2021

Understanding Cyanide Toxicity in Victims of Smoke Inhalation

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April 11, 2021

Abstract

Every day in the United States forty-two people are killed or injured as a direct result of fire. Building construction materials and furnishings have evolved from natural textiles to synthetic plastic-based goods that release excessive lethal toxic gases when heated. Rapid release of gas results in critical levels of hydrogen cyanide and carbon monoxide leading to fatal toxic exposures. Nursing knowledge and confidence can improve victim survivability by improving rapid recognition and assessment of these complex patients. The purpose of this DNP project was to increase emergency department nursing knowledge, confidence and ability in assessing and appropriately triaging smoke inhalation victims exposed to the lethal byproducts of smoke. Forty-one ED nurses attended one of eight two-hour didactic presentations offered covering assessment, toxidromes, testing and treatment of smoke inhalation victims. Assessment of nursing confidence and knowledge in EBP was conducted both pre- and post- education utilizing the EBP-ERI Survey Tools. Paired *t* tests were conducted on the pre- and post-mean scores to evaluate nurses' EBP confidence and knowledge. Nurses reported a 30% increase in confidence ($p < .01$) and demonstrated a 10% improvement in knowledge ($p < .01$) immediately following the program. Two weeks later a post-education knowledge assessment was conducted that showed a median score of 82% accuracy triaging these victims. The findings of this project indicate that ED nurses can improve knowledge, confidence, and proficiency in triaging smoke inhalation victims based on EBP through didactic, case-study education.

Keywords: smoke inhalation, cyanide toxicity, carbon monoxide, hydroxocobalamin, fire death

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Background and Significance

Every 24 seconds a fire department responds to a fire somewhere in the United States (National Fire Protection Association [NFPA], 2020). While the number of fires has dropped slightly, the number of fire-related deaths has increased nearly 20.5% in spite of a 17% decrease in fire-related injuries since 2009 (USFA, 2020). Historical fires such as the Iroquois Theater fire in 1903, the Cocoanut Grove nightclub fire in 1942, Our Lady of Angels School in 1958, Beverly Hills Supper Club in 1977, and the Happy Land Social Club fire in 1990 collectively resulted in 1,354 deaths of adults and children. These fires exemplified the lethal toxicity of carbon monoxide in occupied, closed-compartment building fires, but failed to definitively identify any other toxic gases in smoke (Insurance Information Institute [I.I.I.], 2020).

Epic loss of life fires gave rise to sweeping fire and life safety building codes to reduce future fire-related deaths (I.I.I., 2020). Improved life safety and strict building codes reduced the frequency of large loss-of-life fires, but newer lightweight building construction materials and synthetic home furnishings emerged as a lethal cost-reduction measure. Lower cost materials and synthetic furnishings burn hot and fast and rapidly emit toxic gasses, producing exceedingly more British Thermal Units (BTU's), or units of heat, than natural materials (National Institute of Standards and Technology [NIST], 2020). Thirty-five times deadlier than carbon monoxide (CO), hydrogen cyanide (CN) has quickly emerged as a toxic byproduct more lethal than CO (Drager Safety, 2017). When exposed to the rapidly rising heat of fire, synthetic materials release lethal concentrations of cyanide and other toxins before reaching full ignition –an evolution that reduces victim survivability to just minutes before the space is completely non-survivable (Drager Safety, 2017).

More recently The Station night club fire of 2003 in Warwick, RI resulted in 100 deaths, the Kiss night club fire of 2013 in Santa Maria, Rio Grande do Sul, Brazil resulted in 233 civilian deaths, and 64 people were killed in the Club Colectiv Nightclub fire in Bucharest, Romania in 2015. The three multiple-fatality fires were attributed to burning synthetic sound-proofing materials that ignited when directly exposed to small interior firework displays (NFPA, 2020). The National Institute of Standards and Technology (NIST) investigated and re-created The Station nightclub fire, concluding that burning synthetic materials rendered the stage/dance area uninhabitable within 90 seconds. Fire behavior studies by the NIST directly measured the stratification of heat and the toxicity rate-of-rise for CO and CN. The results, based on recreation of scene fire dynamics, indicated that many of the 462 people in the room were overcome by toxic CN and CO in the smoke before they could exit the building (NFPA, 2020).

Death from closed-compartment building and vehicle fires underscore the importance of understanding the toxicity of CN and recognizing the toxidrome of symptoms observed in victims of smoke inhalation. The increasing fire-related death rate in the presence of fewer fires suggests the need to prioritize nursing understanding of the lethality of toxic inhalation and need for rapid recognition, assessment, triage, and appropriate management of smoke inhalation victims to improve survival. Developing emergency nurses who are confident and knowledgeable in their ability to assess these high-risk, low-frequency patients will improve early recognition and accuracy in assigning the acuity levels that prioritize treatment.

Cyanide is a cellular asphyxiant that inhibits cytochrome c oxidase within the mitochondria of the cell. A toxin that inhibits cellular oxygen metabolism results in limited cellular energy production and initiation of anaerobic metabolism (Desai & Su, 2020). The impaired cell is unable to efficiently utilize oxygen to create energy –a process that leads to rapid death from profound acidity. The buildup of the anaerobic byproduct lactic acid creates an acidic

state that leaves the body unable to meet the oxygen demands of critical neurological, pulmonary and cardiac processes. When the body is exposed to CN through absorption, inhalation or ingestion, these high-metabolic systems become void of oxygen and rapidly deteriorate until death occurs unless exposure is quickly identified and treated aggressively (Drager Safety, 2017).

Evidence-based Intervention

The purpose of this Doctors of Nursing Practice (DNP) project was to improve emergency department (ED) nurse knowledge, confidence and proficiency when triaging and caring for smoke inhalation victims. The program offered an evidence-based interactive educational opportunity where nurses learned toxicology-focused pathophysiology, recognition of lethal toxidromes, and how to assess a variety of smoke inhalation (SI) victims. Interactive cases involving varied scenarios included in the program reinforced learning objectives.

Developing the ability to diagnose CN toxicity in smoke inhalation victims begins with understanding the circumstances involving victim proximity to the fire, overall length of exposure time to smoke, heat and flame, and on-scene victim presentation. Identifying and anticipating the toxicity of CN relies on confidence, knowledge, and experience of the assessor coupled with a high index of suspicion based on subjective and objective data. Management of the SI victim requires an understanding of current evidence and an assertive anticipation in the potential for rapid demise. Cyanide exposure recognition is largely based on symptoms, history, and clinical judgement as there is no rapid CN-specific point of care testing. Interventions are empiric and rely largely on the ability to recognize toxidromes, rapidly triage these patients and initiate evidence-based treatment.

The research, void of randomized control trials, describes CN as a fire gas toxin more lethal than CO emitted as furnishings and materials rapidly decompose during exposure to super-heated temperatures just prior to complete ignition. Unlike CN that reaches toxic levels as

materials are super-heated, elevation of CO occurs in later stages as fire decays and carbon-containing materials smolder from incomplete combustion. Inhalation of this CN profoundly inhibits cellular respiration in a process reversed only by a pharmacological uncoupler to restore aerobic metabolism and reduce lethal metabolic acidosis. Hydroxocobalamin is the medication supported in the literature as the primary antidote for CN toxicity in SI and has been shown to improve patient outcomes with limited side effects. Manufactured and distributed as a Cyanokit©, hydroxocobalamin is the safest current evidence-based treatment for CN toxicity related to smoke inhalation (Desai & Su, 2020).

Anticipation and early recognition of CN toxidromes enable the initiation of limited emergency laboratory testing and diagnostics that may guide medical intervention (Sen, 2017). Administration of hydroxocobalamin continues to be empiric in the absence of definitive randomized control trials, and supports the importance of emergency nursing knowledge and confidence when treating high-risk, low-frequency smoke inhalation victim. Proper assessment and anticipation of symptom progression guides informed decision-making that may reduce morbidity and mortality in these patients.

Literature Review

A literature review was performed to determine if providing evidence-based CN toxicology-focused education improves the knowledge and confidence of emergency nurses when assessing and triaging smoke inhalation victims compared to not providing any focused toxin-specific SI victim education. A search was conducted on correlating triage categories of symptoms with severity, and referencing an assessment or treatment algorithm to better identify patients requiring pharmacological intervention for CN exposure. Four main databases provided the primary source for relevant studies and included the Cumulative Index of Nursing and Allied Health Literature (CINAHAL), the Cochrane Collaboration, Medline and UpToDate.

Keywords used in the database searches included: smoke inhalation injury, cyanide toxicity, carbon monoxide, hydroxocobalamin, and fire death. Using smoke inhalation injury as a primary key search term yielded 690 articles that varied between treatment, burn assessment and discussion of CN as a toxic fire gas. Narrowing the search to include smoke inhalation injury *and* cyanide toxicity yielded 144 articles. Articles reported improved outcomes in smoke inhalation victims when treated with the cyanide antidote hydroxocobalamin, decreased ICU days, decreased vent days, decreased rates of pneumonia and improved rates of survival (Hamad, Babu & Bebarta, 2016; Meillier & Heller, 2015; Nguyen, et al., 2017). One article reported a correlation between acute kidney injury and the administration of hydroxocobalamin empirically in burn patients (Depret, et al., 2019). Key phrases were added and included: fire victims; burns; pediatric burns; and smoke inhalation during pregnancy.

A total of five articles were selected that examined the physiological and laboratory presentation of smoke inhalation victims with suspected cyanide toxicity. The literature supported early recognition, assessment and empiric treatment for acute exposure with hydroxocobalamin. Three of the articles were cohort studies (Depret, et al., 2019; Kaita, et al., 2018; Nguyen, et al., 2017), while two were case studies that evaluated co-located victims through the assessment and treatment continuum (Hamad, Babu & Bebarta, 2016; Meillier & Heller, 2015). The settings for the studies were varied, and included multiple intensive care units (ICU) in the United States (Nguyen, et al., 2017) and France (Depret, et al., 2019). Two of the case studies followed patients from their initial contact with emergency medical services (EMS) through the ICU (Hamad, Babu & Bebarta, 2016; Meillier & Heller, 2015), while another study evaluated cardiac arrest victims secondary to fire exposure who were treated in a Japanese emergency department (ED) (Kaita, et al., 2018). Five of the studies provided direct laboratory correlation between CN levels and acuity through assessment of lactic acid levels (Depret, et al.,

2019; Hamad, Babu & Bebarta, 2016; Kaita, et al., 2018; Meillier & Heller, 2015; Nguyen, et al., 2017) (Appendix B), while only one study quantified comorbidities and injury severity with the APACHE II score (Nguyen, et al., 2017).

Nguyen, et al. (2017) conducted a retrospective review to determine if survival outcomes improve with hydroxocobalamin administration for smoke inhalation victims. The chart review included patients given hydroxocobalamin for smoke inhalation (N=138), versus the control group who were not treated with any antidote for CN toxicity (N=135). The hydroxocobalamin group was associated with lower pneumonia (PNA) rates (23% vs. 49%, $p<0.01$), less ventilator dependent days (4 days vs. 7 days, $p<0.01$), and increased ventilator-free days (20 days vs. 11 days, $p<0.01$) as compared to the control group. These patients also experienced a shorter ICU length of stay (LOS) (6 days vs. 10 days, $p=0.03$), and trended towards an overall reduction in hospital length of stay (HLOS) (7 days vs. 11 days, $p=0.06$) than the control group that did not receive hydroxocobalamin. The overall mortality rate between the two groups was similar (29% vs. 28%, $p=0.90$). The authors concluded that even though patients did not experience any marked change in overall mortality, the routine administration of hydroxocobalamin based on accurate assessment was associated with lower rates of PNA, increased ventilator-free days, and reduced HLOS. The authors further suggested that burn centers should consider the empiric use of hydroxocobalamin more routinely for closed-space smoke inhalation victims to improve patient outcomes.

Kaita, et al. (2018) conducted a retrospective cohort analysis of victims who sustained a cardiac arrest event related to fire in Tokyo, Japan to determine if CN toxicity was the cause of mortality (N=5). Four patients (80%) were found to have CN levels above 0.5mcg/ml, and a lethal dose >3mcg/ml were noted in three of the patients. Two of the three patients with an above lethal dose of CN had carboxyhemoglobin (COHb) levels under 50%. None of the patients

received any CN antidote and all expired in the ED. The authors concluded that in the absence of empiric administration of hydroxocobalamin, mortality remains high in these victims and any delay in the administration of a cyanide antidote has a negative impact on patient outcomes. They endorsed rapid symptom recognition and patient assessment as a barrier reduction to effective antidote administration.

Hamad, Babu, & Bebarta (2016) conducted a case study of two smoke inhalation victims involved in the same house fire to determine the need for empiric treatment with the cyanide antidote hydroxocobalamin, and to develop an assessment and treatment algorithm to guide care. The victims (N=2) were removed from the same house fire, of unknown proximity to one another, and transported by EMS. Victim A had a Glasgow Coma Scale (GCS) of 9, was resuscitated with IV fluid, administered hydroxocobalamin and intubated. Arterial blood gas (ABG) showed pH 6.9, lactate 11.6 mmol/L, so a second dose of hydroxocobalamin was given – the patient survived to discharge. Victim B had a GCS=15, reported vague symptoms and was not given an antidote for CN toxicity, though survived to discharge. The authors stratified the observed symptoms with correlated laboratory values, and combined them with appropriate point-of-care testing to create a diagnostic and treatment algorithm specific to CN toxicity associated with smoke inhalation. They determined that high acuity smoke inhalation victims benefit from rapid, early, assessment and empiric treatment with hydroxocobalamin.

Meillier & Heller (2015) conducted a case study that compared the efficacy of two different cyanide antidotes to determine which medication resulted in the better outcome (N=2). The case involved two co-located victims experiencing the same time weighted average (TWA) exposure to CN while working at a metal plating shop. Victim A presented following cardiac arrest secondary to the CN exposure and was given an older cyanide antidote kit (sodium thiosulfate 12.5gm and sodium nitrite 300mg) 14 mins after arrival in the ED. ABG results

included a pH of 6.67 and serum lactate of 16.0 mmol/L. He was placed on a brain death protocol after CT indicated an irreversible diffuse anoxic brain injury with diminished reflexes.

Victim B was found next to Victim A, unresponsive and apneic. He was intubated in the field, and given hydroxocobalamin 4 minutes after arrival in the ED. ABG results included a pH of 7.09 and serum lactate of 16.3 mmol/L. Within 24 hours of admission to the ICU he was weaned from the vent and extubated. On day 3 Victim B was discharged home with no residual neurological deficits. The authors concluded that with limited side effects, rapid administration of hydroxocobalamin decreases mortality with less severe side effects as compared to the sodium thiosulfate/sodium nitrite combination found in the cyanide kit.

Depret, et al. (2019) conducted a multicenter retrospective cohort study to determine if hydroxocobalamin is associated with increased risk of acute kidney injury (AKI). Twenty-one ICU's in France (N=739) administered hydroxocobalamin to 386 (55.2%) patients and found that 288 (39%) developed AKI. Of that 39%, 186 (25.2%) of those patients developed severe AKI within the first week. The patients who were administered hydroxocobalamin were noted to be symptomatically more severe, had more comorbidities, and experienced higher mortality rates (38.1% vs. 27.2%, p=0.0022). The adjusted odds ratio (95% CI) of AKI following hydroxocobalamin administration was 1.597 (1.055, 2.419) and 1.772 (1.137, 2.762) for severe AKI. Intravenous (IV) hydroxocobalamin was not associated with survival or major acute kidney events (MAKE) with an adjusted odds ratio (95% CI) of 1.114 (0.691, 1.797) and 0.784 (0.456, 1.349). Upon admission, 392 patients (53%) had lactate levels above the median (median=3.0 [1.8-5.2] mmol/L), with 74 patients recording lactate levels ≥ 8 mmol/L (median=10.5 [8.9-12.8] mmol/L). The authors observed an association between the administration of hydroxocobalamin and the risk of AKI and severe AKI, though found that the higher mortality group had a higher trauma burden than the survival group.

UpToDate© (Wolters Kluwer, 2021), a resource utilized by emergency department providers and nursing staff, provides current, evidence-based guidelines on current standards of care. The search terms smoke inhalation and cyanide toxicity in the UpToDate© database result in current evidence-supported treatment and endorse use of hydroxocobalamin as the primary antidote for CN exposure in SI. Desai & Su (2019) reference the need for focused assessment, point-of-care and laboratory testing, and treatment of cyanide toxicity in the smoke inhalation victim along with empiric administration sodium nitrate if hydroxocobalamin is unavailable. The authors define lethal CN levels and encourage obtaining serum lactate levels as the gold standard of diagnosing CN toxicity but caution that differential diagnoses need to be considered when evidence does not support CN exposure.

Early recognition and triage of cyanide toxicity in smoke inhalation followed by rapid, empiric administration of hydroxocobalamin was associated with improved patient outcomes in four articles (Hamad, Babu & Bebarta, 2016; Kaita, et al., 2018; Meillier & Heller, 2015; Nguyen, et al., 2017). The strength of evidence is moderate in the absence of randomized control trials that would otherwise directly evaluate the efficacy of hydroxocobalamin in CN toxicity on humans. The lack of randomized control trials leave most of the research to Level III (Depret, et al., 2019) and Level IV studies (Hamad, Babu & Bebarta, 2016; Kaita, et al., 2018; Meillier & Heller, 2015; Nguyen, et al., 2017) (Appendix E). One more recent study (Depret, et al., 2019) posits that administration of hydroxocobalamin in smoke inhalation victims can induce AKI or severe AKI, though an imbalance lies in the comparison of their samples where the hydroxocobalamin group had more comorbidities, higher levels of deep thermal injuries and required vasopressors for hemodynamic support. Depret, et al. (2019) endorse the need for strong diagnostic and treatment algorithms to guide identification of CN-toxic victims, and encourage the judicious use of hydroxocobalamin in lower-acuity patients.

The research is supportive of early recognition, assessment and accurate triage of smoke inhalation victims to indicate the level and lethality (Hamad, Babu & Bebarta, 2016). The history of a closed-compartment fire (i.e., vehicle, house, etc.) combined with a significantly symptomatic acute patient indicate empiric administration of hydroxocobalamin can improve patient outcomes (Hamad, Babu & Bebarta, 2016; Kaita, et al., 2018; Meillier & Heller, 2015; Nguyen, et al., 2017).

Guiding Theory

Implementation of evidence-based change demands a leadership theory to support the level of awareness and fluidity needed to examine the evidence and issues while educating and guiding staff to the importance of the project. The Situational Leadership Theory developed by Hersey and Blanchard in the early 1970's asserted that no singular leadership style is best for every situation and a strong and effective leader will adapt their style and behavior to the needs of the situation, as context dictates (Chatalalsingh & Reeves, 2014). Hersey & Blanchard (1969) reported that 54% of leaders use the same leadership style for every situation encountered regardless if the situation required modification, indicating that over half of the time the leadership style does not meet the needs of the staff.

Hersey and Blanchard's Situational Leadership Theory (SLT) can be illustrated by using a box diagram outlining relationship and task behaviors by staff and the leader in a scalar fashion from low to high. This configuration highlights four leadership styles as it pertains to the follower's readiness and behavior within the theory:

1. Participating: (Supporting – follower-directed). The leader and staff collaborate on ideas and decisions. This works best with staff who are very competent though may or may not be committed to the project.

2. Selling: (Coaching – Leader-directed). The leader must thoroughly explain the decisions and provide staff opportunity for clarification. Required for staff who may have some competence and some commitment to the project.
3. Telling: (Directing – Leader-directed). Staff can be given specific instructions and parameters to carry out the project though the leader must supervise performance closely.
4. Delegating: (Follower-directed). Staff understands the needs of the project and may be given a high degree of responsibility and decision-making throughout project implementation.

Applying the tenets of the SLT allows the leader to adapt to the needs of the staff based on their relationship behaviors, task behaviors and their basic knowledge and motivation. Increasing emergency nurse confidence and evidence-based knowledge in the understanding of cyanide toxicity in smoke inhalation victims rely on awareness of a need for focused education and support of the program presented. The strong leader will demonstrate acute situational awareness with a wide scope of vision to determine the needs of the group, gaps and strengths and motivation, to facilitate program success (Rizzo Parse, 2018). Assessing group learning needs using SLT as a foundation allows the leader to apply the correct level of assistance and involvement to those staff who need additional support while providing a level of autonomy to those who show independent strength and knowledge (Meier, 2016). Successful staff education advances the process to the implementation portion of assessment and treatment and will again require the leader to reevaluate the staff needs and determine the level of involvement based on the SLT tenets.

Organization Description

Setting

The project was implemented in an urban emergency department with the support of organizational leadership and Clinical Development. The hospital serves a diverse population of over 90,000 people, and has an expanded catchment area that includes 15 towns with an additional 195,00 people.

Congruence of DNP project to organization mission, goals and strategic plan

The organization strives to provide exceptional patient and family-centered nursing care through partnership with the community and by providing evidence-based care and best practices. There are five pillars surrounding the mission and vision and include 1) patient-focused care, 2) respect, 3) accountability, 4) compassion, 5) commitment. This project embodied the essence of these pillars and organizational values through the evidence-based, patient-centered focus of acknowledging the importance of ED nursing knowledge and confidence in recognition of CN toxicity in this unique group of patients whom arrive at the emergency department requiring critical care.

Relevant Policy

Current policy at the National level is limited to triage and assessment standards set forth by the Agency for Healthcare Research and Quality (AHRQ), and the Emergency Nurses Association (ENA) though nothing currently exists to amalgamate the triage and management modalities that are currently available for the smoke inhalation victim. The State of New Hampshire's Department of Safety, Division of Fire Standards and Training and Emergency Medical Services currently has established protocol 2.21A (adult) and 2.21P (pediatric) for Emergency Medical Technicians (EMT's) and Paramedics that succinctly guide the assessment

and treatment of victims of smoke inhalation though nothing currently exist for emergency nursing.

The organization has no specific protocol, policy or guideline to address the assessment, triage and treatment of victims of smoke inhalation. There have not been any continuing education programs to identify the importance of assessing SI patients, nor to understand the toxicity of cyanide poisoning. Emergency Department Physicians and nurses often seek guidance from the Wolters Kluwer UpToDate.com evidence-based practice resource to review current standards and treatments for high-risk low-frequency cases (Wolters Kluwer, 2021).

Stakeholders

Organizational stakeholders include Clinical Development, the Associate Vice President of Emergency Services and the ED Director who strongly support implementation of a patient-centered evidence-based project that will positively impact patients and reduce morbidity and mortality. This project offered emergency department nurses the chance to participate in a dynamic evidence-based education targeting a specific high-risk, low-frequency cohort of SI victims. A strengths, weaknesses, opportunities and threats (SWOT) analysis determined that an opportunity and need for specific education regarding assessment and treatment of smoke inhalation victims is needed (Appendix A). Emergency department nurses comprised the intervention group of stakeholders that directly benefited from the evidence-based quality improvement education program by increasing their knowledge and confidence in understanding, assessing and triaging this high-risk, low-frequency group of fire victims.

The primary group of stakeholders are the patients most positively impacted following the implementation of the DNP project. Fire victims are at highest risk for morbidity and death when not accurately assessed and triaged by nurses knowledgeable and confident in smoke

inhalation. Victims of SI experience specific toxidromes unique to fire gas exposure that must be recognized and treated rapidly in the emergency department to improve chances of survival.

Aims and Objectives

The purpose of this DNP project was to ensure that emergency department nurses are confident, accurate and proficient in rapidly triaging the unique group of smoke inhalation victims. Providing education that builds a strong foundation of knowledge will develop an increase in confidence, proficiency, and accuracy in triaging these unique patients. The specific aims of this project were:

1. Increase nursing confidence, knowledge and understanding of the toxicology and pathophysiology surrounding hydrogen cyanide and carbon monoxide as lethal toxins present in the smoke found in closed-compartment fires (i.e., vehicle, house, etc.).
2. Increase confidence, knowledge and understanding of how to appropriately triage this unique cohort of smoke inhalation victims in the emergency department through the presentation of case studies.
3. To evaluate the ability to accurately triage smoke inhalation victims 90% of the time as evidenced through a battery of fire victim case studies delivered following the primary education.

Methodology

Design

The project was developed to provide emergency department nurses with an educational and quality improvement opportunity to amalgamate existing triage confidence and ability with new, evidence-based knowledge specifically identifying the high-risk, low-frequency smoke inhalation victim. Nurses were given the opportunity, through pre- and post- education surveys, to share their readiness to learn EBP while assessing their reported confidence and knowledge of

new evidence-based information. Two weeks after the nurses completed the educational training, they received an additional anonymous post educational assessment of the new knowledge gained. The follow-up assessment gave nurses the opportunity to apply new knowledge and accurately triage twelve victims in a case-study presentation format.

Implementation Framework – The IOWA Model

Properly implementing a process change associated with case-study based education required guidance from the seven steps found in the Iowa Model of Evidence-Based Practice to Promote Quality Care (Appendix B) as developed and revised by Dr. Marita Titler and her colleagues (Titler, et al., 2001). The Iowa Model provides a method to identify problem-focused triggers and knowledge while encouraging the questioning of current nursing practices to determine if patient care could be improved by more current research findings (Dontje, 2007).

The nursing process is based on a stepped approach of assessment, planning, implementation and evaluation to determine how a change will be introduced, instituted, monitored and evaluated for success—a process that parallels the seven tenets Titler et al., (2001) presents. If success is not reached, the change is reevaluated and the implementation process begins again. Titler, et al., (2001) outlined the following seven-step evidence-based implementation guide that synergizes the nursing process to affect change by working through each phase:

- **Step 1**: *Select a topic.* Analysis and evidence-based research defined the breadth and scope of cyanide toxicity as a lethal component in the smoke of which fire victims are exposed. Background research supported the urgency and need to develop nursing education surrounding assessment and triage of smoke inhalation victims, and the need to specifically educate staff to consider cyanide (CN) toxicity when caring for these patients.

- **Step 2:** *Form a team.* Developing a group of nurses whom will be involved in the evidence-based implementation process is imperative to success. The Emergency Department (ED) nursing staff provide frontline assessment, triage and nurse-driven management for the care of patients. This experienced team were selected for participation in this education process.
- **Step 3:** *Evidence retrieval:* Research of evidence-based smoke inhalation injury and CN toxicity algorithms and assessment modalities provided the foundation and supportive data that developed the process of improving nursing knowledge in this unique cohort of patients.
- **Step 4:** *Grading the evidence:* Assessment of quantitative data determined the need for evidence-based interventions and nursing education to increase nursing knowledge and confidence of smoke inhalation injury. The strength of evidence supported the need for education based on the rapid, accurate assessment, triage and treatment of these patients to improve victim survival.
- **Step 5:** *Developing an Evidence-Based Practice (EBP) standard.* This step introduced ED nurses on how to utilize EBP to initiate change. EBP education provided new knowledge covering the pathophysiology, toxicology, toxidromes, diagnostics and treatment modalities currently in practice for smoke inhalation victims.
- **Step 6:** *Implementing EBP.* Implementation of this process required ED nursing staff to participate in didactic case-study based education that reinforced learning objectives, strengthened confidence in assessment and triage. The education provided a strong foundation of current evidence-based management for victims of smoke inhalation.

- **Step 7:** *Evaluation.* Post-education surveys assessed emergency department nurse knowledge and confidence. Scores indicated increases in both domains, and a short online knowledge assessment confirmed nurses' ability to triage case-study smoke inhalation victims. The staff, considered confident and comfortable with the process, verbalized they felt more comfortable when rapidly and accurately assessing and managing smoke inhalation and burn victims arriving in the emergency department (ED).

The Iowa Model of Evidence-Based Practice to Promote Quality Care seven steps of evidence-based process implementation assisted the change agent with developing a successful process to conduct a gap analysis, educate staff, and implement an educational program to improve confident assessment and knowledgeable triage process prioritizing the toxicity and lethality of CN in smoke inhalation victims. This evidence-based process guided the development of education for the identification, assessment and management of the smoke inhalation victim adversely affected by cyanide toxicity.

Description of Evidence Based Intervention and Activities

The project introduced an education program to ED nursing staff focused on evidence-based knowledge of hydrogen cyanide as a prominent lethal toxin in smoke inhalation. The program reviewed the physiological impacts on the body and the importance of how accurate recognition and triage may reduce patient morbidity and mortality. Triage of smoke inhalation victims extends beyond the physical assessment. The program addressed critical incident information, and highlighted the toxidromes and progression of symptomatology associated with cyanide toxicity in these patients. Classroom case studies served as an interactive experience for nurses to better understand and anticipate rapid decompensation of SI patients. The case-studies gave learners the opportunity to apply knowledge and assess and triage using the standard Nurses Association (ENA) Emergency Severity Index (ESI) triage categories (Gilboy, Tanabe, Travers,

& Rosenau, 2020) . Two weeks later a voluntary anonymous SurveyMonkey® post-education knowledge assessment was sent to participants to offer the opportunity to apply new knowledge to additional patient scenarios. Improving nurse knowledge and confidence with assessment and triage can better guide management of testing and care where time to intervention is critical in reducing morbidity and mortality.

The following steps comprised the implementation and completion of the DNP project:

I. Institutional Review Board (IRB) Approval: Approval of IRB Research Protocol Number #3468 through Eastern Kentucky University (EKU) was obtained on August 19, 2020 to conduct this DNP project within the organization.

II. Email Delivery: Informational emails describing the focus of the DNP EBP implementation project were delivered to attendees prior to each of the eight mandatory Skill Competency Days. The emails explained the focus of the project, nursing goals, and introduced the voluntary project participation through the completion of pre- and post- questionnaires during their Skill Competency Day. The email also explained the voluntary participation in a short post-education evaluation that participants would receive two weeks following their Skill Competency day (Appendix C).

III. Confirmation of Participation: This EBP DNP project was accepted as part of the hospital annual mandatory Skills Competency Day for emergency department nurses and was embedded in the delivery of eight of the educational days (Appendix D). Attendance for this presentation was deemed to be mandatory by the Director of Clinical Development and Director of the Emergency Department. This quality improvement project offered no risk to participants where it was education-focused and evidence-based with the goal of improving patient care in a unique cohort of patients. Consent to participate in the confidence and knowledge assessment was obtained and implied when

nurses agreed to complete the voluntary pre-, post- and case-study surveys, therefore a Waiver of Consent was approved with the Institutional Review Board (IRB) application (IRB #3468) (Appendix E).

IV. Pre-Education and Demographic Questionnaires: Three Evidence-Based Practice Readiness Inventory© (ERI) questionnaires were voluntarily completed by all participants prior to initiation of the education module. The surveys identified 1) basic demographic information of the learners, 2) ERI-Confidence in participation of EBP, and 3) ERI-Knowledge questions to assess pre- and post- understanding of EBP.

V. Education Presentation: Conducted by the Principal Investigator, this didactic presentation focused on the evolution of hydrogen cyanide and carbon monoxide as the prominent toxic byproducts found in the smoke generated in closed-compartment fires. Topics further included pathophysiology, toxicology and toxidromes of both hydrogen cyanide and carbon monoxide, along with interpreting patient presentation following extended exposure to these toxins. Emphasis was placed on the importance of accurately triaging these patients by exposure severity, duration, presentation and presence/absence of pre-hospital interventions initiated to reduce morbidity and mortality.

VI. Post-education questionnaires: The EBP-Confidence and EBP-Knowledge Test were once again administered and completed voluntarily by all program participants immediately following the education presentation to assess if they perceived an increase in EBP confidence and EBP knowledge had occurred.

VII. Case-Study Evaluation Survey: Two weeks post-education participants were emailed a voluntary anonymous SurveyMonkey® post-education knowledge assessment designed to assess the ability to apply newly acquired knowledge on smoke inhalation victims. The assessment gave the opportunity to triage twelve scenario-based smoke inhalation

victims into five ESI triage categories. The case study assessment was designed to determine if learning occurred as evidenced by emergency department nurse participant ability to appropriately triage SI victims.

VIII. Data synthesis: Questionnaires received from participants were entered into the IBM SPSS Version 27 codebook to analyze knowledge and confidence scores, while post-education assessment scores were evaluated through proprietary analytics within the SurveyMonkey® system. The aims and objectives outlined in the IRB sought to achieve the following:

a. Increase reported confidence in the EBP of toxicology and pathophysiology surrounding hydrogen cyanide and carbon monoxide as toxins present in smoke found in closed-compartment fires (house, vehicle fires, etc.).
b. Increase reported knowledge of the importance to utilize EBP in caring for this unique cohort of smoke inhalation victims in the emergency department.
c. Evaluate the ability to accurately triage smoke inhalation victims when presented with twelve case-study patient scenarios.

Setting of the Intervention

The program was conducted inside a secure conference room where current Center for Disease Control (CDC) and hospital-based social distancing and masking guidelines could be safely met. The conference room was located inside the main campus of the hospital and was secure and free from distraction and interruption, and provided a comfortable atmosphere for learners to interactively gain new knowledge.

Recruitment

Subjects. Emergency department nurses not on orientation at the time of the educational delivery were the target subjects for the education questionnaires. Forty-one Registered Nurses

participated in the mandatory Skill Competency Day and each of those nurses voluntarily participated in all of the pre- and post- education questionnaires associated with this project.

Inclusion/Exclusion Criteria. All ED nurses and paramedics participated in the mandatory educational program, however, only those ED nurses whom had completed orientation and agreed to complete both the pre- and post- education questionnaires were included in the data collection for this project. Excluded were any nurses currently on orientation and ED Paramedics.

Access. Access to the education is facilitated through the ED Clinical Educator and scheduled per current COVID-19 distancing guidelines by the Principal Investigator. There were ten scheduled offerings of the education approved by the organization and embedded within the ED mandatory Skill Competency Day education blocks (Appendix F). Two of the schedule offerings were cancelled per the organization. Participants had the opportunity to sign up for a delivery that was conducive to their personal schedule, their attendance was verified, documented and maintained by the ED Clinical Educator.

Recruitment Strategies. The DNP project was embedded within annual mandatory education, leaving few recruiting needs. The principal investigator sent the ED nursing staff an email one week prior to the beginning of the Skill Competency Days explaining the focus of the project, how the process was to be implemented and the purpose of the surveys. The email explained that completing the surveys is strictly voluntary and completion indicated consent of participation in the data analysis portion of the DNP project. There was no risk to participants, nor was there any penalty for any staff that choose not to participate in the surveys.

IRB, Ethics & Consent. There were no risks to participants or costs for participating in this project. Participants were in a paid status and authorized by the organization to attend the education.

Instruments. The Principal Investigator was granted permission to use the following EBP survey instruments from the original author, Dr. Kathleen Stevens:

1. Evidence-Based Practice Readiness Inventory (ERI) Demographic Information (Clinicians) Questionnaire© (Appendix G). Nursing participants completed a basic demographic questionnaire to assess nursing roles, experience and education.
2. Evidence-Based Practice Readiness Inventory (ERI) Confidence© survey utilized a 20-item questionnaire using a six-point Likert scale to assess learner's confidence in performing evidence-based competencies (Appendix H)
3. Evidence Based Practice Readiness Inventory (ERI) Knowledge Test © measured learner's evidence-based knowledge with a 15-item multi-choice exam (see Appendix I).

The survey tools are designed around Stevens' ACE Star Model of Knowledge Transformation as the framework for evidence-based practice implementation, with a validated Cronbach's alpha of >0.90. Cronbach's alpha for this project was ≥ 0.972. Permission for use of all survey instruments and transformation model was obtained by the developer, Dr. Kathleen Stevens (Appendix J).

Data Collection. The ERI Demographic Information Questionnaire©, the EBP Readiness Inventory (ERI) Confidence Survey© and the EBP Readiness Knowledge Test© were administered to the emergency department registered nurses who voluntarily agreed to participate in surveys when they arrived for the education. All nurses agreed to participate, and those nurses and paramedics who fell outside of the scope of the project were given a 15-minute break while others completed paperwork before the start of the education. These anonymous survey instruments were completed in paper format and collected by the Principal Investigator.

In the two weeks that followed the didactic education, emergency department nurses received a voluntary electronic assessment survey that presented twelve fire victim case studies

of varying severity. Nurses were asked to voluntarily triage each patient in the case study based on the new knowledge acquired during the classroom education and submit results electronically and anonymously. The data was collected by the Principal Investigator held securely in a folder inside the locked/badge access only office of the Principal Investigator for the duration of the project. This information will be transferred to Eastern Kentucky University (EKU) to a locked filing cabinet in Dizney 225 at the end of the project.

Data Analysis. IBM SPSS Version 27 provided the software to analyze all survey results. Variables and demographics were identified for the three surveys, labeled, and values created for analysis. Analysis of the EBP-ERI pre- education questionnaire was to establish a baseline of emergency department nurse knowledge and confidence and readiness to understand discovery research, evidence, guidelines, and practice integration of evidence-based knowledge and process changes.

The EBP-ERI Knowledge Test and Confidence Survey© questionnaires were repeated immediately following the program. These instruments were then used to determine if knowledge transformation and confidence improvement through evidence-based practice was reported among learners. The data should assert that didactics provided clear evidence-based learning objectives, strong collaboration between instructor and students, diversity with instructional methods and clear expectations in triaging victims of smoke inhalation based on best practice. A two-week post-education knowledge assessment provided an opportunity for nurses to apply new knowledge appropriately as evidenced by accurately triaging patients into the Emergency Nurses Association (ENA) emergency severity index (ESI) triage categories (Gilboy, Tanabe, Travers, & Rosenau, 2020).

Smoke inhalation victims are a low-frequency, high-risk group of patients that require nurses to rapidly assess, triage, initiate diagnostic order sets, and aggressively initiate treatment

to improve survival and reduce morbidity and mortality. Providing robust education and realistic case-based learning reinforces existing triage and assessment skills by integrating new knowledge into a familiar ESI Triage system.

Timeline, Resources and Budget. Curriculum development for the didactic and case study program was developed from May 2020 through August 2020 with EKU IRB approval in August (IRB #3468) (Appendix K). The Skill Competency Days began on August 28, 2020 and were completed on November 5, 2020 –the last of the case-study surveys were sent out on November 20, 2020 (Appendix L). Data analysis, synthesis, final report completion and formal presentation was conducted during Spring 2021 for the Eastern Kentucky University DNP Project Committee and stakeholders.

Resources. The primary resources required for the education were photocopies of the survey tools and booking a conference room large enough with AV equipment to deliver a PowerPoint presentation and maintain CDC COVID-19 pandemic recommended social distancing requirements.

Budget. There was no cost for the use of the ERI© survey tools, and creation and instruction of the education program was the responsibility of the Principal Investigator. The education conducted for the ED registered nurses was embedded in the mandatory ED Skill Competency Days, therefore no additional staffing costs were incurred for this DNP project. As a three-time Magnet© designated facility, the organization embraced the importance of developing evidence-based education that positively impacts patient care by reducing morbidity and mortality.

Results

Forty-one (73%) emergency department nurses individually attended one of eight Skill Competency Days offered in November and December 2020. All 41 nurses voluntarily

participated in the pre- and post- confidence and knowledge survey, and 29% (n=12) further participated in an additional anonymous two-week post-education knowledge assessment. Data from survey results were entered into the IBM Statistical Package for Social Science (SPSS®) version 27.0 with a statistical significance set at 0.05. Demographics were summarized from the ERI Demographics Information Questionnaire© and paired *t* tests were completed on the mean pre- and post- intervention scores from the ERI-Basic© and EBP Readiness Knowledge Test© to determine if aims were met.

Descriptive Demographics

The ERI Demographics Information Questionnaire© was completed by all participants and indicated that the newest group of nurses reporting 0-5 years of ED was the second-largest cohort at 24.4%. Participants indicating either 6-10 years or over 21+ years of experience comprised the largest groups tied at 26.8%. The respondents having 11-15 years and 16-20 years comprised 14.6% and 7.3%, respectively. A large group of respondents had attained a Baccalaureate degree in nursing (70.7%) while 7.3% had continued on to achieve a Master's Degree. The remaining participants reported having an Associate's Degree (22%), though the organization does require they obtain a Baccalaureate degree within ten years from their date of hire, so many of those nurses are enrolled in a program.

Nearly half of the respondents indicated they perceived themselves a beginner with evidence-based practice (48.8%) while 34.1% reported having no prior EBP experience. The participant age distribution varied, with thirty-six to fifty years (34.1%), with 29.3% reporting ages above fifty-one and 4.9% reporting an age between 19 – 25. Women were the primary cohort (80.9%) with men comprising the remaining 19.5% of overall nursing participants (see Table 1 on following page).

Table 1: *Sample Demographic Characteristics* (*n* = 41)

Variable	*n*	*%*
Years of Experience		
0 – 5 years	10	24.4
6 - 10 years	11	26.8
11 – 15 years	6	14.6
16 – 20 years	3	7.3
Over 21 years	11	26.8
Primary Role in Healthcare		
Clinician	39	95.1
Administrator	1	2.4
Educator	1	2.4
Highest Degree Earned		
Associates Degree	9	22.0
Baccalaureate	29	70.7
Masters	3	7.3
Age		
19 – 25 years	2	4.9
26 – 35 years	13	31.7
36 – 50 years	14	34.1
51 – 60 years	7	17.1
Over 60 years	5	12.2
Gender		
Female	33	80.5
Male	8	19.5
Experience with EBP		
None	14	34.1
Beginning level	20	48.8
Intermediate level	6	14.6
Advanced level	1	2.4

Paired *t* tests were conducted to evaluate if participating emergency department nurses reported an increase in knowledge and/or confidence in evidence-based practice immediately following program delivery. There was a significant increase in both the pre- and post-knowledge and confidence ERI Readiness Inventory Test© scores (Table 2).

Table 2: *Paired Samples Test*

	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper	t	df	Sig. (2-tailed)
Pair 1 Pre-Education Knowledge Score and Post-Education Knowledge Score	-4.707	11.641	1.818	-8.382	-1.033	-2.589	40	.013
Pair 2 Summary of Pre-Education Confidence and Post-Education Confidence	-19.65854	16.59760	2.59211	-24.89739	-14.41969	-7.584	40	.000

Correlation analysis found that knowledge was not a predictor of confidence, but years of experience were positively correlated (Table 3). Advanced education degrees and the post-education score had no correlation with the post-education confidence reported by the participating emergency department nurses.

Table 3: *Correlation table – Post-Education Confidence Scores as the Dependent Variable*

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	94.957	15.055		6.307	.000
	Years of Experience	3.385	1.626	.318	2.082	.044
	Highest Degree Earned	-3.624	4.810	-.115	-.754	.456
	Post-Education Knowledge Score	-.239	.223	-.163	-1.070	.291

A post-education knowledge assessment was created and emailed to participants two weeks following course completion. The voluntary assessment offered twelve scenarios containing smoke inhalation injury victims of varying acuities that required the nurse to assess and triage into an appropriate ESI triage category. Twelve nurses (29%) participated in the post-education knowledge assessment achieving a median score of 82% (M=0.77, SD=0.16), indicating that after a two-week gap in the presentation of new evidence-based knowledge, participants were able to specifically triage smoke inhalation victims with confidence by applying new knowledge obtained in the delivery of the Understanding Cyanide Toxicity in Smoke Inhalation Victims education program. The emergency department of the participating hospital does not have defined parameters of a passing score when assessing staff competency of triage as suggested by the Emergency Nurses Association (ENA) in their Emergency Severity Index (ESI) implementation handbook (Gilboy, Tanabe, Travers, & Rosenau, 2020).

Discussion

Evidence-based knowledge provides the foundation on which best practice is built. A short anonymous voluntary questionnaire was sent to the organization's Emergency Department nurses in 2019, which indicated a profound knowledge deficiency in the recognition and management of cyanide toxicity found specifically in smoke inhalation victims. Participants reported they had never participated in any continuing education specific to smoke inhalation injuries (83.3%) and only 16.7% indicated they understood the toxicity and lethality of cyanide in smoke inhalation victims. Participation was limited to only twelve ED nurses but when the questionnaire was offered to ED nurses in another urban hospital, 18 responded with similar results. Nurses in both surveys indicated that they had not received education specific to fire and smoke inhalation victims in nursing school, and a scant few reported participating in continuing

education on the subject. These findings underscore the importance of active participation of nurses in education programs focused on low-frequency high-risk subjects.

Identification of a shortcoming in the ability to identify, assess and manage these high-risk low-frequency patients provided the starting point for developing an evidence-based emergency nurse-focused education program. The program was developed to build understanding and knowledge while increasing confidence in the ability to accurately triage and manage the treatment of these patients.

Evidence-based education was provided using a case-study format to build understanding of pathophysiology, toxicology and the toxidromes associated with carbon monoxide and hydrogen cyanide in victims of closed-compartment fires (i.e., house, vehicle, airplane, etc. fires). According to Gilroy et al., (2020) interactive case studies give students the opportunity to apply new knowledge, assess multiple victims and triage them into the appropriate ESI category. Pre- and post- knowledge assessments conducted through the EBP ERI Knowledge Test© indicated that learning of this new knowledge did occur, and pre-post confidence scores from the EBP Readiness Inventory (ERI)© assessment supported an increase in nursing confidence when applying new evidence-based knowledge in this unique group of patients.

Two weeks following the classroom education a post-education knowledge assessment was emailed to participants to voluntarily complete. The assessment presented the students with twelve fire incident scenarios, asking them to triage the victim appropriately into the correct ESI category. Twenty nine percent (n=12) of the emergency department nurses completed the assessment and demonstrated basic proficiency with a median score of 85%.

The organization does not have a minimum score associated with evaluating nursing triage competency, and this was a limitation to fully assess the baseline ability of ED nurses to triage this category of patients. The ENA suggests a baseline be established for which to measure

competency –this median score may act as the initial evaluation to which future scholarship and reeducation may be measured by the organization.

Limitations to the project began with the ongoing COVID-19 Pandemic that began in early 2020. The organization acknowledged the importance of this project and allowed work to continue within the guidelines provided by the Centers for Disease Control (CDC). The Clinical Development and Emergency Services Leadership were supportive and agile with changes that occurred to maintain CDC guidelines and hospital policies as the pandemic evolved and the project moved forward. Classrooms were changed multiple times to accommodate student volume and social distancing guidelines and Skill Competency days added to the schedule to reduce the number of students per program delivery. Limitations arose regarding the possibility of using interactive simulation to reinforce learning objectives with students, therefore, the project was modified to implement interactive case studies to aid in developing a deeper understanding of the material.

The overall sample size of participants was considered small with 41 ED nurses (73%) who met inclusion criteria participating. This was in part due to numerous staff absent during Skill Competency days for COVID-19 quarantine, Family and Medical Leave Act (FMLA) absences, a 29% ED nursing vacancy rate and the cancellation of the final delivery day (two programs) due to a Det Norske Veritas and Germanischer Lloyd (DNV-GL) Hospital Stroke Accreditation revisit. The two sessions cancelled by Clinical Development will not be rescheduled until late 2021.

Implications

Providing evidence-based education to improve nursing knowledge may have numerous implications beyond increasing confidence and knowledge in a specific area. The emergency department is a dynamic environment where nurses must remain agile and nimble in their critical

assessment and aggressive treatment of the ill and injured. Preparation for high-risk low-frequency cases is paramount to the reduction of morbidity and mortality of these patients and may be done through diligent assessment and delivery of current evidence-based education.

Clinical Practice

Evidence-based knowledge is correlated with nursing confidence as evidenced by the results of this project. Confidence fosters the ability to quickly and aggressively assess, triage and initiate treatment to sick and injured patients, and confidence provides the vehicle in which nurses carry their knowledge and determines the deployment of assessments and skills when needed.

Policy

Improving care of the healthcare consumer is guided by education, organizational goals and institutional decision-making supporting initiatives that translate to improved patient experience. Emergency Department triage standards are administered through AHRQ and the ENA and supported by the organization. Identifying gaps in education surrounding accurate triage of critical patients is a priority for the organization and its ability to ensure nurses are meeting current standards.

Quality and Safety

Quality of life and reduction of mortality is a priority of patient satisfaction and is a measure inherent to success of the organization. As a three-time Magnet© organization prioritizing patient-centered evidence-based programs, the hospital is focused on initiatives that improve all aspects of patient care including the education provided with the implementation of this project. The hospital has limited resources (two Cyanokits®) available to treat victims of smoke inhalation. The cost of the life-saving kits ranges from $800 - $1200 with a shelf life of 36 months, making additional stock of a limited-use medication cost prohibitive.

Education

Clinical Development and Emergency Services Leadership are committed to support the development of education regarding high-risk low-frequency types of patients, including SI victims. This project highlighted the need for frequent gap analyses specific to the needs of the emergency department, and has garnered commitment to support further scholarship regarding high-risk patients.

Feasibility for Sustainability

Evidence-based patient care is a priority for the organization and this DNP project offered strong data to support focused-education to improve the assessment, triage and management of a high-risk population. The emergency department is a dynamic, changing environment that cares for a multitude of diverse patients with illness and injuries often requiring prompt and aggressive care to achieve positive outcomes. Evidence-based education allows nursing staff to prepare for the high-risk, low-frequency patients such as those presenting with burn and SI injuries from closed-compartment fires. Building, life safety, and fire codes continuously evolve to improve occupant safety and security, while competing against an industry demanding the low-cost, mass-produced building materials and furnishings that exponentially threaten the survivability of victims who experience a fire in their home. The disparity between Fire & Life Safety Codes and inexpensive building materials/home furnishings will continue to create situations where occupants will live or die based on the knowledge and confidence in the assessment and management of care by hospital emergency services.

This project provided an evidence-based foundation for emergency nurses to build confidence, knowledge, triage ability and the decisiveness to assertively intervene when presented with victims of SI. The program was part of the mandatory annual Skill Competency days, so no additional costs were incurred during the delivery of the program. Many of the

limitations encountered during this project were a direct result of the COVID-19 pandemic. As the CDC and this organization modify and relax rules, policies and guidelines, this education will have room to grow into a full simulation, scenario-based activity. Simulation will reinforce concepts and skills that further increase emergency department nursing knowledge and confidence, while providing evidence-based care to this unique cohort of smoke inhalation victims (Kapucu, 2017).

The organization has no policies or clinical practice guidelines in place pertaining to the management and treatment of smoke inhalation victims. The Emergency Services Leadership group along with the Chief Nursing Information Officer are interested in exploring the development of a protocol and Best Practice Advisory (BPA) within the hospital's new EMR. This BPA is activated when either a SI chief complaint or symptom bundle are placed into the system. This BPA is a pop-up window that will provide current evidence-based assessment, diagnostic testing and treatment guidelines based on patient presentation and may guide providers with rapid decision making when presented with a SI patient.

Future Impact

Gap analysis surveys conducted in 2019 underscored the need for constant assessment and reassessment of education surrounding low frequency high risk patient care. The highest chance of smoke inhalation victim survival begins at the fire scene, so in recognizing the educational gap, the principal investigator extended the anonymous surveys to first responders throughout the state. The State Fire Academy was exceptionally supportive and offered to send the surveys out through their statewide listserv –a step that assisted in obtaining 78 first responder responses. Level of certification ranged from Emergency Medical Technician – Basic (EMT-B) (20.51%), EMT – Advanced (37.18%), to Paramedic (39.74%), and over 48% of respondents reported greater than 21 years in Emergency Medical Services (EMS).

Limited EMS respondents reported having received cyanide-specific education (24%) which aligned with how nursing responded to the same question (22%), confirming a gap in the recognition and management of SI victims exists. The EMS results were discussed with the Director of EMS for the State Fire Academy, and a plan was initiated to modify and deliver the Understanding Cyanide Toxicity in Smoke Inhalation DNP project through the fire academy out to an EMS and Fire Service based audience. This program was the first virtual education offered through the State Fire Academy and was scheduled initially for two "live" virtual presentations. The program was recorded and edited, and will be uploaded to the State Fire Academy virtual repository for continuing education. Students can visit the virtual repository and register to watch the presentation at their convenience as a way to obtain continuing education credits. The opportunity to deliver this program through the State Fire Academy has led to requests from Fire Departments in the State have begun to request virtual delivery of the program to offer their staff continuing education on this important topic and EMS protocol. The availability of the program in the State Fire Academy virtual repository and ongoing area interest of this program will sustain this project as a continuing education program into the future.

Emergency department leadership and hospital Clinical Development recognize the importance of ensuring staff are prepared to manage a multitude of low frequency cases. They have expressed full support to continue reinforcing the learning presented in this DNP project through annual simulation and case- study reviews. The work to develop best practice advisories in the new electronic medical record (EMR) will continue in hopes of presenting current evidence in a real-time environment that will prompt providers of diagnostics important to accurate assessment of SI victims.

The ability to improve emergency medical care relies on the ability to identify gaps, strengths and weaknesses in policies, procedures and above all, knowledge. An astute

organization realizes that they are only as strong as their weakest link, and must commit to building that weakness into a strength. The Clinical Development and Emergency Services Leadership of the organization for this project recognizes the importance of building weakness into strength and identifying gaps that exist surrounding low-frequency patients. The organization is a staunch supporter of diverse education and will continue to provide continuing education focused on shoring up perishable skills and knowledge.

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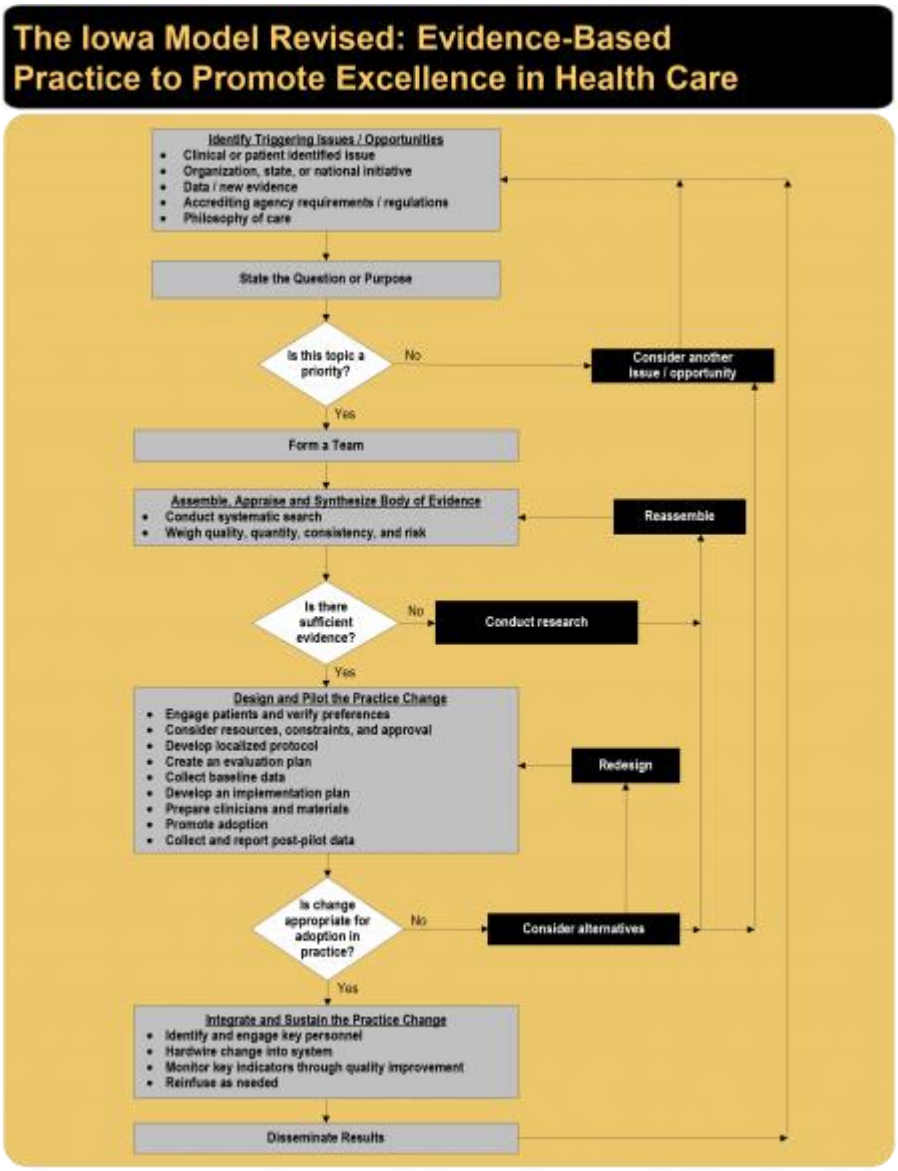
Appendix A: Organization SWOT Analysis

Strengths	• Magnet® accreditation – strong support of EBP • Moderate volume of ED patients • Staff motivated to learn • Strong market position • Strong position within the health system • Active Clinical Development division
Weaknesses	• Lack of regular department-focused education • No high-risk low-frequency patient triage education • No specific smoke inhalation education • No smoke inhalation treatment protocol • No algorithm to guide EBP smoke inhalation diagnostic and treatment modalities • Lack of familiarity with cyanide toxicity treatment options
Opportunities	• Supportive of EBP education • Gap in education identified for smoke inhalation injuries • Introduce an EBP focused triage assessment for smoke inhalation • Utilize new EPIC EMR to support Best Practice Advisory (BPA) for smoke inhalation • Utilize new EPIC EMR to develop a smoke inhalation protocol
Threats	• Ability to keep BPA current within the EMR • Low volume of smoke inhalation victims • Limited available IT to support new projects currently • Limited diagnostic testing for CN and CO toxicity

Appendix B: IOWA Model for Implementation



http://uihc.org/iowa-model-revised-evidence-based-practice-promote-excellence-health-care

Appendix C: Staff Email for Implementation

Good Morning,

I am reaching out to everyone regarding the upcoming annual Skill Competency Days to tell you about some of the new education that you will be receiving during your program!

Most of you know that I have been pursuing my Doctorate in Nursing Practice, and I have reached the end of my program where my project work is ready for implementation! My project is improving nursing confidence and knowledge in the assessment and triage of victims of the smoke inhalation toxicants cyanide and carbon monoxide.

Every 24 seconds a fire department responds to a fire in the United States and though this number is down, the number of fire-related deaths has increased nearly 10% as a result of newer synthetic building materials and furnishings, and lightweight building construction. When these synthetic materials are exposed to high heat and fire, the release toxins into the air, often overcoming victims in less than 1-2 minutes, and reducing survivability dramatically. Increasing our knowledge, understanding and ability to rapidly identify, triage and care for these patients is critical to their survival. These patients are high-risk, low-frequency and often expire rapidly from their injuries without our proper identification and intervention.

The goal of this work is to improve the nursing ability to recognize the lethality of cyanide and carbon monoxide toxicity, increase confidence in accurately triaging these unique patients and understanding what diagnostics we have available to better guide rapid treatment to reduce mortality.

This dynamic, creative education will be presented during Skill Competency Days and will introduce the physiology, toxicology, assessment, triage, and intervention opportunities unique to the cyanide and carbon monoxide toxicity found in these patients. When you arrive for training on your scheduled day, I will ask you to voluntarily complete a short demographics survey, and two short questionnaires describing your confidence and knowledge with evidence-based education that should take no more than 10-15 minutes to complete. The two short surveys are repeated when we are done – this provides the data for my project of assessing if you feel that your confidence and knowledge of evidence-based education has increased.

1-2 weeks after your class, I will send out an online voluntary anonymous survey that will offer some case studies for you to assess the retention of knowledge you gained to specifically triage/assess victims of smoke inhalation.

The surveys are strictly voluntary and anonymous. Your completion of the survey indicates consent to use your deidentified responses in my doctoral work and data analysis. The data is finalized into my final DNP Project Plan for submission.

I cannot thank all of you enough for your continued support of evidence-based knowledge and drive to improve the care that we bring to our patients. I appreciate your time, and hope that everyone will take a few minutes to complete the surveys and participate in this quality improvement project!

Appendix D: EKU Statement of Mutual Agreement

Eastern Kentucky University
Department of Baccalaureate and Graduate Nursing
Doctor of Nursing Practice Program

Statement of Mutual Agreement for DNP Project

The purpose of a Statement of Mutual Agreement is to describe the agreement between a designated clinical agency and the DNP student regarding the student's DNP project.

I. General Information

Student Name:	Jessica Wyman
Project Title:	Managing Cyanide Toxicity in Victims of Smoke Inhalation
Agency:	Southern New Hampshire Medical Center
Agency Contact:	Karen Tollick, Director of Clinical Development

II. Brief description of the project

- The purpose of this DNP project is to ensure that emergency department nurses are confident, accurate and proficient in rapidly triaging the unique group of smoke inhalation victims. The goal is to provide the foundation of knowledge that will facilitate this increase of proficiency in triaging and treating these high-risk, low-frequency patients in an effort to reduce morbidity and mortality while improving patient outcomes.
- Expected project outcomes: Emergency department nurses will report increased confidence and knowledge and will demonstrate accuracy in triaging various case-based fire-victim scenarios.
- On-site Activities: This education will be offered as an interactive and enthusiastic didactic program embedded within the annual Emergency Department nursing Skills Days beginning August 28th and ending December 18th. The education is mandatory though nurses will be asked to complete a voluntary pre- and post- education questionnaire assessing their confidence and readiness to learn evidence-based knowledge. After a one to two-week period, all participants will receive a voluntary online survey where they will have the opportunity to apply learned knowledge by triaging fire victims through case studies. The DNP student will be responsible for the delivery of all educational offering related to this project, the collection and protection of survey information, and securing any and all documentation related to information obtained in the surveys.
- Products resulting from the DNP project: The Powerpoint presentation utilized for this project will be made available to Clinical Development and to the Emergency Department Clinical Teacher for future use and reiteration/remediation of education.

III. Agreement of written and oral communication

- The participating organization, Southern New Hampshire Medical Center will be properly identified in any and all academic work, publications, and presentations.
- Survey information and identities of the participants will remain strictly confidential and all identifiers redacted for data analysis. Sensitive information regarding the organization will remain confidential and protected in any associated publications.
- Formal agency approval will be requested for any publicly shared findings.

Fall 2020

Eastern Kentucky University
Department of Baccalaureate and Graduate Nursing
Doctor of Nursing Practice Program

Appendix E: EKU Waiver of Consent

Eastern Kentucky University Institutional Review Board
Request for Waiver of Informed Consent Documentation

Informed consent is a foundational component of protecting human research subjects and is at the core of the IRB's ethical values. In general, all studies involving human subjects must include a formal informed consent process that is documented with signatures from participants. In a limited number of situations, however, Federal regulations permit an IRB to authorize a waiver of informed consent documentation. When a study is approved with a waiver of informed consent documentation, this means that signatures from subjects are not required on consent forms. However, such a waiver does not eliminate the ethical requirement to provide information to potential subjects and allow them to make an informed decision about voluntarily participating. Investigators are still required to follow a process of obtaining consent and to outline this process in the application for IRB review.

In unique situations where a study cannot be practicably carried out with informed consent documentation, this form may be used to request a waiver of the informed consent documentation requirements. If approved, the waiver will be specifically outlined in the approval notification.

1. Title of Study:
Understanding and Managing Cyanide Toxicity in Smoke Inhalation Victims

2. Principal Investigator and Faculty Advisor:
Principal Investigator Name: Jessica L. Wyman
Primary Faculty Advisor (required only if principal investigator is a student): Dr. Fontaine Sands

3. Category of Waiver Request:
Please indicate which of the following situations apply and respond to the items that follow each category.

☐ **A.** The only record linking the subject and the research would be the informed consent form and the principal risk would be potential harm resulting from a breach of confidentiality. In this case, each subject (or legally authorized representative) must be asked whether the subject wants documentation linking the subject with the research, and the subject's wishes will govern.
- Describe the procedures to be followed for offering this choice to each subject.
  Click to enter text.

☒ **B.** The research presents no more than minimal risk of harm to subjects and involves no procedures for which written consent is normally required outside of the research context.
- Provide a justification describing how the proposed study meets this criteria.

  The study is an educational quality improvement project that aims to increase emergency department nurses confidence and ability to accurately recognize and triage victims of smoke inhalation, and understand the importance of identifying exposure to hydrogen cyanide. Implementation of this project is the delivery of a live educational presentation that reviews the pathophysiology, toxicology, assessment and triage of these patients with emphasis on building nursing confidence and knowledge on caring for this high-risk, low-frequency group of patients when they arrive in the emergency department.

  The hospital has accepted this project and embedded the education within annual emergency department skill competency days that require all emergency department nurses to attend. The mandatory education will be provided to all nursing staff, and voluntary consent to participate in the study is implied when nurses agree to complete the demographic, confidence and knowledge pre- and post- education surveys. They may choose not to complete the surveys and participate in the study, though they will still receive the education.

☐ **C.** The subjects or legally authorized representatives are members of a distinct cultural group or community in which signing forms is not the norm, the research presents no more than minimal risk of harm to subjects, and an alternative mechanism will be used for documenting that informed consent was obtained
- Identify and provide background on the cultural group and cite references for views on signing forms.
  Click to enter text.

- Describe the alternative mechanism to be used for the documentation of informed consent.

EKU Waiver of Consent cont'd

4. Explain how the waiver will not adversely affect the rights and welfare of the subjects.

The quality improvement education will be delivered through ED nursing mandatory training therefore every ED nurse will receive the same education. Nurses that choose to voluntarily participate in the study will complete the pre- and post- education surveys. Nurses who choose not to complete the surveys will not be included in the study, but will receive the same education and information as nurses who choose to participate and will be given a 15-minute break while others complete the pre- survey. Once the educational delivery is completed, the survey group will complete their post- survey while those not participating are able to leave.

This waiver will not adversely affect the rights or welfare of the ED nurses as they simply choose to participate in the surveys or not. Their study participation status does not impact the delivery of the education, and they will receive the same educational presentation as those who chose to participate in the study. There is no adverse or negative impact on the education that they will receive.

5. Explain why the research could not practicably be carried out without the waiver.

This educational quality improvement project has been deemed as part of the mandatory emergency department skill competency days per the Director of Clinical Development for the hospital, therefore attendance and participation in the education is mandatory for ED nurses. Requiring consent to participate in the study may negatively impact attendance during these training days if nurses assume that they can decline participation in the study by not attending the education. In the advent of reducing time and confusion, obtaining the Waiver of Informed Consent allows the nursing staff to attend their mandatory education, participate in the educational quality improvement project with their peers, and agree to complete the pre- and post- surveys if they choose to participate in the study. This also reduces the time spent completing paperwork, limits intrusion of this education into the next part of the competency skill day with respect to time schedules, and gives nurses the ability to decide that day if they want to participate in the study.

Appendix F: Education Delivery Schedule

Confirmation

Customer		Reservation:	42159
Jess Wyman		Event Name:	ED Education
11.6230.75039 EMERGENCY DEPT ADMIN		Status:	Confirmed
		Phone:	281-6603
		Fax:	2290
		Event Type:	Meeting Department
		Event Coordinator:	Jennifer Fisher

Bookings / Details	Quantity	Price	Amount
Friday, August 28, 2020			
10:00 AM - 12:00 PM ED Education (Confirmed) Pelham Room			
Conference Style for 7			
Thursday, September 10, 2020			
7:00 AM - 9:00 AM ED Education (Confirmed) Pelham Room			
Conference Style for 7			
4:00 PM - 6:00 PM ED Education (Confirmed) Board Room			
Conference Style for 7			
Thursday, October 08, 2020			
1:00 PM - 3:00 PM ED Education (Confirmed) Nashua Room			
Conference Style for 7			
Friday, October 23, 2020			
10:00 AM - 12:00 PM ED Education (Confirmed) Pelham Room			
Conference Style for 7			
3:30 PM - 5:30 PM ED Education (Confirmed) Nashua Room			
Conference Style for 7			
Thursday, November 05, 2020			
10:00 AM - 12:00 PM ED Education (Confirmed) Pelham Room			
Conference Style for 7			
12:30 PM - 2:30 PM ED Education (Confirmed) Pelham Room			
Conference Style for 7			
Friday, December 18, 2020			
10:00 AM - 12:00 PM ED Education (Confirmed) Pelham Room			
Conference Style for 7			
3:30 PM - 5:30 PM ED Education (Confirmed) Nashua Room			
Conference Style for 7			

Appendix G: ERI Demographic Survey Tool©

DEMOGRAPHIC INFORMATION (CLINICIANS)

1. Your age: a. 19-25 years b. 26-35 years c. 36-50 years d. 51-60 years e. Over 60 years	2. Years of Nursing Experience a. 0-5 years b. 6-10 years c. 11-15 years d. 16-20 years e. Over 21 years
3. Primary Role in Healthcare a. Educator (Academic & Staff development) b. Clinician/Practitioner c. Clinical Administrator d. Other, specify	4. On average, how many hours per month do you work at this hospital (please provide a number)? _____
5. What year did you start working at this hospital? _____	6. Race/Ethnicity a. Caucasian b. African-American c. American Indian/Alaskan Native d. Asian/ Hawaiian/Pacific Islander e. Hispanic f. Other, specify:
7. Gender a. Female b. Male	8. Highest Degree Earned a. Associates Degree/Diploma b. Baccalaureate c. Masters d. Doctorate e. Other, specify: _____
9. Does your hospital have Magnet Recognition Status? a. Yes b. No c. Application in progress d. Not affiliated with a hospital	10. Rate your EBP knowledge: a. No knowledge b. Beginning level c. Intermediate level d. Advanced level
11. What is your experience with EBP (e.g., committee work in an institution, continuing education program on EBP, formal coursework on EBP, taught an EBP course)? a. No experience b. Beginning level c. Intermediate level d. Advanced level	12. Rate your knowledge of the ACE Star Model of Knowledge Transformation: a. No knowledge b. Beginning level c. Intermediate level d. Advanced level

Appendix H: ERI Confidence Survey Tool©

EBP READINESS INVENTORY (ERI)
© Stevens 2018

This inventory will allow you to self-assess your confidence in Evidence-Based Practice (EBP) competencies.
Rate your confidence in your skill level for each of the following.
There are no right or wrong answers.

CIRCLE the number that represents your confidence that you can perform the activity.

CONFIDENCE
1 2 3 4 5 6
Very little — A great deal

I have confidence that I can:

Activity	Confidence (Very Little → A Great Deal)					
Define EBP in terms of evidence, expertise, and patient values.	1	2	3	4	5	6
Critically appraise original research reports for practice implications in context of EBP with assistance and existing standards.	1	2	3	4	5	6
Use pre-constructed expert search strategies (hedges) to locate primary research in major bibliographic databases.	1	2	3	4	5	6
Recognize ratings of strength of evidence when reading literature, including web resources.	1	2	3	4	5	6
Classify clinical knowledge as primary research evidence, evidence summary, or evidence-based guideline.	1	2	3	4	5	6
Locate systematic reviews and evidence summaries on clinical topics from specific evidence summary databases (e.g., Cochrane Database of Systematic Reviews).	1	2	3	4	5	6
Identify key criteria in well-developed evidence summary reports using existing critical appraisal checklists.	1	2	3	4	5	6
List advantages of systematic reviews as strong evidential foundation for clinical decision making.	1	2	3	4	5	6
Identify examples of statistics commonly reported in evidence summaries.	1	2	3	4	5	6
Identify the major facets to be critically appraised in clinical practice guidelines (CPGs) with assistance and existing criteria checklists.	1	2	3	4	5	6
Access clinical practice guidelines on various clinical topics using specified databases.	1	2	3	4	5	6
Participate on team to develop agency-specific evidence-based clinical practice guidelines.	1	2	3	4	5	6
Compare own practice with agency's recommended evidence-based clinical practice guidelines.	1	2	3	4	5	6

ERI Confidence Survey Tool© cont'd

Describe ethical principles related to variation in practice and EBP.	1	2	3	4	5	6
Participate in the organizational culture of evidence-based quality improvement in care.	1	2	3	4	5	6
Deliver care using evidence-based clinical practice guidelines.	1	2	3	4	5	6
Utilize agency-adopted clinical practice guidelines while individualizing care to client preferences and needs.	1	2	3	4	5	6
Assist in integrating practice change based on evidence-based clinical practice guidelines.	1	2	3	4	5	6
Choose evidence-based approaches over routine as base for own clinical decision making.	1	2	3	4	5	6
Participate in evidence-based quality improvement processes to evaluate outcomes of practice changes.	1	2	3	4	5	6

Appendix I: ERI EBP Knowledge Survey Tool©

Evidence-Based Practice (EBP) Knowledge Test

Select the **best** answer.

1. In EBP, which of the following is considered the strongest basis for clinical decision-making?
   A. Experience from routine daily patient care
   B. Summary of research generated knowledge
   C. Expert opinion regarding best patient care
   D. Results from a single research study

2. Systematic reviews are the result of:
   A. Randomized control design
   B. Synthesis of all research
   C. Case study
   D. Review of literature

3. The stronger level of evidence indicates:
   A. Greater confidence that the intervention is effective
   B. Larger sample was used
   C. Cost of change is too high to integrate
   D. Recommendation is based on expert opinion

4. The least clinically useful EBP resource on the internet is:
   A. Agency for Healthcare Research and Quality (AHRQ)
   B. The Cochrane Library
   C. National Guideline Clearinghouse
   D. Journal article on a clinical topic

5. The most rigorous systematic review on congestive heart failure would be found in:
   A. MedLine
   B. CINAHL
   C. The Cochrane Library
   D. Journal of Cardiology

6. The EBP skill of critical appraisal involves:
   A. Evaluating systematic reviews and guidelines
   B. Knowledge transformation
   C. Classifying strength of evidence
   D. Expert opinion

7. Which form of knowledge is most useful in the clinician's practice setting?
   A. Results from single research studies
   B. Systematic reviews
   C. Evidence-based clinical practice guidelines (CPGs)
   D. Patient outcomes

8. Which source of knowledge individualizes care during an evidence-based intervention?
   A. Clinical expertise to close the scientific gap
   B. Patient preferences
   C. Critical appraisal
   D. Primary research study

ERI-EBP Tool, Cont'd

9. Evidence-based practice (EBP) is defined as: Integrating…
   A. best research evidence into clinical practice.
   B. clinical expertise and research into practice.
   C. patient values and critical thinking into practice.
   D. best research evidence with clinical expertise and patient values.

10. In addition to overcoming barriers posed by large volumes of research, EBP also overcomes the 2nd barrier of:
   A. Understanding statistics
   B. Missing research
   C. Lack of funds
   D. Forms of knowledge unsuitable in care

11. According to the Stevens Star Model, what is the order of the five stages of knowledge transformation?
   A. Integration, Evaluation, Summary, Translation, and Discovery.
   B. Evaluation, Summary, Translation, Integration, and Discovery.
   C. Discovery, Translation, Integration, Evaluation, and Summary.
   D. Discovery, Summary, Translation, Integration, and Evaluation.
   E. I am not familiar with the Stevens Star Model.

12. The most reliable database for locating clinical practice guidelines (CPGs) on hand hygiene is:
   A. CINAHL
   B. MedLine
   C. Well-constructed literature search
   D. American Journal of Nursing

13. Translating evidence summaries into clinical practice guidelines (CPGs) may require:
   A. Asking the patient about preferences
   B. Increasing the rate of adoption
   C. Incorporating expert opinion when research is absent
   D. Searching CINAHL for quality measures

14. Evaluation of impact of evidence-based quality improvement...
   A. Guides adoption
   B. Focuses on service outcomes and patient outcomes
   C. Is not necessary
   D. Is done only at the national level

15. When an evidence-based clinical practice guideline (CPG) is introduced to the nursing unit, the following can be expected:
   A. Improvement will be resisted
   B. Cost benefit will be gained
   C. Nurses are all early adopters
   D. Change is readily made

Appendix J: Permission for Survey Tool Use

RE: [EXTERNAL] RE: RE: ERI Survey Tool Permission

Stevens, Kathleen R <STEVENSK@uthscsa.edu>
Mon 6/22/2020 2:17 PM
To:

- Wyman, Jessica <jessica_wyman@mymail.eku.edu>

Best of luck!! K

2020 Year of the Nurse—We Work Together
...to the best of our knowledge
Dr. Kathleen R. Stevens, RN, EdD, ANEF, FAAN
Castella Endowed Distinguished Professor
210.567.3135 CELL 210.502.8355
UT Health San Antonio MSC 7949
7703 Floyd Curl Drive
San Antonio, TX 78229-3900
The best way to predict the future is to create it.
--Peter Drucker

From: Wyman, Jessica <jessica_wyman@mymail.eku.edu>
Sent: Monday, June 22, 2020 6:31 AM
To: Stevens, Kathleen R <STEVENSK@uthscsa.edu>
Subject: RE: [EXTERNAL] RE: RE: ERI Survey Tool Permission

Good Morning Dr. Stevens,

Thank you so much for your support, and the use of your survey instruments in my DNP project – I appreciate it! I will keep you posted as to how everything goes, and will complete and return the codebook when I am finished with my data analysis.

Take care,

Jess Wyman

Sent from Mail for Windows 10

From: Stevens, Kathleen R
Sent: Sunday, June 21, 2020 5:33 PM
To: Wyman, Jessica
Subject: [EXTERNAL] RE: RE: ERI Survey Tool Permission

Hi, Jessica...
In addition to the previous 3 attachments...
Attached is the information you will need to 'score' the ERI and Knowledge Test component.

Let me know how I can help...
MY BEST. DrS

2020 Year of the Nurse—We Work Together
...to the best of our knowledge
Dr. Kathleen R. Stevens, RN, EdD, ANEF, FAAN
Castella Endowed Distinguished Professor
210.567.3135 CELL 210.502.8355
UT Health San Antonio MSC 7949
7703 Floyd Curl Drive
San Antonio, TX 78229-3900
The best way to predict the future is to create it.
--Peter Drucker

From: Wyman, Jessica <jessica_wyman@mymail.eku.edu>
Sent: Sunday, June 14, 2020 10:11 AM
To: Stevens, Kathleen R <STEVENSK@uthscsa.edu>
Subject: RE: RE: ERI Survey Tool Permission

Good Morning Dr. Stevens,

I am just following up on my last two emails regarding use of the EBP ERI Survey Tool in my DNP work. I am preparing to assemble the components of my IRB that is required be Eastern Kentucky University and will need to submit copies of the surveys.

Thank you for your time,

Jessica Wyman
Eastern Kentucky University
DNP Student

From: Wyman, Jessica
Sent: Thursday, June 4, 2020 7:23 AM
To: Stevens, Kathleen R
Subject: RE: [EXTERNAL] RE: ERI Survey Tool Permission

Good Moring Dr. Stevens,

I am following up on my last email where I indicated my agreement to your terms required to utilize the EBP ERI survey tools in my DNP work. Please let me know if there is anything else that you require from me.

Thank you! I look forward to hearing from you,

Jess Wyman
Eastern Kentucky University
DNP Student

Sent from Mail for Windows 10

From: Stevens, Kathleen R
Sent: Saturday, May 30, 2020 11:06 AM
To: Wyman, Jessica
Subject: [EXTERNAL] RE: ERI Survey Tool Permission

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Greetings, Jessica....
It is an honor to hear that you wish to use my work to further EBP in your work!
I see a growing national/international/global use of my work:

1. The Stevens Star Model of Knowledge Transformation;
2. the National Consensus on EBP Competencies; and
3. the EBP Readiness Inventory.

This interconnected suite of theory, competencies, and measures offers a strong approach to advance EBP: assessing readiness, planning educational interventions, and framing the theory.

I have attached the Stevens Star Model that was used to develop the foundation of the ERI and indicate my permission to use the Model under copyright fair use...please cite that is was 'used with permission.'

I will grant permission to use the EBP Readiness Inventory for your project after we have agreed upon several points of collaboration. (See below)

I am interested in the continued refinement of the psychometrics of the instrument and this will assist.

To that end, I am hopeful that you will contribute your de-identified data to our growing database.

Please indicate your agreement. I will send to you the EBP Readiness Inventory (Clinician Basics) when I hear from you.

USE AGREEMENT

EVIDENCE-BASED PRACTICE READINESS INVENTORY (COPYRIGHT Stevens 2017)

Please indicate your agreements to these items:

ERI AGREEMENT AND PERMISSION

Dr. Stevens will provide permission and the ERI Tool upon RECEIPT OF YOUR AGREEMENT TO THE 9 ITEMS BELOW.

Upon receipt of your agreement, Dr. Stevens will send to you the Clinician Basic ERI which includes

1. 20 items on competency/"self-efficacy" (strongly related to actual skill);
2. 15 items on "EBP knowledge" and
3. a demographics page.

PERMISSION FOR USE:

The EBP Readiness Inventory (ERI) is based on the *Essential Competencies* and framed in the Star Model. The ERI is comprised of self-efficacy section (research connects self-efficacy to actual competencies) and a knowledge section (based on the Star Model). Past use of the ERI suggests that it is reliable, valid, and sensitive enough to detect pre-post differences.

I propose that you and I reach these terms of agreement for your use of the ERI—please respond with your acceptance and I will send you the ERI TOOL, scoring guide, and Excel data template.

1. To activate my permission, you agree to contribute to me your de-identified data set for each use. Otherwise, we can arrange a fee-for-use agreement. I continue to assess the psychometrics so the data may be aggregated with other datasets for this purpose. The user agrees to submit ERI data using the XL file that Dr. Stevens will send you for this purpose.
2. There are 3 levels of competencies, as explained in the Essentials document: Basic (BSN), intermediate (MSN), and advanced (Doctoral). The ERI items reflect the competencies in a self-efficacy Likert format. The ERI also includes a 15-item Knowledge Test.
    a. Most users to date have administered the "basic" ERI, which contains 20 Likert items, the knowledge test, and a demographics section.
    b. The ERI can be administered in paper-pencil format or online survey. I no longer provide the online version…but feel free to use it if you can overcome the barriers to accessing your study participants.
3. The ERI should be used in its original form, as-is, without modification of the items in order to benefit from the reliability and validity. You may add a few items to the demographics section for your use.
4. Notify me each time the ERI is used beyond your initial project; describe the situation and population.
5. Please provide a brief (1-page) report of your study. Is it funded? By whom?
6. Kindly notify me when your project is published. I would enjoy seeing the article and would consent to being acknowledged (not as an author).
7. Do you anticipate acquiring approval for protection of human subjects?
8. Upon your acceptance of these terms of agreement, I will send a MS Word copy of the ERI you select (basic, intermediate, or advanced survey); knowledge test; and permission for duplication and use online or hard-copy).

9. There will be no charge and no requirement to purchase the use of the ERI if you can agree to this collaboration.

BACKGROUND:

The interconnected "suite" of EBP materials I developed are described below-Star Model, EBP Competencies, and the ERI:

A. The Stevens Star Model is attached…it is the core of understanding "knowledge transformation"; details can be organized around each point of the star. Anticipating you may want to incorporate the Star Model into your project, I am jumping ahead and providing permission to you to use/reproduce the Star Model under the fair-use rule, with the stipulation that credit is cited, as you indicated. If later, you are re-publishing the copyrighted material (as in publishing in a journal or book), specific permission is required by the publisher. In that case, there is usually a template letter of permission from the publisher that I will readily sign.

B. The Star Model provides the theoretical basis for the national consensus on *Essential EBP Competencies in Nursing* (2005 and 2009); it is reviewed annually and remains contemporary. If you're interested in ordering an Essential Competencies booklet, just let me know and I will send the order form ($30). If you decide to use the ERI in your project, I will send you a PDF of the booklet at NO CHARGE.

C. The EBP - Readiness Inventory (ERI) was developed based on the consensus *Competencies.* The ERI is a self-efficacy and knowledge instrument, shown to have strong psychometrics. It is currently being used in multiple studies by others. As you know from the literature, a number of clinical agencies and academic institutions have benefitted from using the ERI. The survey can be administered via paper-and-pencil or online and has been used to assesses EBP Readiness in both clinician and student populations. As you develop your proposal, you may wish to state that the ERI was developed within a theoretical framework: The Stevens Star Model of Knowledge Transformation. To my knowledge, this is the only EBP instrument that was developed with such a direct theoretical base and national consensus on EBP competencies.

Also, you may have located descriptions of the Model and EBP Readiness Inventory (ERI) in several places…here are a few:

- Here is a recent YouTube interview done by Boston Childrens Hospital... 38 minute interview from OpenPediatrics July 2019, entitled, The Stevens Star Model of Knowledge Transformation to Improve Care and Outcomes, available at https://www.openpediatrics.org/assets/video/stevens-star-model-knowledge-transformation-improve-care-and-outcomes
- Stevens, KR. (2013). The impact of evidence-based practice in nursing and the next big ideas. Online Journal of Nursing Issues. 8 (2), 4. (open access) http://www.nursingworld.org/MainMenuCategories/ANAMarketplace/ANAPeriodicals/OJIN/TableofContents/Vol-18-2013/No2-May-2013/Impact-of-Evidence-Based-Practice.html

- Saunders, H., Stevens, K. R., & Vehviläinen-Julkunen, K. (2016). Nurses' readiness for evidence-based practice at Finnish university hospitals: a national survey. Journal of advanced nursing. 29 MAR 2016. doi: 10.1111/jan.12963
- Scientists like yourself and doctoral students have completed their studies and DNP and PhD using the EBP Readiness Inventory...so you can have added confidence in moving forward with it.

WILL YOU BE USING ANY OTHER EBP MEASURE?
I look forward to working with you as you continue to advance EBP through your DNP!

Happy Nurses Month—We Work Together
...to the best of our knowledge
Dr. Kathleen R. Stevens, RN, EdD, ANEF, FAAN
Castella Endowed Distinguished Professor
210.567.3135 CELL 210.502.8355
UT Health San Antonio MSC 7949
7703 Floyd Curl Drive
San Antonio, TX 78229-3900
The best way to predict the future is to create it.
--Peter Drucker

From: Wyman, Jessica <jessica_wyman@mymail.eku.edu>
Sent: Wednesday, May 27, 2020 6:03 AM
To: Stevens, Kathleen R <STEVENSK@uthscsa.edu>
Subject: ERI Survey Tool Permission

Good Morning Dr. Stevens,

I am writing to you in hopes of obtaining permission to use your Basic EBP Readiness Inventory (ERI) survey tool, and the Stevens Star Model of Knowledge Transformation to support and guide the implementation and assessment of my DNP project work. I am a Doctoral student at Eastern Kentucky University and my project focus is to improve emergency department nursing ability to recognize and accurately triage and treat victims of smoke inhalation. This is an evidence-based project that involves development of a diagnostic and treatment algorithm to guide nursing assessment of this unique cohort of patients and your ERI Survey tool would provide pre- and post- didactic assessment of knowledge and self-efficacy.

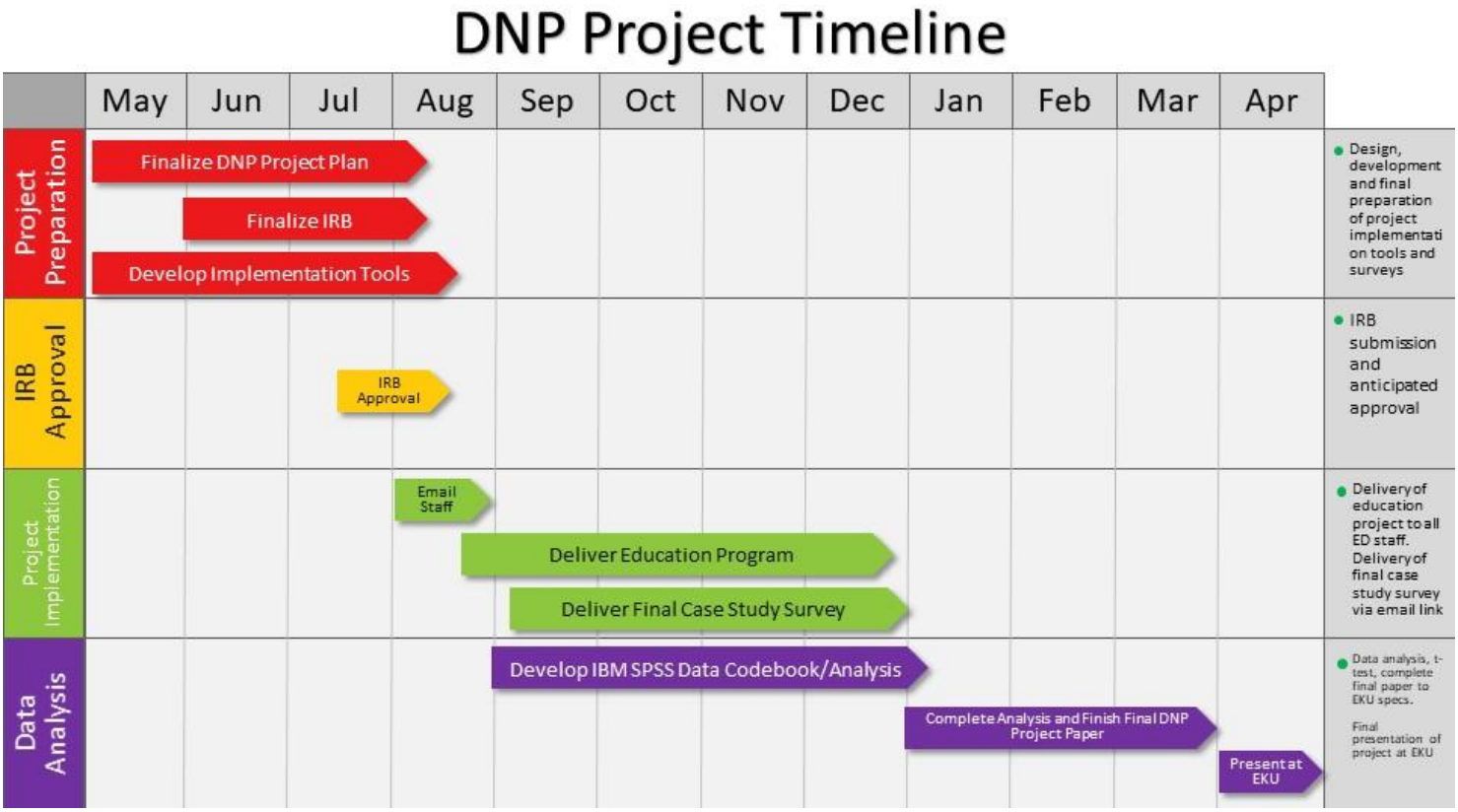
I very much appreciate your time and consideration of permission-for-use of the tool in my DNP project implementation in the Fall. Please let me know if you have any questions about my project or use of the survey tool or Stevens Star Model of Knowledge Transformation.

I look forward to hearing from you!

Respectfully,

Jessica Wyman
Eastern Kentucky University
DNP Student

Appendix K: GANTT Project Timeline



Appendix L: Case Study Example

Case Study #1

EMS calls as they leave the scene of a vehicle fire on a local side street. They advise you that they are enroute with an approximate 22 y/o male pulled from a burning vehicle by bystanders after the vehicle struck a telephone pole. They estimate the victims has suffered approximately 14% burns to the chest and anterior arms and he appears to have soot on his face with singed nasal hairs and carbonaceous sputum. He has spontaneous labored rhonchorous respirations. He is not intubated as they are around the corner from the hospital.

VS as follows: BP 88/48 HR 62 RR16 assisted by BVM (underlying rate of 5-6 breaths/min), GCS: E2 V2 M4 = 8 Initial POX 72%. POX w/BVM 88%.

What ESI triage category would you assign?

1. Level 1
2. Level 2
3. Level 3
4. Level 4
5. Level 5