Creating an Educational Module to Improve the Calculation of Total Body Surface Area Burned

Kristine Eckert

Rutgers University

DNP Chair: Dr. Jeanette Manchester, DNP, RN

DNP Team Member: Robin A. Lee, MD

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Abstract

Initial management of burn patients involves the calculation of total body surface area burned and subsequent fluid management; a series of events which when performed incorrectly leads to complications for the patients. Proper education of graduate level health care practitioner students through an educational module is a solution to the miscalculation of total body surface area burned. A convenience sample of graduate level health care practitioner students was used to implement a burn education module via an online classroom platform. There, students learned how to calculate total body surface area burned using the Lund-Browder chart. It was expected for students to gain knowledge in the care of burn patients as well as experience an increased confidence to care for these patients. Care of the burn patient is essential for all personnel. It is heightened for those in New Jersey who may need to respond in the event of a Mass Casualty incident where burn patients will be placed in a variety of hospitals throughout the state according to the Eastern Regional Burn Disaster Consortium. This educational module focused on graduate level healthcare providers with the ability to be implemented in other disciplines in the future.

Keywords: Total body surface area burned, graduate-level students, educational module, mass casualty, knowledge, confidence

Improving TBSA Calculation Educational Module

The management of patients who have suffered extensive burn injuries typically occurs in a dedicated burn center (BC) where physicians and nurses have received specialty training in the care and surgical practice of burn patients. However, not every hospital is home to a BC. Therefore, not all health care providers (HCP) have learned the art of managing patients who have suffered scald, flame, chemical, or electrical burns. The education either does not occur in collegiate level courses (Vrouwe & Shahrokhi, 2017) or is insufficient to generate provider confidence to care for patients who have been burned (Zonies, Maier, Civil, Eid, Geiser, Guerrero, & Mock, 2012). Due to the lack of provider education, practitioners are not able to accurately calculate a patient's total body surface area burned (TBSAB). Miscalculations in TBSAB causes a sequela of events leading to further complications and increased morbidity and mortality for these patients (McWilliams, Hendricks, Twigg, & Wood, 2015). Proper calculation of TBSAB will help to prevent the progression of the burn wound, having a positive impact on patient outcomes (Tevlin, Dillon, & Clover, 2017). This project aimed to disseminate an educational module for graduate level HCP students on how to properly determine TBSAB. Through education and training, it was expected for there to be an increase in students' knowledge of TBSAB calculation and an increase in provider confidence to care for burn patients upon arrival to their facility.

Background and Significance

Total Body Surface Area Burned

The arrival of a burn patient to an emergency room launches a sequence of events. In terms of life-saving interventions, the priority is airway management and another critical piece is the calculation of a patient's TBSAB. The calculation occurs through methods such as the Rule

of Nines, Lund-Browder Chart, or the Palmar Method (Ministry of Health and Family Welfare Government of India, 2016). The initial calculation of TBSAB typically occurs at a facility other than a verified BC due to the small number of BCs across the country and worldwide. In the United States alone, there are only 66 verified Burn Centers and Alaska, Delaware, Idaho, Montana, New Hampshire, North Dakota, and Wyoming do not have a state burn center (American Burn Association, 2017). The small number of burn centers nationwide explains the lack of hands-on experience for students in the health care fields; there are simply not enough burn centers to accommodate and educate the large number of students.

The state of New Jersey has one verified BC to care for all residents who have suffered burn injuries (American Burn Association, 2017). Therefore, in New Jersey, the initial TBSAB calculation may occur in another health care facility by a HCP other than a burn specialist (BS). The importance of correctly calculating TBSAB cannot be underestimated as it is used to determine proper fluid resuscitation, if a patient should be transferred to a verified burn center, and the timeliness of transfer to a BC (Face & Dalton, 2017). When properly calculated, the patient receives the correct fluid resuscitation and transfer to the closest BC when appropriate.

The percentage error in TBSAB calculated been a non-burn specialist (NBS) and a BS ranges from 75% to 3,500%; for example, if a NBS estimates a burn percentage of 25% and the burn percentage is 50%, this results in a 100% overestimation of TBSAB (Harshman, Roy, & Cartotto, 2018). Miscalculation occurs in all burn sizes as burns less than 10% and mid-size burns (10-20%) are overestimated and large burns (greater than 20%) are underestimated (Harshman, Roy, & Cartotto, 2018). The difference in TBSAB calculation is alarming, and it occurs on a large scale. Harish found 53% of patients admitted to the BC have an overestimation of their TBSAB, and underestimation takes place in 17% of patients (Harish, Issler, Lajevardi,

Chang, Maitz, & Kennedy, 2015). This translates to 70% of burn injuries being miscalculated. Miscalculations such as these lead to over or under resuscitation, improper transfers (delayed or expedited) of burn patients to burn centers, and an increased morbidity and mortality related to complications of mismanaged fluid resuscitation (McWilliams, Hendricks, Twigg, & Wood, 2015).

Morbidity & Mortality Risks

The importance of educating HCP in the correct calculation of TBSAB cannot be underrated. Due to the lack of education and training, individuals not trained in the management of burn patients incorrectly calculate the TBASB (Harshman, 2018). This causes an alteration in the management of these patients including incorrect fluid resuscitation and unnecessary or delayed transfers to a verified burn center. The misinterpretation of TBSAB leads to increases in morbidity and mortality and complications of underestimating a burn percentage leading to dehydration and decreases in blood pressure, putting the patient at risk for organ failure (Harish et al., 2015). Miscalculation can also lead to overestimating a burn injury, and the ensuing over-resuscitation can lead to "pulmonary complications, compartment syndrome, [and an] increased need for escharotomy" (Harish et al., 2015).

When initially caring for a burn patient, another aspect to include in their management is the need to transfer the patient to the closest BC. Transfers to a BC are appropriate with burns greater than 10% in adults, 5% in children; burns of delicate areas including the face, neck, hands, genitals, and circumferential limb or chest burns; burns of an electrical or chemical cause; and burns in populations of an age extremes (Dias, 2018). The calculated TBSAB determines not only the level of severity, the need for transfer, but also the speed of transfer to a BC (Chattopadhyay, Sheckter, Long, & Karanas, 2018). Patients can be transferred via ground or air

transportation and the speed of transfer is based upon the stability of the patient and the critical nature of their burn. The financial consequences of this are greater for a patient who has been overestimated in their burn estimate and are transferred unnecessarily via helicopter as opposed to ground transportation to the closest BC. The price of base ground transportation in the United States is roughly $220 and air transportation is $3483 with an additional $7-$11 per mile and $23-$34 per mile respectively; most commercial insurance companies do not cover these costs, leaving the financial burden on the patient or family members (Chattopadhyay et al., 2018). In the event a patient suffers a burn injury, the patient needs to be transferred if necessary, in the safest and most appropriate method possible. In conjunction with providing the most appropriate care for burn patients, expeditious transfer to a BC is warranted for appropriate patients as the care of burn patients is optimized at verified burn centers (Pacella, Harkins, Butz, Kuzon, & Taheri, 2005).

Preparing for a Mass Casualty

Within the past 20 years, it has also become a priority to prepare HCP for a mass casualty event. Relative to the burn patient population, practitioners need to be prepared to manage these patients in the event of a catastrophe such as September 11th or other burn mass casualty events including fires in an entertainment venue, or natural disasters such as earthquakes and wildfires (Kearns, R.D., Hubble, M.W., Holmes, J.H., Lord, G.C., Helminiak, C., & Cairns, B.A. 2015). Surrounding hospitals of metropolitan areas are prepared to handle a large influx of burn patients and plans are in place to move patients to Burn Centers, Trauma Centers, and tertiary hospitals (Conlon et al., 2014). In the event of a mass casualty disaster, practitioners need to be knowledgeable in the initial care of burn patients. This knowledge will allow HCP to provide

the necessary care prior to patients being transferred as patients may be sent to regional medical centers or the closest hospital in proximity to the event (Kearns et al., 2015).

Educational Intervention

Patient complications, increased morbidity and mortality, and financial factors can be curtailed with the implementation of an educational module. The education was targeted towards HCP students, teaching them how to properly determine TBSAB and proper fluid resuscitation, and if necessary, prompt transfer to a burn center. This study looked to determine if an online module provided to HCP students would increase their ability to determine TBSAB and their confidence level to care for burn patients. The module was available to enrolled students in the nurse practitioner programs at a large nursing program in New Jersey. A pre-test was provided prior to initiation and after completion, a post-test was completed to determine if there was an increase in knowledge. A survey was also administered to see if providers experienced an increase in confidence in their ability to assess and manage a patient recently burned. The purpose of educating proper TBSAB calculation is to decrease complications, decrease morbidity and mortality, decrease unnecessary transfers, and to provide safe and accurate care of burn patients.

Needs Assessment

Global and Local Needs

According to the World Health Organization, an estimated 11 million individuals suffer burn injuries annually (2018). In the United States for the years 2016-2017, there were 486,000 burn injuries requiring medical treatment, an estimated 52,540 of those patients were in the Northeast region (American Burn Association, 2017) and 5500 burn patients in the state of New Jersey per year (Conlon et al., 2014). Burn injuries affect all areas of the world and people of

every different age and background. There is no protective feature of burns save for proper education and prevention (Ministry of Health and Family Welfare Government of India, 2016). A globally identified problem is the lack of accuracy in calculating the TBSAB. When examining the miscalculations which occur, an estimated 70% of patients receive improper fluid resuscitation (Harish, et al., 2015). The goal was to educate graduate level health care students in New Jersey to prevent the mismanagement of burn patients and consequently decrease associated morbidity and mortality.

Planning for a Mass Casualty Event

Unique to New Jersey is the need to plan for a mass casualty event with its close proximity to New York City and home to the "most dangerous two-mile stretch in the United States" according to the Division of Public Health Infrastructure, Laboratories and Emergency Preparedness (Conlon et al., 2014). This two-mile stretch is home to Port Elizabeth, Newark Airport, a rail corridor used by New Jersey Transit, Amtrak, and Acela; and multiple oil refineries (Conlon et al., 2014). If an event similar to September 11th were to occur along this area, HCP throughout the state, regardless of their confidence level in evaluating burn patients will be called to action to initially assess and care for patients who have suffered burn injuries. It is essential for HCPs in New Jersey to be prepared for a mass casualty event including how to properly calculate TBASB, how to calculate fluid resuscitation, and how to manage these patients until the Eastern Regional Burn Disaster Consortium (ERBDC) coordinates placement for these patients. In the event of a mass casualty event, the ERBDC will “optimize patient distribution” according to best practices as set forth by the American Burn Association (Conlon et al., 2014). Facilities are labeled as Tier I, II, III, or IV in the Northeast Region and burn patients would be placed according to their level of injury and the abilities of each facility

(Conlon et al., 2014). A verified BC is a Tier I facility while a trauma center is a Tier II facility where burn patients can be cared for on a short-term basis (Conlon et al., 2014). However, there are still various facilities throughout the state which would be required to temporarily care for burn patients during this time.

Methods to Determine Total Body Surface Area Burned

In order to determine TBSAB, multiple models have been created to assist HCP in their calculation efforts. These methods include the Rule of Nines, the Lund-Browder chart, and the Palmar Method (Gaikwad, 2016). According to Thom, the Lund Browder Chart created in 1944, continues to be the gold standard for burn size estimation due to its high validity and its correspondence to a "3% more accurate calculation of TBSAB with less variability" as compared to other estimation methods (2017). However, despite the accuracy when using the Lund-Browder chart, there remains an inherent user flaw in the inability to accurately determine the patients' percentage burn. Some of these flaws include failure to include lateral burns in the calculation as well as the miscalculation of patients who may have a larger body habitus (Thom, 2017). Appropriate education has the potential to reduce flaws in the current methods of TBSAB calculation.

Miscalculation of TBSAB has been witnessed at the (BC) at [redacted] The BC has witnessed adult and pediatric patients transferred via helicopter when not medically necessary. Conversely, patients have experienced a delay in transfer due to a miscalculation in the TBSAB causing the patient to experience effects related to under resuscitation such as decreased urinary output and decreased blood pressure. When calculated properly, TBSAB determines the patient fluid requirements for the next 24 hours which is termed the Parkland Formula (Yastı, Şenel, Saydam, Özok, Çoruh, & Yorgancı, 2015).

The formula is: 4 mL of lactated ringers x TBSAB x patients' weight in kilograms; half of the volume is given over 8 hours with the remaining volume given over the next 16 hours (Yastı et al., 2015). Insufficient fluid resuscitation as a result of the improper calculation can accelerate the "progression of burn depth", worsening patient outcomes (Tevlin et al., 2017). Over-resuscitation on the other hand due to overestimating the TBSAB and subsequently administering excessive amounts of intravenous fluids can lead to complications including pulmonary edema, orbital edema, and abdominal compartment syndrome (Liu, 2018). Therefore, the need for education on proper determination of TBSAB is essential.

Advanced Burn Life Support

One reason for the level of miscalculation is related to the lack of education for HCP pertaining to the care of burn patients. On a global and national level, the American Burn Association (ABA) has created an online version of Advanced Burn Life Support (ABLS) for providers to access. The program teaches providers about the immediate and initial care of burn patients in the 24-hours after injury (ABA, 2019, para 1). This program is valuable for HCP, however, there is a fee associated with the course and it only reaches providers who are interested in expanding their knowledge in the management of burn patients. The information should not be voluntary, rather it should be a part of entry-level graduate healthcare practitioner studies in order to "improve knowledge and confidence [and] to better enable future graduates [to manage] burn injuries" (Sadideen, Goutos, & Kneebone, 2017). Of medical students in the final year of their education, only 50% felt prepared to provide basic burn care (Zonies et al., 2012). This is alarming as these students will be practicing in healthcare facilities in the following year as medical residents who are at times the initial provider to examine a burn

patient and determine TBSAB. This lack of education and inability to calculate TBSAB indicates the need for increased education pertaining to care of the burn population.

National Academy of Medicine

With regards to nurse practitioner students, the National Academy of Medicine (formerly known as the Institute of Medicine or IOM), stated in the Future of Nursing Report "nurses need to attain requisite competencies to deliver high-quality care" which includes competencies such as system improvement (IOM, 2010). These competencies are essential as nurse practitioners are taking on more advanced roles to meet the ever-growing demands of the population (IOM, 2010). Therefore, nurse practitioner students should be included in educational sessions targeted towards physicians to promote quality care. An advantageous time to educate all healthcare providers is with those who have yet to practice independently (Vrouwe & Shahrokhi, 2017). Through the provision of an educational module via graduate-level health care students' online classroom platforms, there is an opportunity to attract and educate a multitude of future providers.

To achieve the objectives of this project, an online educational module was provided to graduate level nurse practitioner students. The session educated these students on the calculation of TBSAB and fluid requirements, preparing for a mass casualty event, and appropriate transfer to the BC. The goals of the educational session for graduate level HCP students was to lead to an increase in educational competency as well as increased confidence in their ability to assess and care for burn patients.

Problem Statement

The problem currently occurring throughout the country and around the world is a lack of education for graduate level healthcare students regarding the assessment, management, and

treatment of burn patients (Vrouwe & Shahrokhi, 2017). Burn injuries occur frequently and all health care providers need to be prepared for a mass casualty event which may lead to an influx of burn patients to their local emergency room or hospital setting. Minimal education and training leads to a discrepancy between BS and NBS in determining TBSAB. The calculation of TBSAB is one of the most important determinants of the patients care, save for airway management. Therefore, education needs to be provided to all graduate health care provider students regarding how to accurately calculate TBSAB in order to manage and properly care for burn patients.

Clinical Question

The question driving this project was: in health care provider students, will an online educational module, as opposed to no educational module, increase their confidence level and their ability to initially assess and calculate the total body surface area burned?

Aims and Objectives

The aim of this project was to improve HCP ability to calculate TBSAB. The main objective was to increase the confidence level in calculating TBSAB and the understanding and application of this calculation in a patient recently burned. The objectives included:

1. To evaluate deficits in the calculation of TBSAB in injured burn patients
2. Learners would be able to assess and properly calculate the TBSAB
3. To implement new knowledge in the acute management of burn patients
4. To compare pre- and post-test scores assessing HCP knowledge of how to properly calculate TBSAB
5. To show an increased confidence level in treating burn patients after completion of the educational module

In meeting the objectives of this project, the goal was for HCP to have an increased understanding and confidence level in calculating TBSAB to provide proper fluid management as well as appropriate and timely modes of transportation to a verified BC. This would lead to decreased complications, increased patient safety, and decreased costs related to unnecessary transfers.

Review of Literature

A thorough research process was conducted to identify the difference in calculation of TBSAB between BS and NBS, the problems which arise as a result of miscalculation, the importance behind proper calculation and resulting fluid requirements, and the correlation between the education of health care providers and proper calculation of TBSAB. Keywords used to identify research included “total body surface area burned” and “education”, “burns” and “medical education”, and “medical school education” and “burn injuries”. Search engines used included CINAHL, Medline, Scopus, and Joanna Briggs Institute with a total of 63,975 results. The search was tapered down through the complementary key phrases “medical education”, “clinical competence” and “burn estimation” which yielded 188 results. After a thorough appraisal of the literature, 14 references were chosen to answer the clinical question which consisted of (9) research articles, (5) non-research articles, with one of the non-research articles being a piece of Grey Literature.

The nine research articles were non-experimental and two were qualitative studies, one was a cross-sectional survey, and the remaining six studies were descriptive and comparative studies. The research took place in The United States, The United Kingdom, Canada, Australia, and Vietnam. Research articles were appraised using the John’s Hopkins Evidence Appraisal Tool for research and non-research articles. Applying this tool, each article was given a level of

evidence. Eight articles were rated as high quality, five articles were good quality, and one was low quality related to the study not being sponsored. The John's Hopkins tool was also used to apply a level of evidence to the articles, indicating the strength of evidence. Of the researched articles, three were level II (quasi-experimental studies), six level III (non-experimental studies or qualitative studies) and five (non-research) level V articles, expert opinions. Due to a large number of non-experimental studies, there is an inherent limitation in determining the differences in TBSAB calculation between BS and NBS. Additional limitations realized during the research process included studies not examining all types of health care providers, small sample sizes, not exploring the initial TBSAB among burn providers, and the potential for error in charting and transcribing incorrect TBSAB (Appendix A).

The International Association for the Surgery of Trauma and Intensive Care (IATSIC) along with the World Health Organization (WHO) published the *Guidelines for Essential Trauma Care* which detailed items relating to the training, staffing, required skills and physical resources (equipment and supplies) needed for trauma care at health care facilities (Zonies, et al., 2012). Included in the guideline are core competencies taught to medical students to standardize burn and trauma training practices (Zonies et al., 2012). In accordance with the IATSIC, the objective of this project is to provide an educational module related to the core training required of future health care providers on the most accurate method to calculate TBSAB to decrease morbidity and mortality for this patient population.

In 2004, as a result of the events which occurred on September 11, 2001, the United States Department of Health and Human Services (DHHS), Health Resources and Services Administration (HRSA) and the Bioterrorism Hospital Preparedness Program (BHHP) mandated all states to implement a plan to mobilize and manage a surge of burn patients (Kearns, et al.,

2015). After the directive, providers across the country verbalized the difficulties experienced in the treatment of burn patients including the initial care of these patients and the low level of comfort felt in caring for this patient population (Kearns et al., 2015). To overcome the level of discomfort, Advanced Burn Life Support (ABLS) was offered to HCPs to educate about burn management and prepare HCPs for a burn disaster (Kearns et al., 2015). Despite the educational benefits of ABLS, there were also drawbacks noted; most notably the cost to attend ($225-$350 per provider) and the limited number of classes offered (Kearns et al., 2015). To overcome challenges such as these, it would be valuable for burn education to be provided to collegiate level students and practicing providers. The educational needs remain for current practicing providers not only to prepare for a burn surge incident but also due to the inaccuracies evident in the initial calculation of TBSAB by NBS.

HCP education regarding care of the burn patient is in alignment with the Institute of Medicine (IOM) and the six domains of health care quality which include providing safe, effective, patient-centered, timely, and efficient care (2001). Healthcare quality will be ensured through the education of HCPs in the most accurate method to determine the TBSAB. The proper percentage will ensure patients receive patient-centered care via safe and effective fluid management, timely and efficient care, and safe and appropriate transfer to a burn center when necessary.

Throughout the research, three themes became evident, the first of which is the disparity in calculation of the TBSAB between BS and NBS (Armstrong et al., 2017; Harshman et al., 2018; Lam et al., 2018; Martin et al., 2014; McCulloh et al., 2018; Swords, Hadley, Swett, & Pranikoff, 2015; Tevlin et al., 2017; & Vrouwe et al., 2017). Lam et al., (2018) determined only 10% of health care providers can accurately determine the TBSAB and Harshman et al., (2018)

calculated the percentage error in TBSAB in NBS ranged from 75%-3500%. A program such as ABLS is ideal to train HCPs in the proper methods to determine TBSAB, treatment of the burn, and fluid management. However, due to the costs associated with the program and the limited number of classes available, it was evident another educational supplement is needed to prepare HCP in the management of burn patients, regardless of a surge. The importance of accurate TBSAB calculation cannot be overlooked due to the problems which occur related to miscalculation. Problems identified include fluid overload, complications of fluid overload, increased need for escharotomy, the risk of multisystem organ failure, unnecessary transfer to a burn center, and even death (McCulloh et al., (2018). The differences in percentages calculated and problems resulting from miscalculation demonstrated the need for educational programs related to the care and management of burn patients.

The second theme identified was the need for increased provider education which was identified by practicing providers who substantiated the need for continuing education in the management of burn patients specifically related to properly calculating TBSAB (Anzarut et al., 2007; Armstrong et al., 2017; Egro (2017); Harshman & Cartotto 2018; Lam et al., 2018; McCulloh et al., 2018; McWilliams et al., 2015; Spiwak et al., 2014; Swords et al., 2015; Tevlin et al., 2017; and Vrouwe et al., 2017). Another aspect of educational deficiencies was identified in medical schools which determined insufficient time was spent reviewing the management and care of burn patients (Egro, 2017; Lam et al., 2018; and Tevlin et al., (2017).

The final theme evident in the research was the lack of confidence providers felt in caring for patients who have suffered burn injuries. Anzarut et al., (2007) determined health care providers requested increased education on the care of burn patients, believing it would have a large impact on the care they provide. After HCP attended a course receiving additional

education on the care and management of burn patients, providers experienced an increase in understanding and confidence level to care for these patients leading to safe, effective, and efficient care (Reeves et al., 2018; and Spiwak et al., 2014). Reeves et al., (2018) tested 60 providers who had participated in ABLS training and 87% experienced improved self-confidence after having taken the course. Spiwak et al., (2014) provided essential burn management to 21 health care providers. 100% of the respondents stated they had a better understanding of burn management after course completion, 81% felt the course improved their knowledge of burn care; and 38% felt more confident in the treatment of burn patients (Spiwak et al., 2014). The confidence level improved slightly however the question pertained to the management of the patient from initial presentation through to the rehabilitation phase versus only focusing on initial management of the burn patient.

The miscalculation of TBSAB is related to the lack of education for future health care providers as well as practicing providers. Providing education regarding care of the burn patient will improve provider accuracy in calculation of the TBSAB. This will decrease the consequences of miscalculation and finally increase the confidence levels for providers initially caring for these patients. Improvement in the care of burn patients adheres to the quality of care model set forth by the IOM indicating there is a need for increased education for HCPs caring for burn patients. The differences in TBSAB calculation and the potential to harm patients is also in alignment with DHHS/HRSA/BHHP and the IOM to provide high quality and safe healthcare to patients suffering burn injuries and to prepare HCP for a surge event.

The benefits of an online learning module pertaining to the care of burn patients have proven to be beneficial for several reasons. First, as was previously discussed, there is an insufficient number of burn centers to educate HCPs and students throughout the United States

(American Burn Association, 2017). Egro (2017), questioned 18 medical students about the benefits of an e-learning module and determined a module is both versatile and efficient and can reach a multitude of students at various times and across many geographic locations. This solves the dilemma of limited access to burn centers and ABLS for both students and practicing providers. The benefits of educating HCP in the initial care of burn patients were identified by Spiwak et al., (2014) as evidenced by the improved understanding and confidence in the care of burn patients. Combining the efforts of an educational session with an online module can attract a large student audience, increasing the understanding and confidence levels of future health care providers; increasing safety, and the quality of care for burn patients. These are in agreement with the objective of this project, to increase the abilities and confidence levels of HCP students in the management of burn patients through an educational module. The literature supported the proposed outcome of increased student confidence in caring for burn patients and an increased ability to accurately calculate the total body surface area burned after successful completion of the online educational module.

Theoretical Framework

The theoretical framework guiding this project was the Knowledge to Action (KTA) Model (Appendix B). The KTA model describes knowledge moving through stages until it is adopted and used, synthesized, and tools are used for knowledge to be applied in the appropriate setting (White and Brown, 2012). Included in the KTA cycle are seven phases starting with identifying a problem and research relevant to the problem; adapting knowledge use to the local context; assessing what barriers may exist to knowledge; selecting and implementing interventions for the new knowledge; monitoring use of the newly acquired knowledge; evaluating outcomes of the new knowledge; and finally, sustaining the same level of knowledge

(White and Brown, 2012). Pertaining to this project, the problem identified was NBS inaccurately calculating TBSAB. With thorough research, it was determined the Lund-Browder chart was not only the gold standard in terms of assessment and calculation of the TBSAB, it was also associated with a 3% more accurate calculation of TBSAB (Thom, 2017). The barrier is the lack of education for HCP which currently exists concerning the care and management of the burn patient. To overcome this barrier, the intervention was to implement an online module educating HCPs and students on how to correctly calculate TBSAB. After completion of the module, a post-test was administered and compared to a pre-test determining if knowledge and confidence levels increased after implementation of the educational module. This level of knowledge can be sustained through continued use of the module after project completion.

Methodology

Throughout the literature review, it was determined HCP struggle to accurately calculate a burn patients' TBSAB and therefore experience a decreased confidence level in their ability to care for and manage burn patients in the initial hours of injury. Therefore, the goal of this quality improvement project was to increase HCP proficiency in calculating TBSAB and thus increase their confidence level to care for burn patients. The project used a pre-test and post-test to ascertain knowledge gained as well as a survey to determine providers experienced an increased confidence level to care for burn patients after completing the educational module.

Setting

An educational module was made available to all full-time and part-time Nurse Practitioner students at a large nursing school in New Jersey with a Canvas account. The TBSAB educational module was available via the online classroom platform "Canvas" and optional to all nurse practitioner students.

Study Population

The Nursing school where project implementation occurred has locations throughout the state of New Jersey. Inclusion criteria included graduate and doctoral level HCP students who have access to "Canvas", the online educational platform. Exclusion criteria include non-graduate or doctoral level students without access to "Canvas".

The module was available to students for two months (July 2019-August 2019), indicating this quality improvement project consisted of a convenience sample. Recruitment consisted of an introductory email as well as reminder emails to eligible students to participate. Due to the timing of the module during the summer semester, there was the possibility for a decreased response rate as not all HCP students were in session during the summer semester. However, this platform enabled all included students the opportunity to complete the education, allowed for the collection of a variety of student responses, and for future practitioners to increase their confidence and ability to calculate TBSAB. Using a priori power analysis based upon an estimated 500 enrolled Nurse Practitioner students (US News, 2019), a 95% confidence interval, and a 5% margin of error, the necessary sample size was 218 students (Raosoft, 2004).

Subject Recruitment

The recruiting of students began in June 2019 with an email sent to all current Advanced Practice Nursing (APN) students and APN faculty at University School of Nursing via their university email address (see Appendix C). The emails were sent once a week for three weeks prior to the intervention period. Flyers (Appendix D) were posted in the student lounge one week prior to the intervention. The co-investigator (CI) also handed out flyers to APN students after their classes one week prior to the intervention period. If potential participants had

questions regarding the educational module or the information contained; the number and email address of the researcher was be provided on the flyer in the email.

Consent Procedures

Participants were invited to participate in the module through a recruitment email. Once in the module, consent was obtained through subject participation and agreement to participate in the Canvas educational module. Within the consent (see Appendix E), details were stated regarding risks, benefits, financial disclosure, maintenance of participant confidentiality as well as how to withdrawal from the module. Included in the consent was the CI contact information. The consent document was the first requirement of the educational module and a required pre-requisite to continue in the module and for module completion.

Risks/Harms/Ethics

Minimal risks were associated with this project however, participants may have experienced an increased confidence level in their ability to calculate TBSAB and therefore may have been disappointed with their initial test results prior to completing the educational module. There was a risk for the participants' identification to become known pertaining to their participation and test scores however, there was no identifiable information traceable to the student. To protect against this, all test results had identifiable information removed with the use of a Qualtrics server and the primary investigator is the only individual with access to the de-identified information.

Benefits of participating in the Quality Improvement project included knowledge and confidence gained pertaining to the initial care and management of the burn patient, and an increased ability to contribute during a burn mass casualty event. These lead to efficient and safe

care provided to patients suffering from burn injuries in the state of New Jersey with appropriate transfers to Burn Centers when medically necessary.

Subject Costs and Compensation

There were no costs for the subjects participating in the Quality Improvement project. Participants did not receive monetary compensation, instead, participants received continuing education units upon completion of the module.

Study Intervention

The intervention was the use of an online education module available to graduate and doctoral level nurse practitioner students via the online platform "Canvas". The following education regarding the proper calculation of TBSAB was provided: (see Appendix F)

- The problem
    1. 486,000 patients are burned annually in the United States (ABA, 2017)
        a. 5500 of these patients are in New Jersey (Conlon et al., 2014)
    2. 70% of TBSAB calculations are miscalculated when comparing NBS to BS (Harish et al., 2015)
    3. Incorrect TBSAB calculation leads to increased morbidity and mortality for burn patients (Harish et al., 2015)
        a. Incorrect fluid management (Harish et al., 2015)
        b. Inappropriate transfers to a BC (Chattopadhyay et al., 2018)
        c. Incorrect fluid selection (Ahuja et al., 2016)
- The importance of preparation for management of the burn patient in the event of a mass casualty event

1. Providers in the State of New Jersey need to be prepared in the event of a burn mass casualty
    - New Jersey is home to the most dangerous 2 mile stretch in the country (Conlon et al., 2014)
        - Port Elizabeth
        - Newark Airport
        - Rail Corridor
        - Oil Refineries
    - HCP need to be prepared to calculate TBSAB and initially manage burn patients until transfer is available to appropriate hospitals according to the ERBDC (Conlon et al., 2014)

- Most accurate method to determine TBSAB
    1. Lund-Browder Chart (see Appendix G)
    2. 3% more accurate calculation of TBSAB with less variability (Thom, 2017)
- Calculation
    1. First degree burns are not to be included in TBSAB calculation
    2. These are superficial burns, erythematous
    3. Leads to inaccuracies in calculation of TBSAB
        - McCulloh, 2018
- Practice your calculation of TBSAB!
    1. TBSAB example
- What was the correct calculation of TBSAB was for this patient example?
- Parkland Formula

1. Proper calculation
    - 4 mL of lactated ringers x TBSAB x patients' weight in kilograms; half of the volume is given over 8 hours with the remaining volume given over the next 16 hours (Yasti et al., 2015)
        - Lactated Ringers is the preferred choice of intravenous fluids initially for burn patients due to the decreased acidity and the similarity to normal plasma electrolytes as compared to normal saline
            - (Ahuja et al., 2016)
        - Miscalculation leads to increased morbidity and mortality for burn patients (McWilliams, 2015)
            - Over-resuscitation leads to pulmonary edema, orbital edema, compartment syndrome and an increased need for escharotomy (Liu, 2018)
            - Insufficient fluid leads to a progression of the wound depth (Tevlin et al., 2017)

- Trial fluid resuscitation
    1. 20% burn in a female patient who weighs 85kg
        - LR at 425 ml per hour for 8 hours
        - LR at 200 ml per hour for 16 hours
    2. 40% burn in a female who weights 85kg
        - LR at 850 ml per hour for 8 hours
        - LR at 425 ml per hour for 16 hours

3. 60% burn in a female who weighs 85 kg
    - LR at 1,275 ml per for 8 hours
    - LR at 635 ml per hour for 16 hours

- Criteria to transfer a patient to a burn center
    1. Burns greater than 10% in adults, 5% in children;
    2. Burns of delicate areas including the face, neck, hands, genitals, and
    3. Circumferential limb or chest burns;
    4. Burns of an electrical or chemical cause; and
    5. Burns in populations of an age extremes
        - (Dias, 2018)

Outcomes to be Measured

The literature review determined there was a lack of education in medical school, and a lack of continuing education pertaining to the care of burn patients, leading to a decreased ability and confidence level to care for burn patients. The literature review determined when programs and education were provided to HCP, there was an increase in ability and confidence to care for these patients but there continues to be a lack of education in medical school. The Lund-Browder Chart, as was previously stated, increases the accuracy in calculation of TBSAB, therefore this tool was used to educate students in the proper calculation of TBSAB. Questions were used to determine knowledge gained using identical pre-test and post-test questions which were administered prior to beginning the module and then immediately upon completion of the module. After the post-test, the 13 question Student Satisfaction and Self-Confidence in Learning questionnaire (SSSL) was administered, courtesy of the National League of Nursing (see Appendix G). The SSSL has been tested for reliability using Cronbach's alpha with a

satisfaction of 0.94 and self-confidence of 0.87. The pre-test scores and post-test scores were compared to determine an increase in knowledge gained and the SSSL score was calculated to ascertain if there was an increased self-confidence.

Project Timeline

The proposal was submitted and Institutional Review Board (IRB) approval was received in June 2019. Once approved, implementation began within the Canvas educational module on July 1st, 2019 and commended August 31st, 2019 for APN students. Data collection and analysis, as well as evaluation was completed in September 2019. Presentation of the findings from the educational module will be completed in October 2019 and graduation occurs in May 2020. (See Appendix I)

Resources Needed/Economic Considerations (Project Budget)

There were minimal costs to the CI aside from costs to purchase the Statistical Package for the Social Sciences (SPSS). There was also the cost of the continuing education credits for the participants which was provided in kind by RU. The CI was responsible for all costs of this project. The anticipated budget is included in Appendix J.

Evaluation Plan

The pre-test and post-test scores were compared to determine if there was knowledge gained during the educational module. The SSSL was used to ascertain if the students experienced an increased confidence level after having completed the educational module. The overarching goal of this project was for future providers to have an increased confidence level in caring for burn patients as well as to provide safe and efficient care for burn patients.

Data Analysis Plan, Maintenance & Security

To statistically analyze the data, a statistical platform was used (SPSS) and a Wilcoxon Rank Sum test was run to determine the statistical significance of the data.

Data Maintenance & Security

The data obtained from the education module, including pre and post-test responses as well as SSSL results are being securely stored in a password-protected computer in the Biomedical Health Sciences at the school of nursing. All data is locked, following the RU encryption process. The data collected was tracked using Microsoft Excel for analysis. A secure Qualtrics server collected and stored the data in a password protected electronic format. This server ensured that all responses remained anonymous, as it did not collect information such as name, e-mail, or IP address. No names or identifying information is included in any publications or presentations, and all responses to the questionnaire remained confidential. Subject confidentiality was maintained and only the CI had access to the information from the pre and post-tests.

Anticipated Findings

The initial goals of this project were to increase provider knowledge and confidence in initially caring for burn patients. This was to be validated through statistically significant test scores between pre and posts tests and through a questionnaire asking participants if they experienced an increased confidence level in caring for burn patients after the educational module. Achievement of these goals will lead to increasing the safety and efficacy in the care of burn patients including appropriate transfer to a burn center when medically necessary. In improving the care of burn patients, this will lead to decreased unnecessary transfers to burn centers including medivac transfer which will decrease the financial burden for stakeholders.

Plans for Sustainability and Translation

With test scores indicating an increase in HCP knowledge and confidence, this project can be applied to a broader population of HCP including a variety of graduate level HCP students and currently practicing providers and mid-level practitioners. The educational module can be available to a larger audience through the university continuing education platform; educating HCP throughout not only in New Jersey, but also nationwide.

Plans for Dissemination and Professional Reporting

The results of this Quality Improvement project have been made available to the director of the Burn Center at [redacted]. It is the hope of the CI that the educational module will be a part of HCP collegiate education in order to more effectively educate HCP on the proper calculation of TBSAB, the initial management, as well as preparation for a burn mass casualty event. Finally, the researcher has submitted an abstract for the annual American Burn Association with hopes to disseminate the information to the ABA as a potential educational initiative for practicing mid-level practitioners, medical residents, surgical residents, and fellows involved in the care of burn patients.

Results

Implementation occurred July 1st, 2019 through August 31st, 2019. In total, 33 students participated of the 500 invited, indicating a 6.6% return rate; short of the 218-sample size recommended by Raosoft. After course completion, a Wilcoxon Rank Sum Test was run using SPSS. The results showed a *p* value of 0.122 showing a lack of statistical significance (Appendix M). However, the mean score between pre-test and post-test improved 4 ¼%. 53% of participants calculated the burn percentage correctly, which is improved from previous research finding 70% of burn percentages are miscalculated by a non-burn specialist. 88-94% of

participants experienced an increase in their confidence level to evaluate deficits in the calculation of a patients burn percentage, and 88% felt an increased confidence level to assess, calculate, and evaluate a patients burn percentage, and in their ability to apply the knowledge from the course to care for burn patients. 75% of participants continue to seek additional information on the care of burn patients and the calculation of total body surface area burned (Appendix N).

Discussion

The results of this study coincide with previously established literature by Spiwak et al., (2014) and Reeves et al., (2018) finding non-burn specialists who were educated in the care of burn patients experienced an increased confidence level to care for burn patients. This study tested participants in their ability to correctly calculate the burn percentage, which occurred 53% of the time (16/30 determined the correct burn percentage; 14/30 did not determine it correctly and 3 participants did not answer the question). This is improved from previous research completed by Harish et al., (2015), stating burn percentages are miscalculated 70% of time. Participants experienced an increased confidence level similar to prior research. Where 81% experienced an increased knowledge in burn care in the study completed by Spiwak et al. (2014), as compared to this study, 88% felt an increased confidence to assess, calculate, evaluate, and apply the knowledge to care for burn patients and 94% experience an increased confidence to care for burn patients as compared to the study by Reeves et al., (2018) where 87% of participants experienced an increased confidence level to care for burn patients.

Therefore, this study was effective in its approach to educate graduate level HCP students in the assessment, evaluation, and application of knowledge to care for burn patients, as well as to improve their confidence to care for burn patients.

The first objective was to evaluate deficits in the calculation of TBSAB in injured burn patients. One participant described a deficit as time, stating if they had more time with the Lund-Browder chart, they feel they would be better prepared to calculate the TBSAB. In an effort to improve NBS ability to calculate the TBSAB, a pocket guide in the form of a copy of the Lund-Browder chart was provided to those who participated in the module to use in their future practice. The next objective was for learners to be able to assess and properly calculate the TBSAB, which was achieved when 53% of participants were able to calculate the percentage appropriately. Next, participants would be able to implement new knowledge in the acute management of burn patients, which was assessed through the pre and post-test scores, with an increase in scores of 4 ¼% indicating an increase in their ability to implement new knowledge. The final objective was achieved as participants stated they agreed (44%) or strongly agreed (50%) they experienced an increased confidence level to treat burn patients upon completion of the module, totaling 94% who agreed they have an increased confidence in their ability to care for burn patients after completion of the education module.

Completing the objectives in this educational module was made possible due to the ease of use of the Canvas course module. The software allows for multiple modes of education which were utilized in the course such as audio power point, demonstration to determine TBSAB, a location for pre and post-tests, and creating a location to obtain consent. Canvas acted as a facilitator also due to the participants being comfortable with the course shell as a result of using canvas for previous courses.

A barrier impacting completion of the objectives was the time frame the module was offered. The module was available during the summer session which is a shorter class session. Therefore, students may have had a more demanding schedule during the summer and did not

have a sufficient amount of time to complete the educational module. Also, some students in the program did not have a summer class, therefore they may not have acknowledged the course invitation.

Unfortunately, the time frame the course was offered may have impacted the number of students who participated in the course. If implementation occurred in the Fall Semester, this may have resulted in an increased number of students participating. However, the results are still favorable; students determined the TBSAB more frequently than previous research, and 94% experienced an increased confidence level to care for burn patients.

Implications

Clinical Practice

In terms of clinical practice, the implication of the DNP project to improve the TBSA calculation can be used in educational settings as well as the clinical setting. The course can be shared or created in a variety of settings. Therefore, the class can continue to be offered in this platform. It is also currently available to a larger audience in online continuing education through the Center for Professional Development at the School of Nursing and can continue to be offered in this platform. Finally, the course can be offered to health care professionals throughout various health care settings such as their educational platform in the hospital.

Making this course available to a larger audience such as emergency room providers, primary care providers, and physicians, residents, nurse practitioners, and physicians assistants will continue to educate non-burn specialists. This will, according to the study, decrease the associated increased morbidity and mortality with miscalculation of TBSAB, decrease unnecessary transfers, and increase the confidence level of providers to initially care for and manage burn patients.

In this setting, HCP have access to burn education without the associated costs of ABLS, eliminating the barrier HCP spoke of regarding ABLS. The information is also available for as long as the student has access to the Canvas software for the participants from the School of Nursing. Finally, the Lund-Browder chart has been provided as a pocket guide for users to continue to have access to a key aspect of the educational module and implement the knowledge gained in their clinical practice.

Healthcare Policy

In accordance with the DHHS, HRSA, and BHHP requirements, the module can be used to educate HCP in the initial management of burn patients. The DHHS/HRSA/BHHP mandated states to create a plan to mobilize burn patients in the event of a burn surge event. When approached with this mandate, providers around the country expressed their level of discomfort in handling burn patients and feeling unprepared to manage a burn patient in the event of a burn surge event. Specific to New Jersey, HCP need to be prepared to care for a burn patient as a result of the state being home to the most dangerous 2-mile stretch in the country (Conlon et al., 2014). The 2 miles are home to Newark Airport, Port Elizabeth, multiple oil refineries, and multiple modalities of mass transit. New Jersey is also neighbor to New York and more importantly, New York City, the most populous city in the country. There is a daily risk of the potential for a burn surge event and HCP throughout the state need to be prepared to acutely care for a burn patient regardless of their facility not being a trauma facility or a burn center. Patients will be mobilized to surrounding area hospitals in accordance with the plan created by the Northeast Regional Burn Disaster Consortium. Therefore, this educational module is an opportunity to overcome the knowledge gap as well as lack of confidence HCP experience in caring for burn patients. Educating HCP in the care of burn patients can once again decrease the

associated morbidity and mortality related to improper TBSAB calculation as well as prepare those in and around New Jersey for an event such as a burn surge event. In an event such as this, it is imperative to accurately calculate the TBSAB in order to properly place burn patients in verified burn centers, trauma centers, and tertiary centers according to the Northeast Burn Disaster Consortium.

Quality & Safety

Educating HCP in the proper calculation of TBSAB improves upon the quality of care for burn patients and also creates a safer healthcare environment for them, decreasing associated complications, risks, and morbidity and mortality. Quality is improved through the provision of better healthcare for burn patients. This is accomplished through educating HCP on how to correctly calculate a patients' burn percentage. Correct calculation leads to proper fluid resuscitation, and decreased adverse effects associated with incorrect calculation. Incorrect calculation is associated with increased need for escharotomy for patients whose percentage is over-estimated, fluid overload, and the potential for pulmonary complications related to an over estimated burn percentage. By improving the quality of care for burn patients, their safety is also ensured. Safety is improved upon by correctly calculating TBSAB, providing the correct fluid resuscitation and preventing the associated complications with over or under calculation. The TBSAB calculation occurs in the initial hours after injury and is one of the more important aspects of their healthcare. The percentage calculation then determines the patients' fluid requirements for the next 24 hours according to the Parkland Formula. A miscalculation of 20% in either direction in an 85 kg woman creates a discrepancy in fluid requirements of upwards of 14 liters of fluid over 24 hours. The Burn Center at [redacted] has witnessed burn percentages being miscalculated. Patients have been grossly over estimated,

therefore over fluid resuscitated and patients flown to the burn center when not medically necessary. On the other hand, patients have also been underestimated and arrive for follow-up care in the outpatient office and then immediately hospitalized with deep third-degree wounds which require split thickness skin grafting. Education in TBSAB calculation can prevent these complications, improving the quality and safety of healthcare for burn patients.

Education

The implication for education is to continue to offer this educational module to graduate level HCP students. However, this project was only made available to graduate level Nurse Practitioner students where in the future, it could be offered to other graduate level HCP students including physician assistant students and medical students. After initially offering it to a larger population in the university, the module can be offered to other collegiate programs. Next, it can continue to be offered as a continuing education module through the Center for Professional Development, and finally, the module can be offered to already practicing providers through a national continuing education service or through hospital educational departments. The benefit to online education is the ability for students to access education on their own time as opposed to meeting in a traditional classroom setting at a pre-determined time.

There is no limit to where this educational module can be implemented due to the method employed to educate the graduate-level nurse practitioner students. The course can be recreated in other online educational modalities with the same methods of instruction and evaluation. The course can also be offered as a live class through more traditional methods of education. The same pre-test can be delivered, followed by a lecture related to the Lund-Browder chart, TBSAB calculated, Parkland Formula, and when to transfer a patient to a verified Burn Center. Next, the same post-test can be delivered, followed by the Student Satisfaction and Self-Confidence in

Learning questionnaire. A traditional method of education such as in a classroom setting has the potential to improve upon this educational module where students would have the opportunity to ask questions of the instructor who is trained in the method of determining a patients TBSAB. This may lead to an increased number of students determining the correct TBSAB calculation and further increased confidence to care for burn patients.

Economic Implications

The economic implications of the educational module are the prevention of complications associated with over or under resuscitation including fluid overload and potential pulmonary complications including ventilator requirements or the progression of wounds resulting from dehydration and the potential for escharotomy. These complications can lead to increased length of stay for the patient, the potential for ventilator associated pneumonia, catheter associated urinary tract infections, central line associated blood stream infections, and an increased risk for hospital acquired pressure injuries. Wound progression can lead to not only the need for escharotomy but also an increased need for split thickness skin grafting procedures which once again increase a patient's length of stay, and places the patient at risk for surgical complications.

Another economic implication associated with this educational module is the prevention of the unnecessary use of medivac transportation. As was previously stated, base ground transportation in the United States is roughly $220 and air transportation is $3483 with an additional $7-$11 per mile and $23-$34 per mile respectively; most commercial insurance companies do not cover these costs, leaving the financial burden on the patient or family members (Chattopadhyay et al., 2018). Correct calculation of TBSAB, can prevent unnecessary transfer or prevent the excessive use of medivac transportation.

The final economic implication is the impact on patients and their family members if they are hospitalized. Employed patients will not be working and will incur lost wages; parents of children may not work during the hospitalization and are also at risk of lost wages. There is also the cost of travel to and from the hospital and expenses incurred as a result of being hospitalized such as food and potential hotel costs if not offered accommodations from the hospital. Proper calculation will prevent associated complications and potential increased of length of stay as well as possibly preventing the unnecessary transfer to a verified burn center if not medically indicated.

Sustainability

The educational module can continue to be offered through the Center for Professional Development and to current graduate level nurse practitioner students and in the future, made available to other graduate level HCP students including medical students and physician assistant students. Next, the course can be offered to interested practicing HCP. The goal is to continue to educate HCP in the art of determining a patients TBSAB. Therefore, the longer the module is available for and the more students who participate in the module translates to decreased morbidity and mortality for burn patients.

Future Scholarship

The results of this educational module have been written in an abstract for the Northeast Regional Burn Conference as well as the 2020 American Burn Association conference. It is also a goal for the results to be disseminated to the Journal of Burn Care and Research, if selected. Finally, the results were shared with the Director of the Burn Center at [redacted]

Upon completion of the module, the goal is to continue to teach HCP how to calculate TBSAB. This can be accomplished through an educational session at [redacted] for Nurse Practitioners, Physicians Assistants, Medical and Surgical Residents, as well as Emergency Room Physicians. Another opportunity is to become an Advanced Burn Life Support instructor.

Summary

The project to improve TBSAB calculation among HCP was intended to increase education and confidence levels among HCP in the initial management of patients suffering burn injuries. Research has revealed practicing HCP are not adequately prepared to manage burn patients nor do they feel confident to care for patients in the initial hours after injury. It is now prudent for all HCP to be trained in the initial management of burn patients in order to be prepared for a mass casualty incident which could lead to burn surge events in any hospital around the country. The education took place in an online education platform available through the School of Nursing to APN students who met the inclusion criteria. The results of the educational module were not statistically significant, however participants scored higher than previous research in determining the TBSAB percentage, and 94% of participants agreed they felt an increased confidence level to care for burn patients upon completion of the module.

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Zonies, D., Maier, R. V., Civil, I., Eid, A., Geisler, B. P., Guerrero, A., & Mock, C. (2012). Trauma and burn education: a global survey. *World Journal of Surgery, 36*(3), 548-555. doi:https://dx.doi.org/10.1007/s00268-011-1419-6

Appendix A

Evidence Table

ARTICLE	AUTHOR & DATE	EVIDENCE TYPE	SAMPLE, SAMPLE SIZE, SETTING	STUDY FINDINGS THAT HELP ANSWER EBP QUESTION	LIMIT - ATIONS	EVIDENCE LEVEL & QUALITY
1	Anzarut, A., Singh, P., Cook, G., Domes, T., & Olson, J. (2007)	Research	41 emergency and primary care physicians	On-call plastic surgeons were asked what they perceived to be the greatest educational need for them; care of minor burns was listed as a necessary educational session as burns are frequently encountered and the education will have one of the highest impact factors	Other groups of physicians and health care practitioners were not included in the conversation	Level III Good quality
2	Armstrong, J.R., Willand, L., Gonzalez, B., Sandhu, J., & Mosier, M.J. (2017).	Non-research	326 chart reviews [redacted]	Differences in percentage calculations of total body surface area between referred patients and burn center calculations. What occurs when over/underestimate Physicians from referring hospitals have difficulty estimating %TBSA burned; Needs: Increase outreach and training	Referring hospitals may be using Rule of Nines to calculate whereas burn physicians are using Lund-Browder. Rule of Nines has a greater tendency towards overestimation	Level V High quality (expert opinion)
3	Cancio,	Non-	n/a	Importance of	Potential for	Level V

	L.C. (2014)	research		proper TBSA calculation to determine adequate fluid resuscitation and what occurs with miscalculation	user error when transferring burn injury to paper	High quality (expert opinion)
4	Egro, F.M. (2017)	Research	18 medical students	e-learning module regarding basic burns management 72% of students felt e-learning module would be beneficial in medical curriculum e-learning tool is versatile and efficient "lack of knowledge on how to correctly diagnose and initially manage burns could potentially lead to mismanagement of burns by junior doctors" Goal of e-learning tool was to promote burn education among learners with minimal to no knowledge of burn care	Small sample	Level III High quality
5	Harshman, J., Roy, M., & Cartotto, R. (2018).	Non-research 37 chart reviews were performed	n/a	Accuracy of TBSA calculation -Leads to proper fluid resuscitation; proper transfer or discharge and proper intubation Errors in calculation are occurring Professional burn	Limited chart review	Level V High quality

				centers need to improve efforts to correct problems with calculation and fluid resuscitation The goal is to help emergency providers improve their management of burn patients. The problem is inadequate education of providers		
6	Lam, N.N., Huong, H.T.X., & Tuan, C.A. (2018)	Research	397 Doctors	"The knowledge and practical skills of healthcare providers play an important role in the success of diagnosis, prognosis, and treatment of the [burn] population" Current reports worldwide show different knowledge levels regarding initial management of burn patients. This study found physicians continue to have limitations in determining TBSAB in adults and children and following fluid resuscitation. When mass casualty events occur, it is important for emergency department providers to know how to assess initial burn injuries	Same test should be administered to burn physicians to determine accuracy in calculation and patient management among experienced providers	Level III High Quality

				Only 39% of physicians could answer correctly half of the questions correctly with similar results in England and Western Australia Only 10% can properly calculate TBSA; 60% of providers fully understood Parkland formula Physicians who had taken a training course had a higher level of knowledge in the care of burn patients versus those who did not take a class "Continuing medical education focusing on burn emergency management is the best way to improve knowledge of healthcare providers". Lemon – 35% of participants from English medical schools did not receive training on how to care for burn patients and only 1/3 felt confident providing treatment "Conduct continuing medical education for all grades of doctors regardless of their working experience".		

7	Martin, N.A.J, Lundy, J.B., & Rickard, R.F. (2014)	Research Qualitative	40 health care providers	Comparing TBSA calculations between different levels of practitioners	Small sample size	Level III Good quality
8	McCulloh, C., Nordin, A., Talbot, L.J., Shi, J., Fabia, R., & Thakkar, R.J. (2018).	Research	139 patients over 8 years	Examined the difference between burn team calculation and other providers Complications of over resuscitating including pneumonia, blood stream infections, and affecting patient transfer Pediatrics – incorrect TBSA leads to complications such as PNA, organ failure, and death % over/under estimation -Costs and risks associated with improper or slower transfer times Education regarding calculating TBSAB can "improve the lives of many people worldwide through improved acute care and resource utilization". Research and education should be directed to improve upon TBSAB measurement	Incorrect TBSA (overcalculation) can be due to providers including areas which are erythematous in TBSA	Level III High Quality

9	McWilliams, T., Hendricks, J., Twigg, D., & Wood, F. (2015)	Research Qualitative	281 health care providers	Educating non-burns specialist about burn assessment and management and assess and their confidence level after education New technological learning methods address the issue of remote locations and far distances from a burn unit; bringing education to the students; "facilitating the best treatment for burn patients".	Increased knowledge was not tracked over time	Level III High quality
10	Reeves, P.T., Borgman, M.A., Caldwell, N.W., Patel, L., Aden, J., Duggan, J.P., Serio-Melvin, M.L., & Mann-Salinas, E.A. (2018).	Research	60 ABLS students	Providing burn education through ABLS and then participants used the Student Satisfaction and Self-Confidence in Learning questionnaire to determine if there was an increased self-confidence in the ability to care for burn patients. (Provided by the National League for Nursing)	Small sample size	Level II Good quality
11	Spiwak, R., Lett, R., Rwanyuma, & Logsetty, S. (2014).	Research	21 health care providers	Essential burn management course provided to health care practitioners; survey was provided after which showed providers had an increased understanding of the care of the burn	Small study but easily reproducible	Level II High Quality

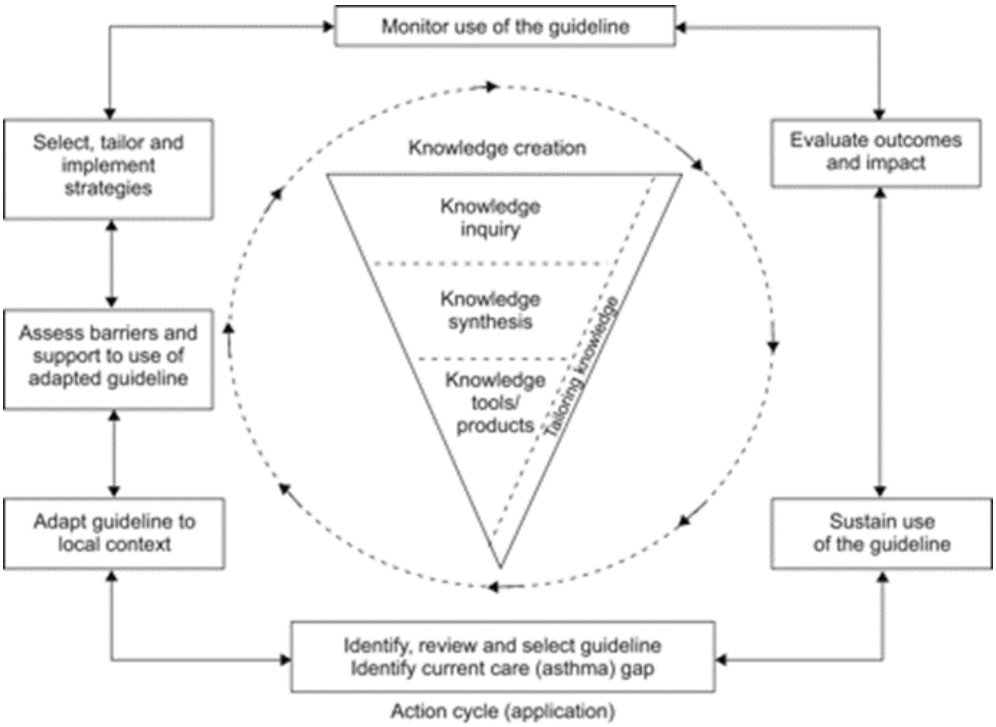
				patient and they felt the course would help them save lives		
12	Swords, D.S., Hadley, E.D., Swett, K.R., & Prankikoff, T. (2015)	Non-research Retro - spective analysis	n/a	"There is a need for educational initiatives aimed at community ED physicians regarding the importance of consistently documenting TBSA" based on differences between referring institutes and burn centers in the TBSAB. "Efforts are needed not just in geographical area, but on a national level".	Possible for incomplete medical records; potential errors in charting both in TBSA as well as fluid recordings	Level V Good quality
13	Tevlin, R., Dillon, L., & Clover, A.J.P. (2017)	Non-research	n/a	ER MDs need to be educated in burn care, burns not included in medical school; use a teaching day in regional burn centers. Important to teach individuals how to approach, assess and provide basic treatment -Structured and methodical approach Individuals who have training are better prepared to care for burn patients Importance of initial management -Leads to improved	It was not sponsored, limited search	Level V Low Quality

				survival and decreased M&M		
14	Vrouwe, S.Q., & Shahrokhi, S. (2017)	Research Cross-sectional survey	117 post graduate trainees	Opportunity for burn care specialists to collaborate with primary care training programs to deliver an educational intervention to provide long lasting improving care to burn patients -Primary care trainees aren't comfortable managing the care of burn patients; opportunity for educational intervention -Best to educate students who aren't in practice yet Used a survey to determine comfort level in the management of burn patients -Minimal teaching was provided to students in burn care; speaks of students in UK medical schools not teaching care of the burn patient = low comfort levels -Examined differences in family medicine trainees and plastic surgery in terms of care of the burn patient -Practicing PCPs found management	Limited participation rate (117/427 returned)	Level II Good quality

				of burns to be an educational topic with the most utility -Preferred method to learn was clinical rotation and traditional lecture		

Appendix B

Conceptual Framework of Knowledge to Action Model



(Boulet et al., 2012)

Appendix C

Recruitment Email

Dear Rutgers Behavioral Health Sciences Student,

You have been selected to participate in an educational module for a DNP candidate of the Rutgers School of Nursing Family Nurse Practitioner program.

The module will focus on how to properly calculate a burn patient's total body surface area burned, the initial management of the burn patient, and proper times to initiate transfer to the burn center. There will be a pre-test, and post-test included in the educational module.

The module will take less than 30 minutes to complete. Completion of the module, and the tests will provide you with continuing education units.

Participation in the module is completely voluntary and all information will remain confidential.

Thank you for your time

Sincerely,

Kristine Eckert, DNP candidate
[redacted]

JOINT ACCREDITATION™
INTERPROFESSIONAL CONTINUING EDUCATION

In support of improving patient care, Rutgers Biomedical and Health Sciences is jointly accredited by the Accreditation Council for Continuing Medical Education (ACCME), the Accreditation Council for Pharmacy Education (ACPE), and the American Nurses Credentialing Center (ANCC), to provide continuing education for the healthcare team.

Appendix D

RUTGERS
School of Nursing

Participate in an Educational Module to Improve the Calculation of Total Body Surface Area Burned

June 1, 2019 – July 30, 2019

You are invited to participate in a module highlighting how to calculate a burn patient's total body surface area burned, their initial management, and the appropriate transfer of patients to the Burn Center at Saint Barnabas.

Goals

The aims and objectives of this module are to increase awareness of the most accurate method to calculate a patient's burn percentage, the initial management, and timely and efficient transfer to a burn center when medically necessary.

Methods

The module will be available on Canvas, with a pre-test, education provided, and a post-test. All results will remain confidential

Kristine Eckert, DNP Candidate
[redacted]

JOINT ACCREDITATION
INTERPROFESSIONAL CONTINUING EDUCATION

In support of improving patient care, Rutgers Biomedical and Health Sciences is jointly accredited by Accreditation Council for Continuing Education (ACCME), the Accreditation Council for Pharmacy Education (ACPE), and the American Nurses Credentialing Center (ANCC), to provide continuing education for the healthcare team.

Rutgers, The State University of New Jersey

Appendix E

Consent for Participation

Title: Creating an Educational Module to Improve the Calculation of Total Body Surface Area Burned

Researcher: Kristine Eckert, RN, BSN, DNP Candidate

[redacted]

The purpose of this research project is to educate health care provider students on the Lund and Browder method of calculating total body surface area burned in order to increase provider accuracy in determining the percentage burned. When the percentage is properly calculated, burn patients receive proper fluid resuscitation, preventing further complications. You are being asked to take part in this project because you will be a future health care provider.

Participating in this research study is completely voluntary. You can choose not to be a part of this project. You can say yes now, and change your mind later. Deciding not to partake in this project will not affect your status as a student at Rutgers, the State University of New Jersey.

If you agree to participate, you will be asked to complete a pre-test and post-test and complete an education module on Canvas. Your participation will take about 30 minutes. I expect 25 people to participate in this educational module.

You can choose not to complete the module. You can also choose to exit the module at any time. You must be at least 18 years old to participate, if you are younger than 18 years old, please stop now.

The possible risks to your participation in this module are:

- Being unaware of the answers and therefore feeling uncomfortable
- Having others be aware you were a part of this educational module
- Potential loss of confidentiality of data

The possible benefits to your participation include:

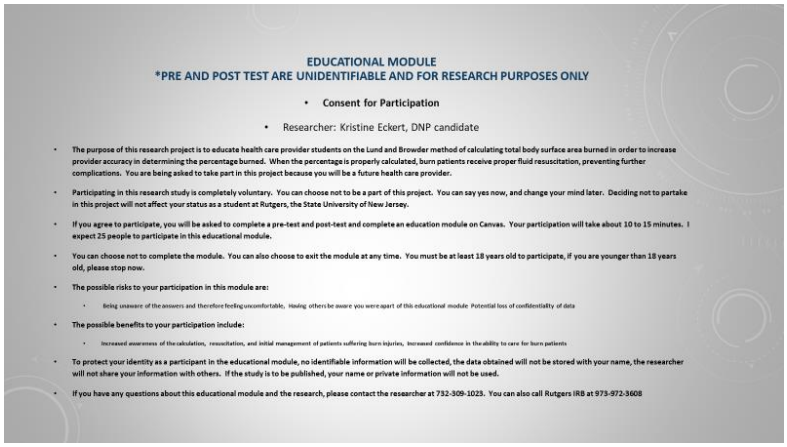
- Increased awareness of the calculation, resuscitation, and initial management of patients suffering burn injuries
- Increased confidence in the ability to care for burn patients

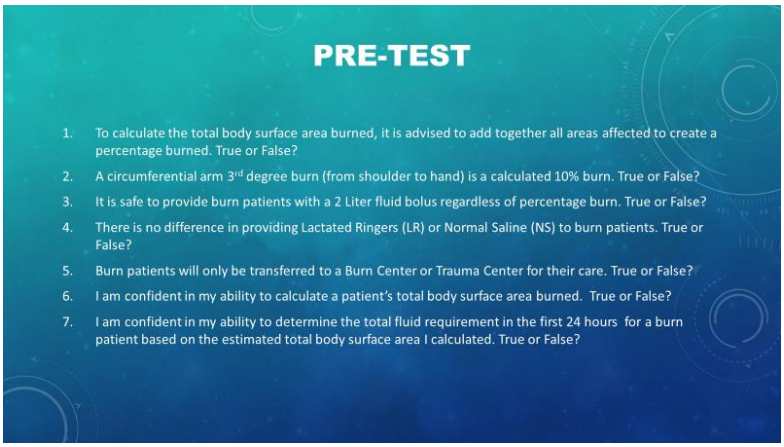
To protect your identity as a participant in the educational module, no identifiable information will be collected, the data obtained will not be stored with your name, the researcher will not share your information with others. If the study is to be published, your name or private information will not be used.

If you have any questions about your rights as a research subject, please contact the researcher at [redacted] or the IRB Director at Newark Health Science at 973-972-3608.

Appendix F

Educational Module





PREPARATION FOR A BURN MASS CASUALTY

- Providers in the State of New Jersey need to be prepared to be a part of a burn mass casualty event
  - New Jersey is home to the most dangerous 2-mile stretch in the country
    - Port Elizabeth
    - Newark Airport
    - New Jersey Transit, Acela, and Amtrak rail corridor
    - Oil Refineries
  - HCP need to be prepared to calculate TBSAB and initially manage burn patients until transfer is available to appropriate hospitals according to the Easter Regional Burn Disaster Consortium (ERBDC)
    - Depending on the Mass Casualty Incident, burn patients will be dispersed to any and all hospitals throughout the state based upon the ERBDC
      - (Conlon, 2014)

LUND-BROWDER CHART

- Lund-Browder Chart created in 1944 has been proven to be a more accurate method to determine TBSAB
  - Leads to a 3% more accurate calculation of TBSAB (Thom, 2017)
    - For the purpose of this exercise, we will be using an adult patient example
  - Image courtesy of the Burn Center at [redacted] adapted and reprinted with permission from the Journal of the American College of Surgeons, formerly Surgery, Gynecology & Obstetrics (1944).

HOW TO PROPERLY CALCULATE TBSAB USING LUND-BROWDER CHART

- Only calculate 2nd and 3rd degree wounds
- First degree burns are erythematous, superficial burns
- Including first degree burns in the calculation of TBSAB leads to miscalculation of TBSAB, and incorrect fluid resuscitation
  - Increases morbidity and mortality
  - McCulloh, 2018

NOW'S
YOUR TURN!

25 year old female, 85 kg, no past medical history, no known allergies suffering scald burns after falling down a flight of stairs while carrying a vat of soup

Burns to her anterior face, neck, anterior torso, bilateral arms (shoulder to elbow), and right hand are mixed 2nd and 3rd degree wounds; with areas of erythema to her left hand, and posterior scalp

NOW'S YOUR TURN!

- What is your calculated TBSAB?

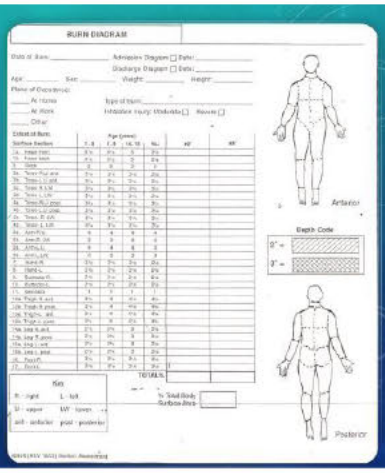


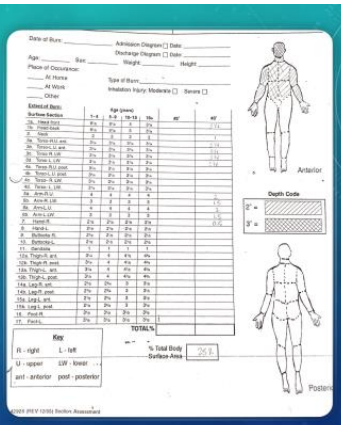
Image Courtesy of The Burn Center at [redacted]
adapted and reprinted with permission from the Journal of the American College of Surgeons, formerly Surgery Gynecology & Obstetrics (1944).

WHAT WAS THE CALCULATED TBSAB?

- 25%
  - Were you correct

PERCENTAGE BURNED

- Notice the different shadings used for 2nd and 3rd degree wounds
- The anterior aspect is shaded, and not the posterior aspect of the body
- The hand is minimally shaded to represent the limited areas affected on her right hand
- The Lund-Browder chart although more time consuming, allows for more accuracy



PARKLAND FORMULA

- **4 mL of lactated ringers x TBSAB x patients weight in kilograms; half of the volume is given over 8 hours with the remaining volume given over the next 16 hours**
  - **(Yasti et al., 2015)**

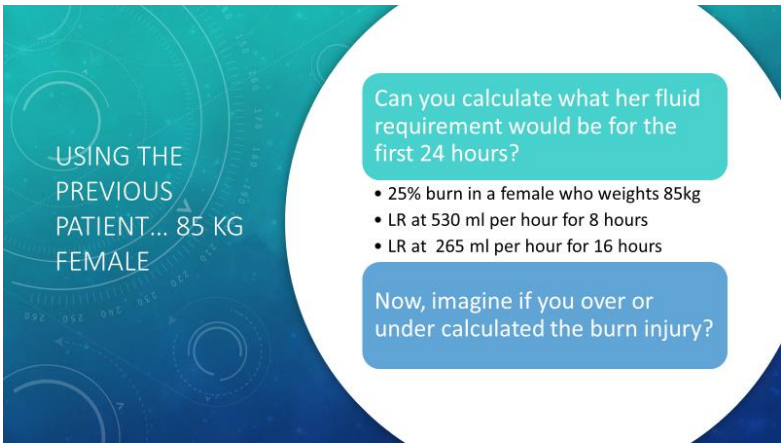
PARKLAND FORMULA

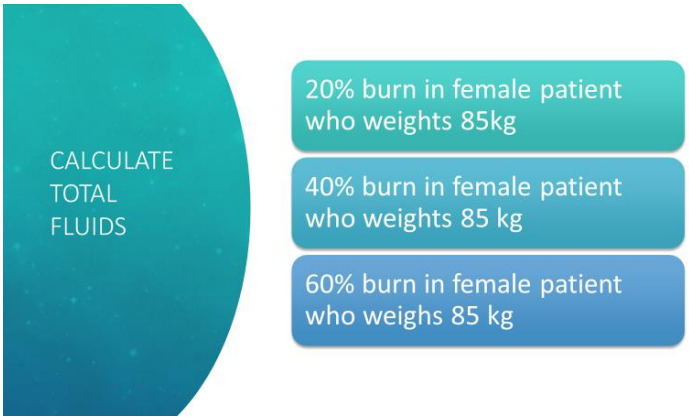
Miscalcuation → progression of burn depth

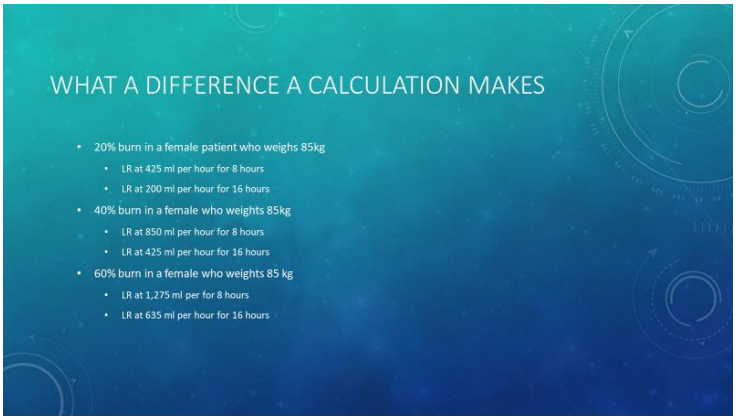
- Worsened outcomes
- Overresuscitation → pulmonary edema, orbital edema, compartment syndrome, and increased need for escharotomy

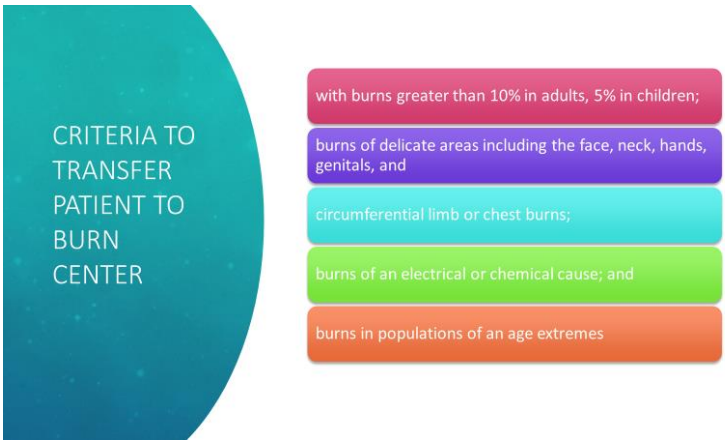
Lactated Ringers is the fluid of choice for initial burn injuries due to the decreased acidity and the similarity to normal plasma electrolytes in comparison to normal saline

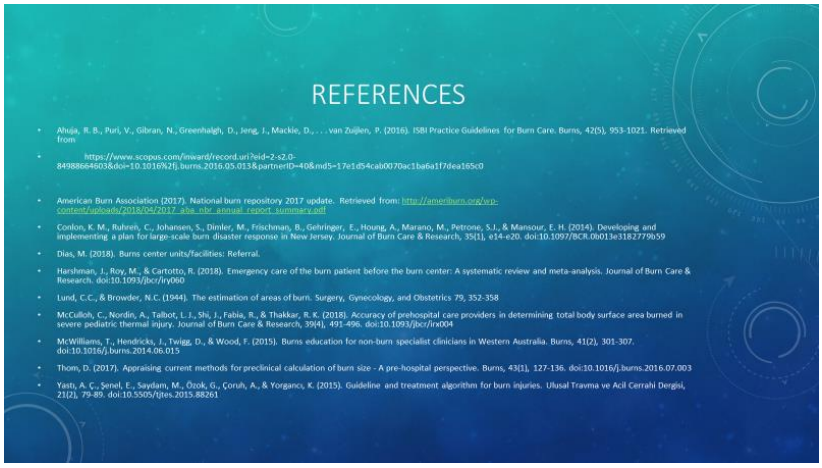
- Ahuja et al., 2016


USING THE PREVIOUS PATIENT… 85 KG FEMALE
Can you calculate what her fluid requirement would be for the first 24 hours?
• 25% burn in a female who weights 85kg
• LR at 530 ml per hour for 8 hours
• LR at 265 ml per hour for 16 hours
Now, imagine if you over or under calculated the burn injury?


CALCULATE TOTAL FLUIDS
20% burn in female patient who weights 85kg
40% burn in female patient who weights 85 kg
60% burn in female patient who weighs 85 kg


WHAT A DIFFERENCE A CALCULATION MAKES
• 20% burn in a female patient who weighs 85kg
• LR at 425 ml per hour for 8 hours
• LR at 200 ml per hour for 16 hours
• 40% burn in a female who weights 85kg
• LR at 850 ml per hour for 8 hours
• LR at 425 ml per hour for 16 hours
• 60% burn in a female who weights 85 kg
• LR at 1,275 ml per hour for 8 hours
• LR at 635 ml per hour for 16 hours


CRITERIA TO TRANSFER PATIENT TO BURN CENTER
with burns greater than 10% in adults, 5% in children;
burns of delicate areas including the face, neck, hands, genitals, and
circumferential limb or chest burns;
burns of an electrical or chemical cause; and
burns in populations of an age extremes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McCulloh, C., Nordin, A., Talbot, L. J., Shi, J., Fabia, R., & Thakkar, R. K. (2018). Accuracy of prehospital care providers in determining total body surface area burned in severe pediatric thermal injury. Journal of Burn Care & Research, 39(4), 491-496. doi:10.1093/jbcr/irx004
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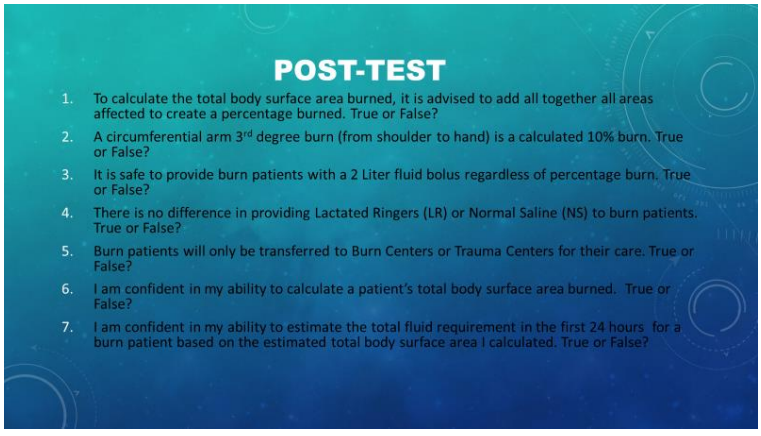
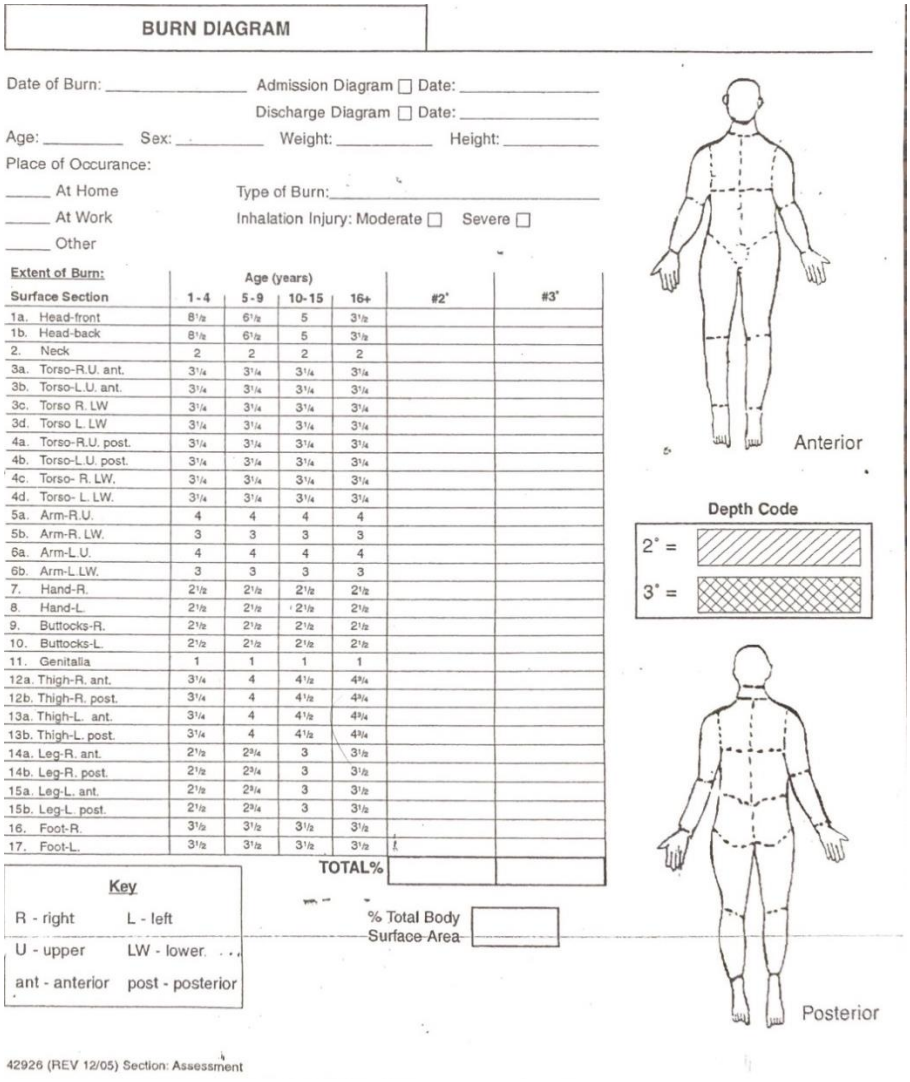

POST-TEST
1. To calculate the total body surface area burned, it is advised to add all together all areas affected to create a percentage burned. True or False?
2. A circumferential arm 3rd degree burn (from shoulder to hand) is a calculated 10% burn. True or False?
3. It is safe to provide burn patients with a 2 Liter fluid bolus regardless of percentage burn. True or False?
4. There is no difference in providing Lactated Ringers (LR) or Normal Saline (NS) to burn patients. True or False?
5. Burn patients will only be transferred to Burn Centers or Trauma Centers for their care. True or False?
6. I am confident in my ability to calculate a patient's total body surface area burned. True or False?
7. I am confident in my ability to estimate the total fluid requirement in the first 24 hours for a burn patient based on the estimated total body surface area I calculated. True or False?

Appendix G

Lund and Browder Chart



BURN DIAGRAM

Date of Burn: _____ Admission Diagram ☐ Date: _____

Discharge Diagram ☐ Date: _____

Age: _____ Sex: _____ Weight: _____ Height: _____

Place of Occurance:

_____ At Home

_____ At Work

_____ Other

Type of Burn: _____

Inhalation Injury: Moderate ☐ Severe ☐

Extent of Burn: Surface Section	Age (years) 1 - 4	5 - 9	10 - 15	16+	#2°	#3°
1a. Head-front	8½	6½	5	3½		
1b. Head-back	8½	6½	5	3½		
2. Neck	2	2	2	2		
3a. Torso-R.U. ant.	3¼	3¼	3¼	3¼		
3b. Torso-L.U. ant.	3¼	3¼	3¼	3¼		
3c. Torso R. LW	3¼	3¼	3¼	3¼		
3d. Torso L. LW	3¼	3¼	3¼	3¼		
4a. Torso-R.U. post.	3¼	3¼	3¼	3¼		
4b. Torso-L.U. post.	3¼	3¼	3¼	3¼		
4c. Torso- R. LW.	3¼	3¼	3¼	3¼		
4d. Torso- L. LW.	3¼	3¼	3¼	3¼		
5a. Arm-R.U.	4	4	4	4		
5b. Arm-R. LW.	3	3	3	3		
6a. Arm-L.U.	4	4	4	4		
6b. Arm-L LW.	3	3	3	3		
7. Hand-R.	2½	2½	2½	2½		
8. Hand-L.	2½	2½	2½	2½		
9. Buttocks-R.	2½	2½	2½	2½		
10. Buttocks-L.	2½	2½	2½	2½		
11. Genitalia	1	1	1	1		
12a. Thigh-R. ant.	3¼	4	4½	4¾		
12b. Thigh-R. post.	3¼	4	4½	4¾		
13a. Thigh-L. ant.	3¼	4	4½	4¾		
13b. Thigh-L. post.	3¼	4	4½	4¾		
14a. Leg-R. ant.	2½	2¾	3	3½		
14b. Leg-R. post.	2½	2¾	3	3½		
15a. Leg-L. ant.	2½	2¾	3	3½		
15b. Leg-L. post.	2½	2¾	3	3½		
16. Foot-R.	3½	3½	3½	3½		
17. Foot-L.	3½	3½	3½	3½		
				TOTAL%		

Key

R - right L - left

U - upper LW - lower

ant - anterior post - posterior

% Total Body Surface Area

Anterior

Depth Code

2° =

3° =

Posterior

42926 (REV 12/05) Section: Assessment

Image courtesy of the Burn Center at [redacted] adapted and reprinted with permission from the Journal of the American College of Surgeons, formerly Surgery, Gynecology & Obstetrics (1944).

Appendix H

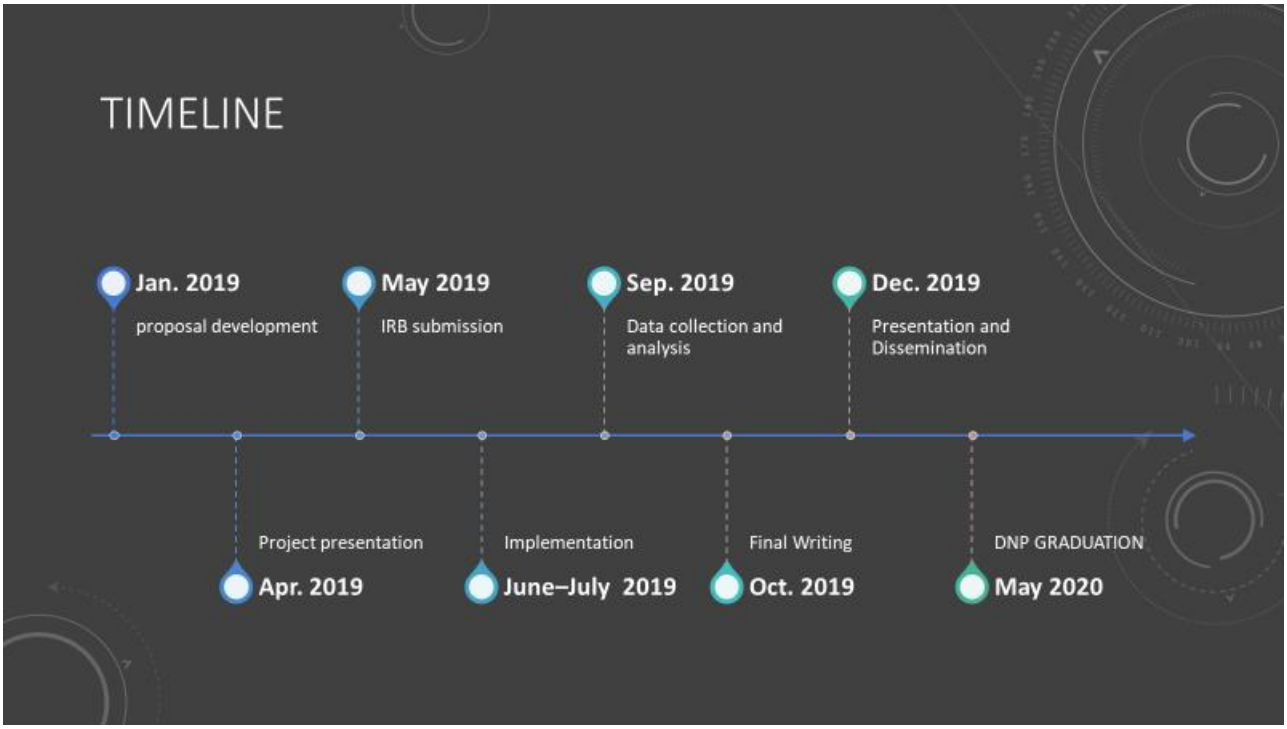
Student Satisfaction and Self-Confidence in Learning Tool:

1 = STRONGLY DISAGREE with the statement
2 = DISAGREE with the statement
3 = UNDECIDED – you neither agree or disagree with the statement
4 = AGREE with the statement
5 = STRONGLY AGREE with the statement

Satisfaction with Current Learning	**SD**	**D**	**UN**	**A**	**SA**
1. The teaching methods used in this simulation were helpful and effective.	○ 1	○ 2	○ 3	○ 4	○ 5
2. The simulation provided me with a variety of learning materials and activities to promote my learning the medical surgical curriculum.	○ 1	○ 2	○ 3	○ 4	○ 5
3. I enjoyed how my instructor taught the simulation.	○ 1	○ 2	○ 3	○ 4	○ 5
4. The teaching materials used in this simulation were motivating and helped me to learn.	○ 1	○ 2	○ 3	○ 4	○ 5
5. The way my instructor(s) taught the simulation was suitable to the way I learn.	○ 1	○ 2	○ 3	○ 4	○ 5
Self-confidence in Learning	**SD**	**D**	**UN**	**A**	**SA**
6. I am confident that I am mastering the content of the simulation activity that my instructors presented to me.	○ 1	○ 2	○ 3	○ 4	○ 5
7. I am confident that this simulation covered critical content necessary for the mastery of medical surgical curriculum.	○ 1	○ 2	○ 3	○ 4	○ 5
8. I am confident that I am developing the skills and obtaining the required knowledge from this simulation to perform necessary tasks in a clinical setting	○ 1	○ 2	○ 3	○ 4	○ 5
9. My instructors used helpful resources to teach the simulation.	○ 1	○ 2	○ 3	○ 4	○ 5
10. It is my responsibility as the student to learn what I need to know from this simulation activity.	○ 1	○ 2	○ 3	○ 4	○ 5
11. I know how to get help when I do not understand the concepts covered in the simulation.	○ 1	○ 2	○ 3	○ 4	○ 5
12. I know how to use simulation activities to learn critical aspects of these skills.	○ 1	○ 2	○ 3	○ 4	○ 5
13. It is the instructor's responsibility to tell me what I need to learn of the simulation activity content during class time..	○ 1	○ 2	○ 3	○ 4	○ 5

 Revised December 22, 2004

Appendix I


TIMELINE
Jan. 2019
proposal development
May 2019
IRB submission
Sep. 2019
Data collection and analysis
Dec. 2019
Presentation and Dissemination
Project presentation
Apr. 2019
Implementation
June–July 2019
Final Writing
Oct. 2019
DNP GRADUATION
May 2020

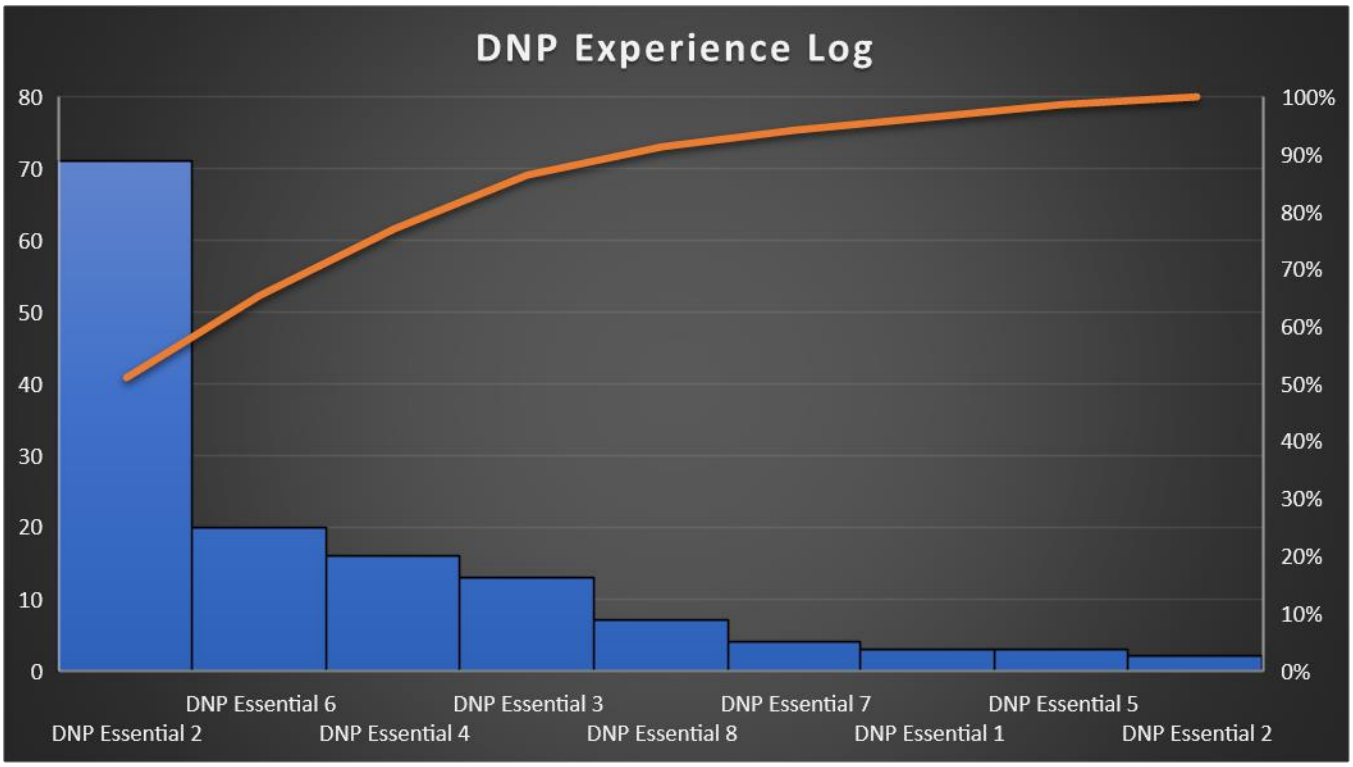
Appendix J

Budget

Expense	**Cost**	**Total**
SPSS	$90	$90
Statistician Consultation	1 session $100/hr x 2 hours	$200
Dissemination Poster for Presentation	1 poster = $75	$75
CEUs (provided by RU)	($400)	$0
Total Budget		$365

Appendix L

DNP Experience Log



Appendix M

SPSS Results

Test Statistics[a]

	POST TEST - PRE TEST
Z	-1.546[b]
Asymp. Sig. (2-tailed)	.122

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

Appendix N

Results

VARIABLE	STRONGLY AGREE	AGREE	NEUTRAL
To evaluate deficits in the calculation of TBSAB	7/16 (44%)	8/16 (50%)	0%
Assess, calculate, and evaluate the patients' TBSAB	7/16 (44%)	6/16 (38%)	1/16 (6%)
Demonstrate how to assess and properly calculate TBSAB	7/16 (44%)	7/16 (44%)	2/16 (12%)
Apply the knowledge learned to experience an increased confidence to care for burn patients	8/16 (50%)	7/16 (44%)	1/16 (6%)
Identify requirements for transfer of a burn patient to a verfied burn center	9/16 (56%)	5/16 (31%)	2/16 12%)