used later to send out the post-posttest. A pretest was administered at the inception of the class to measure the nursing staff's knowledge base (Appendix F). The teaching session lasted approximately 20 to 25 minutes with the allotted time used to provide the education and answer the questions posed by the staff to the DNP student presenter. The teaching

session was presented in groups, but because of time constraints, one-to-one teaching was also utilized. A pretest, posttest, and post-posttest were administered to the nurses to assess their knowledge about trauma and trauma activation prior to the intervention as well as after (see Appendix F). For the post-posttest, there were 21 returns out of the 56 initial participants.

Immediately after the class, the DNP student conducted the posttest (Appendix F). The teaching session consisted of anywhere from 2 to 4 nurses per session, and there were 8 nurses who received the material on a one-to-one basis. Three weeks after the teaching implementation, the nurses who received the intervention completed another posttest (post-posttest) to evaluate the long-term effectiveness of the teaching project (Appendix G). The post-posttest was emailed to the nurses using the email address they provided during the teaching session. After having the nurses complete the pretest, posttest, and the post-posttest (see Appendices F & G), it was noted that on the pretest, 63% of the nurses missed question number 10. The nurses answered question number 8, 98% of the time correctly. On the posttest, there was a vast improvement in the scores. From all the participants, there was one nurse who obtained an incorrect answer. The participant answered question number 4 incorrectly (2%). The remaining participants answered all questions correctly on the first posttest questionnaire.

The post-posttest presented with some challenges, predominantly the rate of returns of the questionnaire via email. Only 21 (37.5%) participants out of the initial 56 responded to the post-posttest. A review of the post-posttest questionnaire revealed that the participants failed to answer question number 4 at a rate of 33%. Question number 5 was answered correctly 100% of the time by the participants. Total mean scores of the questionnaires are depicted in Figure 1.

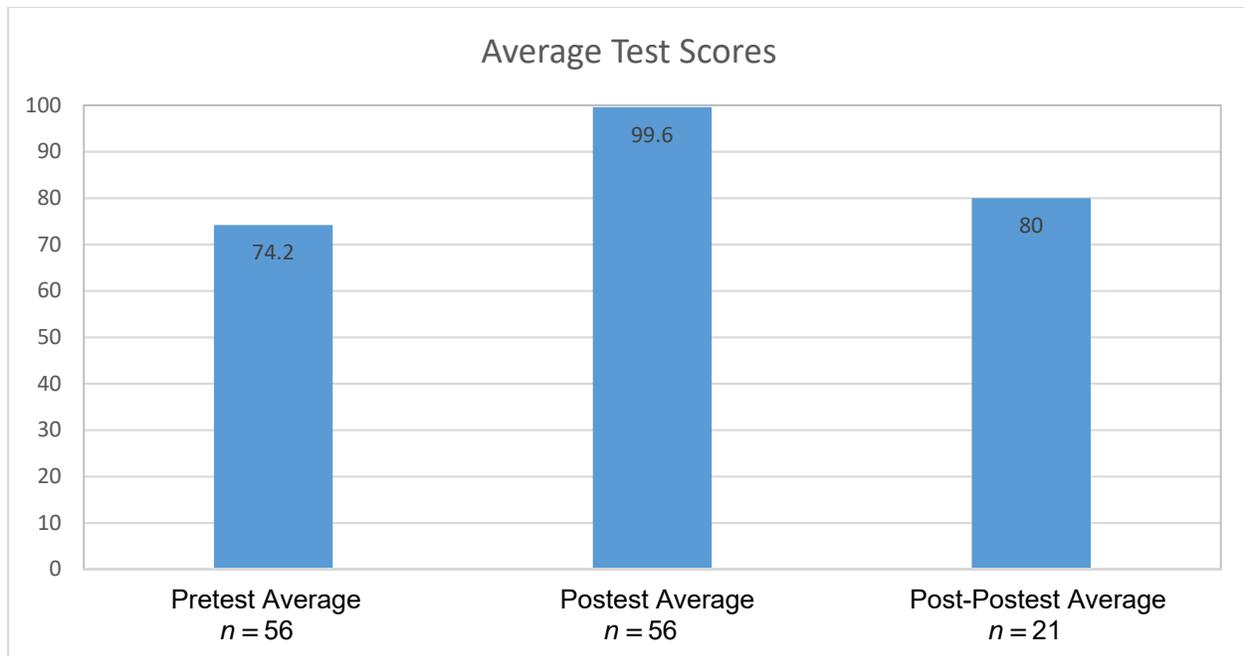


Figure 1. Hospital A's nursing staff's pretest, posttest, and post-posttest mean scores by percentage.

Evaluation of Objectives

Objective 1. By August 31, 2017, utilizing concepts from the Kirkpatrick Evaluation Model, the student determined that the nursing personnel obtained the necessary knowledge regarding the proper implementation of the trauma activation protocol based on posttest results. Fifty-six nursing staff attended a 20- to 25-minute educational session provided by the DNP student from July 22 to July 30, 2017. A 10-question pretest was administered to the staff prior to the educational session to establish a knowledge baseline. The posttest and subsequent post-posttest quantified knowledge that was gained through the educational session and most importantly elucidated potential areas where further improvement could be achieved through further investigation and teaching, specifically, the care of trauma patients who were greater than 20 weeks pregnant and the specific trauma needs they required.

Objective 2. By August 31, 2017, the nursing staff improved the delivery of care to the trauma patients and the subsegment of that population that required a higher level of care. The nursing staff was able to appropriately identify those patients who merited trauma team activation. The Kirkpatrick model concepts were applied to evaluate the nurses' ability to implement and utilize the trauma activation protocol with trauma patients via student observation (see Appendix I). This objective was also measured by a chart audit of trauma activations.

Objective 3. By August 31, 2017, the rate of undertriage was less than 7% in the ED. The proper utilization of the trauma activation guidelines by the nursing staff was measured by reviewing the trauma records via the trauma database and compared the data from August 2017 and the same corresponding month for August 2016.

Data Analysis

The data collected from the pretest/posttest/post-posttest were analyzed to ascertain whether there was any improvement in the nurse's knowledge after the implementation of the teaching session. As described earlier, the number of questions answered correctly was calculated per individual questionnaire and assigned a percentage; then, a mean score was determined by dividing the percentage by the number of nurses who completed the questionnaire. This same procedure was repeated for the posttest and post-posttest. The posttest was repeated at three weeks after the educational session. The information obtained from the pretest ($n = 56$), the posttest ($n = 56$), and the post-posttest ($n = 21$) was then utilized to compare results between the three time periods and to quantify knowledge retention. Because less than 56 questionnaires were returned for the post-posttest, the sample size needed to conduct inferential statistical analysis was not met (see Figure 1). Therefore, only descriptive statistics could be calculated.

The chart audit procedure described previously was implemented as planned. The number of undertriage cases in August 2017 was compared to the number of undertriage cases in August 2016. This comparison was used to evaluate if there were any changes post-intervention in the number of undertriage cases. Another source of data obtained were from direct observation of the nurses in their response to trauma patients and whether they conducted a hands-on triage assessment, whether the patient merited a trauma activation, and if so, if it was activated appropriately. The observation phase also aimed to see whether nurses would actively search for assistance when in doubt regarding activation of the trauma team.

Findings

The analysis of the data obtained from the nurse's pretest and subsequent posttest demonstrated an improvement in the overall scores (see Figure 1). There was an increase of 30% between the average score in the pretest and posttest. This score increase was not surprising since the material in the test had been covered immediately prior to the educational session. Based on percentage scores of the post-posttest conducted three weeks after the teaching session, the average score gain was 14.2% and indicated that there was some retention of the material covered in the teaching session. However, only 21 of 56 nurses who participated in the educational sessions returned the post-posttest, so results were interpreted cautiously.

The second objective was to ascertain whether the nurses could appropriately identify patients who merited trauma activation and the data were obtained through direct observation of the staff. For the month of August, the DNP student conducted 6 to 8 hours of direct observation each week to collect further information (see Appendix I). On August 1, 2017, 88% of the patient cases observed arrived via EMS; and in 38% of those cases, a hands-on triage assessment was conducted by the nurse. There was one trauma activation, and it was appropriately identified

and a trauma activation was initiated by the nurses. For the day of August 8, 2017, 73% of the trauma patients were received in the ED from EMS, and in only 18% of those cases did the nurses conduct a hands-on triage. There were no trauma activations or missed activations during the hours of observation. On August 19, 2017, 86% of the patients arrived via EMS, and no hands-on triage was observed. There were no trauma activations, and there were no missed trauma activations observed. On August 21 and August 26, there was 80% and 78% patients, respectively, who arrived via EMS, and on August 21, 10% of the patients received hands-on nurse triage and zero patients received hands-on nurse triage on August 26. On both days, there were no observed trauma activations or any cases where a trauma activation was deemed necessary. Overall, there was not one observable case in which a trauma activation was missed by the nursing staff. Yet, it is disturbing that such a small percentage of nurses performed a hands-on triage assessment. Opportunities to activate a trauma may be missed when nurses rely solely on an EMS report and fail to conduct their own patient trauma triage assessment.

The data for the third objective were obtained by accessing the department's trauma database. Data for August 2017 and the corresponding month in 2016 were obtained (Table 2) to ascertain whether there were any changes in the undertriage rate between the two months (pre-intervention and post-intervention). Objective 3 was to decrease rate of undertriage in the ED to fewer than 7%. Based on these numbers, the rate of undertriage for the month of August 2017 was 0%. In the process of attempting to isolate possible missed trauma activations, the DNP student identified 50 patient charts for the month of August 2017 that could have had the potential for a missed activation. However, none of the charts met the trauma activation guidelines, therefore, adding to the data to support that all the trauma cases had been properly identified for trauma activation.

Table 2

Hospital A's ED Number of Trauma Patients and Missed Activations for August 2016 & 2017

Time Period	Total Number of Daily ED Patients	Total Number of Daily Trauma Patients	Number of Level I Trauma Activations	Number of Level II Trauma Activations	Number of Missed Level I Trauma Activations	Number of Missed Level II Trauma Activations
August 2016	5567	890	6	24	0	3
August 2017	4806	715	3	14	0	0

Discussion and Conclusions

Transforming the healthcare system to provide safe, quality, patient-centered, accessible care requires a comprehensive rethinking of the roles of many healthcare professionals, including nursing, and most importantly, doctorally prepared nurses (IOM, 2010). As patient needs and the healthcare environment become increasingly complex, doctorally prepared nurses need to attain requisite competencies to deliver high quality care through advanced education, leadership, health policy, system improvement, research, evidenced-based practice and teamwork/collaboration (IOM, 2010). In keeping with those ideals, the purpose of the DNP's quality improvement project was to effectively impact the care of trauma patients through improving nurses' understanding of the trauma guidelines, and in so doing, decrease the rate of undertriaged patients. Ultimately, as nurses apply their knowledge to trauma assessment, outcomes may mitigate mortality, morbidity, and hopefully improve quality of life.

The overall aim of the quality improvement project was to augment the nursing staff's knowledge about early identification of patients who warranted a trauma activation. Overall scores in post-questionnaires did increase demonstrating some improvement in retention of the information presented. There was an improvement of the participant's average score of 14.2% between the scores from the pretest and the post-posttest. However, only a small percentage of nurses were observed to have performed their own hands-on triage assessment once a patient was

received from EMS. Changing long-standing patterns of behavior is difficult, and nurses in the ED department at Hospital A have shown a reluctance to conduct an individual assessment, but rather rely on the EMS report. Indeed, the Theory of Reasoned Action and the Theory of Planned Behavior highlight the multitude of variables that impact behavior change (Glanz & Rimer, 2015). Unfortunately, one educational intervention did not increase the nurses' use of a hands-on triage assessment.

A retrospective chart review revealed no missed trauma activations for the month of August 2017, as opposed to the same month in the previous year in which there were three missed cases. Furthermore, while conducting observations of the nursing staff, there were zero cases in which the trauma activation was not activated appropriately.

Implications for Practice

Nurses and advanced practice nurses play a pivotal role in the development of new and innovative methodologies to impact the care imparted to the public. The educational session that was provided to the nursing staff demonstrated an increase in knowledge about trauma activation, and there was an evident decrease in missed trauma activation; yet, these results do not imply causality. In the time after the intervention, the trauma activation protocol has been clarified and has provided the nurses a clear path to follow when addressing the needs of the trauma patients. Nurses are integral to trauma resuscitation, and their contribution through the high quality they provide through their effective communication, leadership, and teamwork enables quality patient outcomes (Clements et al., 2015).

Limitations

Although the project was able to demonstrate an increase in nursing knowledge, it did possess several limitations. The first limitation was attributed to the short length of time in which

the project transpired. In order to obtain a more precise insight into the nursing staff's level of knowledge retention, a return of all 56 post-posttests would have allowed for conclusions based on inferential analysis. Unfortunately, the conclusion of the project coincided with the landfall of Hurricane Harvey on the east coast of Texas, causing considerable flooding and damage to the surrounding areas. Many nurses may have failed to return the post-posttests because it coincided with the hurricane's landfall, and preparing for their families and the hospital needs most likely took precedence over the project.

Additionally, collection of trauma activations from chart audits beyond the one-month post-intervention period may have provided further insight into the nurse's application of knowledge since the month of August was affected by Hurricane Harvey and devastated the local area and may have impacted the number and type of patients seen in the department. The hurricane made accessibility to the hospital nearly impossible. This may be the reason that there was a decrease in the number of patients seen in the ED for the month of August 2017.

Another limitation was the DNP student's presence in the department that could have influenced the way the nursing staff approached the care of the trauma patients. The presence of the DNP student conducting direct observations, chart audits, and communicating with the department's management could have potentially created a Hawthorne Effect.

Recommendations for Future Sustainability

In order to ensure the positive strides that have been achieved during the implementation of the quality project at Hospital A's ED, there must be sustainability recommendations that are available. The overall project's objective was to improve trauma activation guideline adherence by the nursing staff. The quality improvement project should be sustained and further education

regarding nurses conducting their own triage assessment rather than accepting the EMS report as the assessment should be reinforced.

It is recommended that there be regular re-education sessions for the nursing staff throughout the year to ensure adherence to the trauma activation protocol. New hires should receive training prior to providing care on the floor. This process will allow the nurses to be exposed to the guidelines very early on and continue learning throughout their tenure in the department. The trauma coordinator, who is an expert in the field, may be the best-positioned employee who can ensure that the nursing staff receive ongoing continuing education regarding trauma care and adherence to the trauma activation protocol.

Regular staff and management meetings may also ensure that education provided addresses nurses' questions and concerns as well as providing the staff with update outcomes regarding trauma activations. The department's leadership and nursing staff have maintained support for this project since its inception and made all the materials available to the student and staff in order to facilitate success. This support allowed the project to progress almost without confronting any major obstacles.

The perceived benefits from the nursing staff and management for a quality improvement project must be clear to allow for sustainability of the project. The reported perception from management (department director, day and night manager, chief nursing officer) is that the hospital will continue to be distinguished from surrounding hospitals as an accredited trauma center along with the potential reimbursement that can be substantial not only from properly identifying trauma patients who merit trauma activation and applying applicable hospital charges, but also due to possible state reimbursement for those facilities that qualify for monies set aside for hospitals designated as trauma centers. For the nursing staff, the trauma activation

protocol must be clear and readily available to facilitate decision-making and the ability to properly identify patients who merit trauma activation rapidly ensuring they receive the resources they need.

Over the past few decades, the ED volume not only has increased, but the patients are now presenting with more serious and complex illnesses in large part because of advances in the treatment of many chronic diseases that have long placed a heavy burden on our healthcare system (IOM, 2007). This changing landscape requires that healthcare providers including nurses (a) be skilled in responding to varying patient's expectations and needs, (b) provide ongoing quality patient care, and (c) deliver and coordinate care across teams and settings for which training is scarce in today's clinical education setting (IOM, 2010). Ultimately, nurses should be supported and encouraged by providers and management to activate traumas based on the guidelines.

Advanced Practice RN Role for DNP Graduate and Implications for Practice

The American Association of Colleges of Nurses (AACN, 2006) stated that “transforming healthcare delivery recognizes the critical need for clinicians to design, evaluate, and continuously improve the context within which care is delivered” (p. 3). These mandates are clearly illustrated throughout preparation of the quality improvement project. AACN (2006) is adamant in their belief that advanced practice nurses be prepared at the doctoral level with a combination of clinical, organizational, economic, and leadership skills. Nurses with these skills are most likely to be able to analyze nursing and clinical scientific findings and design programs of care delivery that are locally acceptable, economically feasible, and which significantly impact healthcare outcomes. The complexity of today's healthcare system demands that nurses, and especially nurses in advanced practice, possess knowledge, skills, and the ability to function

efficiently in today's complex healthcare system. Advanced practice nurses are being called on to fill and expand roles in the everchanging healthcare landscape.

Conclusion

Transforming the healthcare system to provide safe, quality, patient-centered, accessible care requires a comprehensive rethinking of the roles of many healthcare professionals including nursing and, most importantly, doctorally prepared nurses (AACN, 2006; IOM, 2010). As patient needs and the healthcare environment become increasingly complex, doctorally prepared nurses need to attain requisite competencies to deliver high quality care, through leadership, health policy involvement, systems improvement, research knowledge, evidence-based practice, and teamwork and collaboration (IOM, 2010). In keeping with these ideals, the purpose of this DNP student's quality improvement project was to impact the care of trauma patients through improving nurses' understanding of the hospital's trauma guidelines and to appropriately utilize these guidelines in providing quality patient care. Ideally, the educational intervention will be utilized as part of the new nurse's orientation and will continue to serve the department after the project is completed.

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Appendices

Appendix A: Trauma Activation Guidelines

LEVEL I**ACTIVATIONS FOR HIGH RISK OR LIFE-THREATENING INJURIES:**

1. Glasgow coma scale **<8** with mechanism attributed to trauma
2. Confirmed systolic blood pressure **<90** at any time in adults & age specific hypotension in children
3. Penetrating wounds to the neck, chest or abdomen
4. Transferred patients from other hospitals receiving blood to maintain vital signs
5. Intubated trauma patients transferred from the scene
6. Trauma patients with respiratory compromise or obstruction
7. Emergency physician's/provider's/nurse's discretion

LEVEL II**ACTIVATIONS FOR PATIENTS WHO HAVE ONE OF THE FOLLOWING:**

1. Falls greater than **≥ 20** feet or **3 times** the height of a pediatric patient
1. Ejection (partial or complete) from an enclosed vehicle
2. Auto-Pedestrian/Bicyclist thrown, struck or run over with **≥ 20** mph impact
3. MCC **≥30 mph**
4. Two or more proximal long bone fractures
5. Mangled extremity
6. Patients **≥ 65** years old in MVC
7. Emergency physician's/provider/nurses' discretion

TRAUMA ACTIVATION MAY NOT BE INITIATED ON THE FOLLOWING

1. Blunt trauma with CPR in progress
2. Burns meeting criteria for Burn center should be expeditiously transferred to burn center
3. Isolated penetrating head trauma requiring Neurosurgical evaluation/intervention.
The patient with an isolated penetrating head injury will be managed by the EC physician and expeditiously transferred to a facility with Neurosurgery (Goal transfer time < 2 hours)

CRITERIA FOR ADMISSION/TRANSFER TO BURN CENTER

1. Second and Third-degree burns BSA 10% - Age < 10 years > 50 years
2. BSA 20% all other areas
3. Significant burns to face, hands, feet, genitalia, perineum, major joints
4. Electrical, chemical, inhalation injury (with or without burns)
5. Burn patients with concurrent trauma-pre-existing diseases
6. Patients with circumferential burns to torso, extremities or head

Appendix A—continued

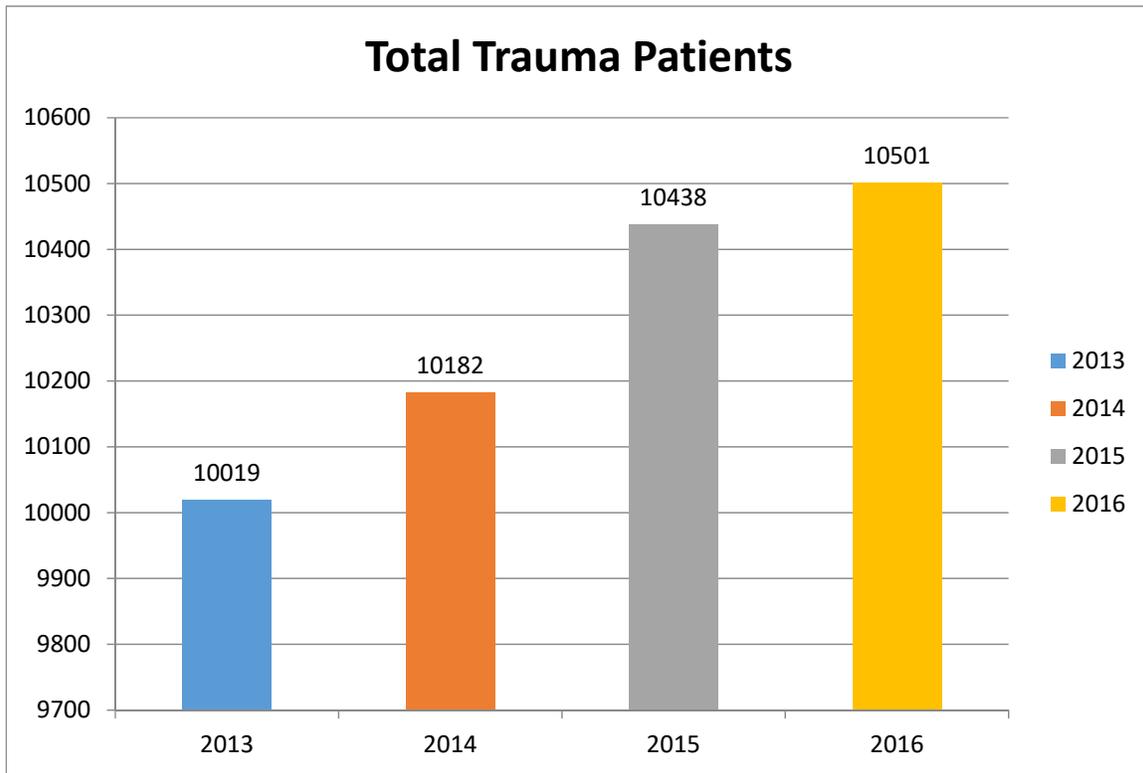
Age	Preterm	Newborn	3 mo	1 yr	3 yr	6 yr	8 yr	10 yr	12 yr	14 yr
Systolic BP	<50-70>	<60-70>	<60-70>	<70-80>	<76-90>	<80-100>	<84-110>	<90-120>	<90-120>	<90-130>

Any trauma nurse can activate a LEVEL 1 activation based on the information provided by the EMS report before the patient arrives. Page the trauma surgeon on call at the time you call the LEVEL 1 activation.

Always document the time the surgeon is notified and the time of surgeon arrival.

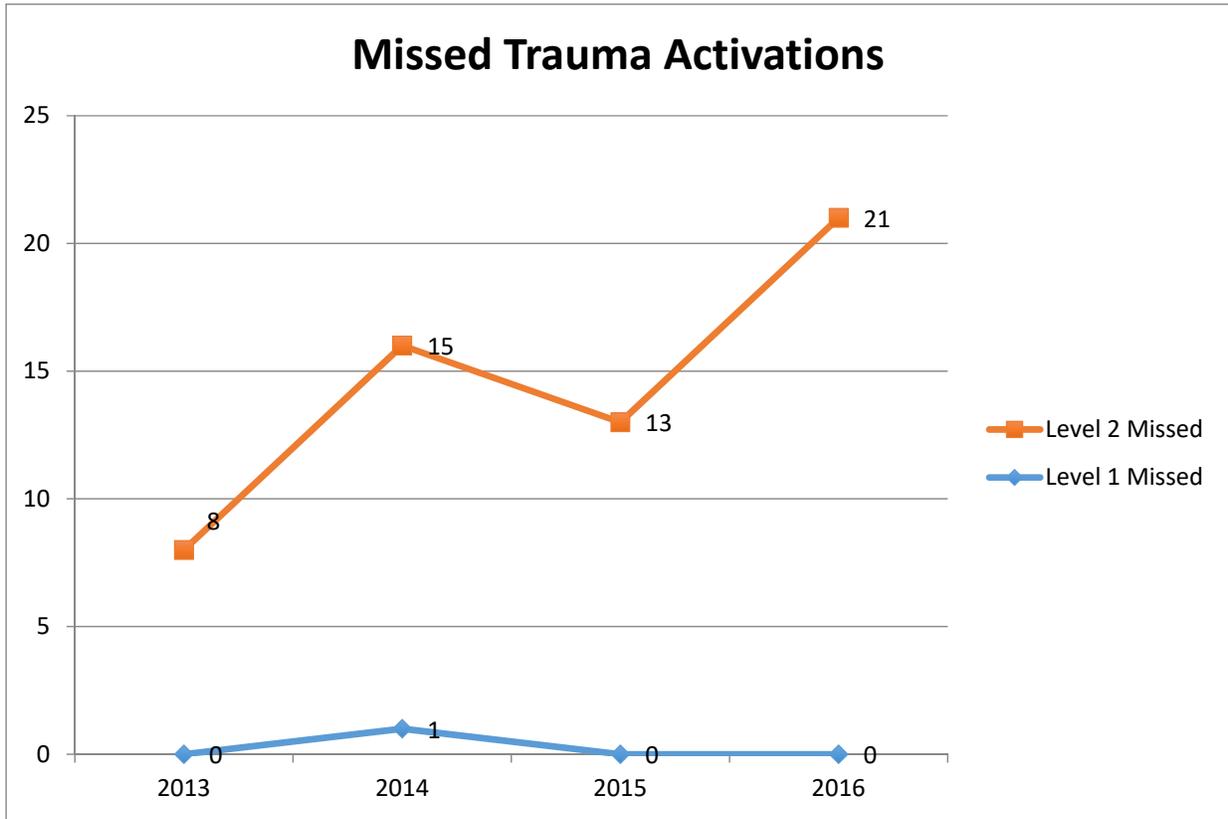
Source. Hospital A.

Appendix B: Total Trauma Patients



Source. Hospital A Trauma database.

Appendix C: Number of Missed Activations



Source. Hospital A trauma database.

Appendix D: Employee Questionnaire

Please take a few minutes to tell us about your job

I feel confident calling a trauma team activation
 I have the necessary knowledge to initiate a trauma activation
 I feel confident that my coworkers will assist me in the activation of the trauma team
 I fear that activating a trauma activation might reflect negatively on my abilities as an emergency care nurse

Strongly Disagree 1	Somewhat disagree 2	Neither Agree or Disagree 3	Somewhat Agree 4	Strongly Agree 5
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Appendix E: Interview Questions

1. Do you feel there is a problem regarding the trauma team activation process?
2. What do you think is the root of the problem?
3. What would you recommend to address what you perceive is the problem?
4. Do you support the idea of giving the nurses more autonomy when activating the trauma team activation protocol?
5. If yes or no: please give supporting ideas/facts.
6. Do you feel the nursing staff is adequately trained to initiate activation?
7. What has been your experience during trauma team activation? May give examples on how the process went well or when it confronted problems and did not go as well as it should have.
8. Do you feel that new nurses and their lack of experience may contribute to the problem in delaying the trauma team activation?
9. If so, what would you propose to remedy this problem?

Appendix F: Pretest/Posttest

Pre/Post Knowledge Questionnaire

1. The department utilizes a two-tier trauma activation model.	True	False
2. The trauma surgeon assumes the team leader position from the ED physician upon arrival.	True	False
3. On a Level 1 activation the surgeon has 30 minutes to perform a bedside evaluation upon initiating the trauma activation.	True	False
4. On a Level II the surgeon also has 30 minutes to arrive at the bedside if the ED physician request a surgical evaluation.	True	False
5. Only an ED physician or APRNS can initiate a trauma activation.	True	False
6. You should initiate a Level II trauma activation for patient 65 year or older involved in a motor vehicle collision (MVC).	True	False
7. All trauma patients greater or equal to 20 weeks gestation without mechanism criteria are made a level 2 trauma activation	True	False
8. The OB Hospitalist should be notified of a Level II trauma patient greater or equal 20 weeks gestation by the provider.	True	False
9. Trauma activation will be initiated on patients with CPR in progress with blunt trauma	True	False
10. Trauma activation will be initiated on patient with isolated penetrating head trauma requiring neurosurgical evaluation/intervention	True	False

Appendix G: Post-Posttest

1. The department utilizes a two-tier trauma activation model.	True	False
2. The trauma surgeon assumes the team leader position from the ED physician upon arrival.	True	False
3. On a level 1 activation the surgeon has 30 minutes to perform a bedside evaluation upon initiating the trauma activation.	True	False
4. On a level II the surgeon also has 30 minutes to arrive at the bedside if the ED physician requests a surgical evaluation.	True	False
5. Only an ED physician or APRNS can initiate a trauma activation.	True	False
6. You should initiate a Level II trauma activation for patient 65 year or older involved in a motor vehicle collision (MVC).	True	False
7. All trauma patients greater or equal to 20 weeks gestation without mechanism criteria are made a level 2 trauma activation	True	False
8. The OB Hospitalist should be notified of a Level II trauma patient greater or equal 20 weeks gestation by the provider.	True	False
10. Trauma activation will be initiated on patients with CPR in progress with blunt trauma	True	False
11. Trauma activation will be initiated on patient with isolated penetrating head trauma requiring neurosurgical evaluation/intervention	True	False
Overall, do you think the information provided was useful?	Yes	No

Please elaborate:

Appendix H: Review Form

TRAUMA BASE # _____ DISPO _____ DIAGNOSIS _____

TRUAMA REVIEW PI FORM

FIN#		NAME:									
Was EMS run sheet on	Y	N	Date:	Check in		ER MD		Over/Under	Y	N	
Was run sheet data	Y	N		Triage		GCS		Triage?			
Was EMS Scene < 20	Y	N		Depart		RTS					

ADMIT			TRANSFER						DEATH			
OR	ICU/ IMCU	FLOOR	LOCATION			DELAY?	Y	N	COMMENTS:		Y	N
			Non-desig or lower level?			Y		N				

TRAUMA TEAM ACTIVATION										
Was this a TT Activation? (4)	Y	N	LEVEL	Surgeon arrival ≥ 30 min for Lev 1 activation (5)				Y	N	N/A
Did it meet criteria for TT activation?	Y	N	1 2							
Was the TT appropriately activated?	Y	N	N/A	Surgeon arrival > 60 min for consult admit?				Y	N	N/A
Was activation appropriately charted?	Y	N	N/A							
Documentation of TT response (7)	Y	N	N/A	COMMENTS:						

CASE SUMMARY:

TT use, mech of injury, assessment, interventions/response (6-10) Protocols, Standard of Care	Y	N	
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Appendix I: Observation Form

DATE & TIME	Arrival method (EMS or private vehicle)	Hands on Triage/ Assessment (Yes or No)	Was this a Trauma Team activation (Yes or No)	Did it meet criteria for Trauma Team activation (Yes or No)	When in doubt about Trauma Team activation was there any communication with MD or charge nurse?
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Appendix J: Consent Form



University of Texas Health Science Center at Houston/Memorial Hermann Healthcare System

INFORMED CONSENT FORM TO TAKE PART IN RESEARCH

Improving Trauma Activation Guideline Adherence in a Level III Emergency Department

HSC-MH-17-0608

Adult

INVITATION TO TAKE PART

You are invited to take part in a research project called, Improving Trauma Activation Guidelines Adherence in a Level III Emergency Department, conducted by Jesus Valdez FNP-BC of the University of the Incarnate Word and JoAnn Mick, PhD, RN, NEA-BC of Memorial Hermann Healthcare System. For this research project, Jesus Valdez will be called the Principal Investigator or PI.

Your decision to take part in this study is voluntary. You may refuse to take part or choose to stop taking part, at any time. Your decision whether or not to participate will not affect your current or future relations with Memorial Hermann. Furthermore, your employment will not be affected by your decision to participate or not participate in this research.

You may refuse to answer any questions asked or written on any forms. This research project has been reviewed by the Committee for the Protection of Human Subjects (CPHS) of the University of Texas Health Science Center at Houston as HSC-XX-XX-XXXX.

PURPOSE

The purpose of this research study is to evaluate if providing essential information to nurses, using valid and evidence based information, to expand their knowledge for adequately identifying patients that merit trauma team activation will increase appropriate use of trauma activation guidelines by nurses in a Level III emergency department.

Appendix J—Continued

PROCEDURES

If you agree and are able to take part in this study you will first sign the consent form before undergoing these study procedures:

1. The participant will be asked to attend a 25 minute educational session and respond to three questionnaires. The first questionnaire will be administered prior to the educational session and the second immediately after the education session. The third and final questionnaire will be emailed to study participants three weeks after they attend the educational session.

TIME COMMITMENT

The total amount of time you will take part in this research study is approximately 55 minutes during a three month timeframe. The estimate of 55 minutes includes your time to attend the educational session and complete three questionnaires.

BENEFITS

You may receive no direct benefit from being in the study; however, your taking part may help nursing practice with trauma patient care get better in the future.

RISKS AND/OR DISCOMFORTS

The risks and discomfort associated with participation in this study are no greater than those ordinarily encountered when attending a work education session or completing a questionnaire. Your decision to participate is voluntary. Your employment and/or evaluations will not be affected by your decision to participate, or to not participate, in this study. The PI has no direct-reporting relationship with any of the study participants.

Confidentiality: There is a possible risk of breach of confidentiality

Questionnaires: You may get tired when we are asking you questions or you are completing questionnaires. You do not have to answer any questions you do not want to answer.

ALTERNATIVES

The only alternative is not to take part in this study.

Appendix J—Continued

STUDY WITHDRAWAL

Your decision to take part is voluntary. You may decide to stop taking part in the study at any time. A decision not to take part or to stop being a part of the research project will not affect your employment with Memorial Hermann Health System. If you withdraw from the study after completing the pretest, your data will not be used in the study. If you withdraw after completing the pretest and posttest, your pre and posttest data will be included in study results.

COSTS, REIMBURSEMENT AND COMPENSATION

There will be no cost to you if you decide to take part in this study.

You will not be paid for taking part in this study.

CONFIDENTIALITY

You will not be personally identified in any reports or publications that may result from this study. You will be assigned a study participant number by the PI using a key. The PI will be the only person with access to the key which will associate a study number with each participant's name and email address. You will be asked to write your study number on each survey form instead of your name or any other personal identification. Use of a study number allows the PI to link your pre, post, and post-post questionnaires for data analysis without using your name. The key will also provide your email address so the PI can send you the post-post questionnaire 3 months after you attend the education session. The key and all data collected will be maintained in a locked and secure location in the hospital.

Conflict of Interest Template Language

The PI, the University of the Incarnate Word, and Memorial Hermann Hospital have no financial interest in the project and no other conflict of interest to disclose.

QUESTIONS

If you have questions at any time about this research study, please feel free to contact Jesus Valdez FNP-BC at 713-449-7131 or Heather Wallace at 281-929-6484 as they will be glad to answer your questions. You can contact the study team to discuss problems, voice concerns, obtain information, and offer input in addition to asking questions about the research.

Appendix J—Continued

SIGNATURES

Sign below only if you understand the information given to you about the research and you choose to take part. Make sure that any questions have been answered and that you understand the study. If you have any questions or concerns about your rights as a research subject, call the Committee for the Protection of Human Subjects at (713) 500-7943. You may also call the Committee if you wish to discuss problems, concerns, and questions; obtain information about the research; and offer input about current or past participation in a research study. If you decide to take part in this research study, a copy of this signed consent form will be given to you.

Printed Name of Subject	Signature of Subject	Date Time (If applicable)
Printed Name of Legally Authorized Representative	Signature of Legally Authorized Representative	Date Time (If applicable)
Printed Name of Person Obtaining Informed Consent	Signature of Person Obtaining Informed Consent	Date Time (If applicable)

CPHS STATEMENT: This study (HSC-XX-XX-XXXX) has been reviewed by the Committee for the Protection of Human Subjects (CPHS) of the University of Texas Health Science Center at Houston. For any questions about research subject's rights, or to report a research-related injury, call the CPHS at (713) 500-7943.

Appendix K: SWOT Analysis

SWOT Analysis

