Advancing Support for Bronchiolitis Patients in Rural Communities With Simulation Training

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I have no known conflict of interest to disclose.

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Abstract

Annually, bronchiolitis impacts 40% of children under 2 years of age. Acute respiratory failure (ARF) is a significant concern for pediatric patients who present with bronchiolitis. When response times are delayed or patients receive inappropriate interventions, ARF can lead to poor outcomes and higher mortality. Nurses who do not routinely care for high-acuity pediatric patients feel unprepared to care for them when they develop ARF. This quality improvement project aimed to improve nurse (RN) readiness when caring for pediatric patients experiencing ARF in a rural community hospital. We evaluated the standard of care and measured change to R.N. self-efficacy longitudinally with training in the bronchiolitis disease process, a predictive respiratory status score (ROX), and standard communication strategies (SBAR). Using a standardized and validated basic resuscitation skills self-efficacy scale, two-tailed Wilcoxon signed rank tests and two-tailed paired samples t-tests were analyzed and identified a significant change in pre-post intervention self-efficacy for assessment of the patient condition with alpha value of 0.05, V=6.50, z=-2.14, p=0.032, factor 2, Resuscitation actions with alpha value of 0.05, V=6.50, z=-2.14, p=0.032, and employment of defibrillation with alpha value of 0.05, V=5.50, z=-2.45, p=0.014. Using a tiered skill acquisition model with simulation training, ROX scoring, and SBAR training improved nurse self-efficacy for caring for patients experiencing respiratory decompensation.

Keywords: Simulation, bronchiolitis, pediatric, nurse.

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Providers in rural communities face unique challenges, specifically regarding advanced and specialty services. Without comprehensive local healthcare, communities may face increased costs, healthcare delays, and family displacement. Community hospitals may find that as the population grows, advanced medical services are needed to meet the growing demand in the community. Advancing services also requires the elevated skills of nursing staff for increasingly complex and unstable patients.

Problem Statement

Bronchiolitis is a common viral lower respiratory ailment in children and presents as fever, congestion, cough, and dyspnea that could progress to respiratory failure. Most children experience an uncomplicated course of disease, but approximately 100,000 children annually require hospitalization for respiratory failure (Lee & Meliones, 2021). Patients with bronchiolitis may require escalation of care if their condition deteriorates. Rural community hospitals without a pediatric intensive care unit (PICU) may be ill-prepared to meet the healthcare needs of a deteriorating patient if they do not encounter these scenarios regularly. Bronchiolitis, the leading cause of hospitalization in children, costs $1.7 billion annually (Wolf et al., 2021; Suessman et al., 2020; O'Brien et al., 2019; Dadlez et al., 2019).

In a large retrospective study of 177,344 children aged 0-23 months diagnosed with bronchiolitis, 41% lived in rural settings, 33% lived in suburban settings, and 26% lived in urban settings (Wolf et al., 2021). Wolf et al. (2021) identified that children seeking care in a rural setting were also prone to receiving care for bronchiolitis that did not meet current guideline standards, and care variation exists widely based on the care venue. Slain et al. (2019) report bronchiolitis as a condition whose progression to unfavorable outcomes can be challenging to predict with variable interventions ranging from minimal support, to simple supplemental oxygenation, or full airway support including extracorporeal membrane oxygenation. In a descriptive retrospective study in a community hospital, 157 patients were admitted with bronchiolitis, of which 34 patients required pediatric intensive care unit (PICU) support (21%), including four (2.5%) patients who required invasive airway management (Van Winkle et al., 2021). Studies completed in large urban children's hospitals report that 10-15% of children with bronchiolitis require invasive airway management (Suessman et al., 2020; Slain et al., 2019). The unpredictability and variability of the condition create challenges for hospitals that do not have systematic methods of treating these patients. Hospitals with structured protocols for advancing and maintaining staff competency for treating critically ill patients experience shorter time to oxygen weaning, improved length of stay, and better outcomes (Bennett et al., 2021; Wiser et al., 2020). Finally, Franklin et al. (2019) identified cost savings for families, facilities, and communities that use advanced modalities in lieu of tertiary transfer.

Purpose and Rationale

Patients with bronchiolitis can experience unpredictable disease progression, and general pediatric ward staff may not be exposed to situations involving patient decompensation often enough to build confidence in nursing actions. Fluctuating changes to patient stability can create safety concerns and be traumatic for nursing staff. Having clinically prepared and confident nurses promotes optimal patient outcomes, decreases delay to treatment, reduces external transfers, decreases costs, and fosters family unity when pediatric patients can be safely treated in a rural hospital. This project explored the opportunities to improve nursing staff competency in recognizing, communicating, and managing pediatric bronchiolitis on the general pediatric floor.

Background and Significance

Bronchiolitis is the most frequent cause of hospitalization and the most prevalent lower respiratory tract disorder in children less than 2 years old, both nationally and internationally (Slain et al., 2019; O'Brien et al., 2019; NICE, 2021; Pelletier et al., 2021). The incidence of bronchiolitis is estimated at 40% of all children under two (Fujiogi et al., 2019). In a retrospective study of 203,000 patients, authors confirmed that 18% of all patients with bronchiolitis required hospitalization (Pellitier et al., 2021). Up to 15% of patients with bronchiolitis may require respiratory support, and the global mortality rate for bronchiolitis is estimated at 200,000 deaths per year in children less than 2 years old (Luo et al., 2019). While the overall incidence of bronchiolitis is on a 20-year decline, the hospital length of stay, ventilatory support requirements, and cost of care are sharply increasing (Fujiogi et al., 2019). The American Academy of Pediatrics (AAP) has published clinical guidelines for the treatment of bronchiolitis (Ralston, 2014), and the United Kingdom and Australia have also published bronchiolitis guidelines that are consistent with the current AAP guidelines (O'Brien et al., 2019; National Institute for Health and Care Excellence [NICE], 2021).

Population

Nursing staff that infrequently experience acute patient deterioration may be ill-prepared to recognize the changing patient condition, communicate effectively, and intervene appropriately. Most children with bronchiolitis have a mild disease, but the course can be unpredictable, and many children require hospitalization and advanced forms of oxygenation and ventilation support (Dadlez et al., 2019; Hoefert et al., 2022; NICE, 2021; Pelletier et al., 2021). Rapidly changing disease patterns create challenges for appropriate patient placement within the hospital and concerns about staff competency in caring for patients that could decompensate. Slain et al. (2019) identified that a general pediatric ward could manage most patients. However, pediatric nurses require confidence in managing potentially unstable patients, including competency with advanced forms of ventilatory support, appropriate skills, and confidence in recognizing signs of decompensation. The American Heart Association (2020) has identified response time, responder confidence, and skill when addressing medical emergencies as critical components of survivability in cardiopulmonary emergencies. In a recent studies, Bennett et al. (2021) and Raab et al. (2024) identified nurses' delay in initiating basic skills in patient deterioration, especially in units that infrequently experienced patient emergencies. While pediatric nurses routinely care for patients with bronchiolitis, the unpredictability of the illness trajectory can produce uncertainty regarding professional skill and competence in providing high-quality nursing care for these children.

Interventions

Multidisciplinary simulation training can improve nursing confidence in managing scenarios involving patient condition change and decompensation (Saqe-Rockoff et al., 2019; Dadlez, 2019; Bennett et al., 2021; Raab et al., 2024). Some specific practice gaps identified by simulation include locating equipment, medication administration accuracy, communication patterns in an emergency, and knowledge base for expected pediatric vital signs (Saqe-Rockoff et al., 2019; Dadlez, 2019; Bennett et al., 2021; Raab et al., 2024). Administrative improvements exist with the opportunity for resuscitation space organization, interdisciplinary communication ease, and supply availability (Saqe-Rockoff et al., 2019). Simulation improves skills, but competence and confidence can deteriorate within weeks (American Heart Association, 2020), so the frequency of skill practice is essential (Bennett et al., 2021; Raab et al., 2024; Hernandez-Padilla et al., 2016).

Using a standard communication method is a proven strategy for ensuring safety and continuity in patient care. A well-studied intervention to support team communication is the SBAR (situation, assessment, background, recommendations), a format of concisely communicating patient needs (Noh et al., 2021; Al-Kalaldeh, 2022). Using this format within the venue of high-stakes simulation training improves skills for communicating in critical situations, grows assertiveness, and builds confidence (Noh & Kim, 2021). Improved interdisciplinary communication has remained a national patient safety initiative for its importance in effective care (The Joint Commission, 2022).

Using an objective assessment score that can quantify patient severity or predict the need for care escalation has been shown to objectify patient assessment, evaluate clinical response to treatment, and guide research. Various scales stratify the severity of symptoms to mild, moderate, or severe based on objective findings of patient behavior, respiratory rate, use of accessory muscles, oxygen saturation, and requirement, apneic episodes, and feeding (O'Brien et al., 2019; Dadlez et al., 2019; Suessman et al., 2019; Siraj et al., 2021; Hansen et al., 2019). The at-risk for Pediatric Acute Respiratory Distress Syndrome scale (ar-PARDS) identifies children that are 20 times more likely to develop Acute Respiratory Distress Syndrome (ARDS) and a 10-fold higher likelihood of the need for mechanical ventilation (Slain et al., 2019). The Critical Bronchiolitis Score (CBS) is a validated tool for predicting bronchiolitis severity, PICU-level respiratory support needs, and length of stay (Mount et al., 2021). Other calculations are widely accepted for objectively quantifying clinical severity and the need for support escalation. Calculating the oxygen saturation with the fraction of inspired oxygen (P.F. ratio), or the ratio of oxygen saturation (ROX), which involves using the P.F. ratio with the respiratory rate, can predict heated humidified high flow nasal cannula (HHFNC) failure (Kim et al., 2022; Kim et al., 2021). While scoring tools are valuable to frontline staff, they are sensitive to interrater variability that can drive down reliability (Siraj et al., 2021). A key consideration in implementing any tool should be ensuring the end user has training and that it is used in conjunction with clinical reasoning (Hakizimana et al., 2021).

Institution of unit-based protocols for using noninvasive positive pressure ventilation in the general ward are effective. Hansen et al. (2019) identified that initiating protocols for HHFNC on the ward has also shown promise in reducing PICU admissions by 44% and identified safety structures to guide protocolized patient reassessment. Van Winkle et al. (2021) recommend unit-based protocols that guide patient placement decisions based on acuity and support needs. Early initiation of HHFNC can offer patients support with oxygenation and ventilation and decrease escalation (Franklin et al., 2018). A multi-pronged approach to improving nurse competency and confidence for assessment and care of the decompensating bronchiolitis patient via simulation-based training, objectifying assessment findings, new communication strategies, and unit-based acuity and placement protocols will enable the rural hospital to elevate the acuity level of patients in the unit safely.

Comparison/Current State

Rural community hospitals without pediatric intensive care competency frequently transfer all moderate and high acuity patients to tertiary care before clinical decompensation. Nurses in these environments must remain certified in Pediatric Advanced Life Support (PALS), but the recertification requirement is infrequent and usually does not incorporate simulation for recertification. With the infrequency of nurses experiencing high acuity patient situations, they may experience atrophy of clinical assessment and response skills necessary to care for critically decompensating patients.

Outcomes

Using noninvasive positive pressure ventilation on the regular pediatric ward is safe. (Dadlez et al., 2019). In a large cohort study, researchers identified that 13% of patients admitted to the general pediatric ward required HHFNC, of which 41% later required transfer to the PICU for closer monitoring. They found that 58% of those transferred to the PICU required escalation of respiratory support following the transfer with no adverse outcomes for the population (Dadlez et al., 2019). Another study of 157 children identified that 34 (21.7%) children receiving HHFNC in the general ward required PICU admission within 24 hours of starting HHFNC (Van Winkle et al., 2021). Four (2%) individuals required endotracheal intubation, and none experienced adverse outcomes. A small study in rural Alaska indicated that air transport of patients on noninvasive positive pressure ventilation was safe should the pediatric patient in a rural setting need escalation to tertiary services (Roy et al., 2021).

The review indicates that patients can be safely cared for in a general pediatrics unit, but the patient population may require escalation of care. Patients requiring escalation require staff confidence in recognizing deterioration, communicating these findings, and providing appropriate interventions during care escalation. Advancing nurses' skill set in a general pediatrics unit can be successful using simulation-based experiences, implementing tools that aid the unit in recognizing patients at risk for respiratory failure, and implementing protocols to aid decision-making on the unit, which can improve health outcomes for patients experiencing acute bronchiolitis illness.

Internal Data

In a rural Arizona community hospital, frequent emergency transfers to a higher level of care negatively impact patients, families, staff, and the hospital. The hospital's capacity includes 406 acute care beds, a 42-bed adult intensive care unit, adult surgery, and a comprehensive cardiovascular care program. The hospital serves predominantly minority, underserved, underinsured, and transient populations. Additionally, the hospital maintains general pediatric surgery, a newborn nursery, and a neonatal intensive care unit with 20 beds. Acute care pediatric services in this community consist of a general pediatric ward licensed for 22 beds. The hospital has no PICU; this service line is currently under development. Between October 2021 and October 2022, 37 patients were admitted with bronchiolitis. Any patients diagnosed with bronchiolitis requiring oxygenation using more than the standard nasal cannula were transferred via fixed wing or helicopter to the nearest urban PICU, 185 miles away. Transportation companies in this region cannot support children on noninvasive positive pressure ventilation. Patient oxygenation and ventilation needs cannot exceed a standard nasal cannula, or children are required to have endotracheal intubation for transportation to the tertiary care center. Because the unit cannot initiate noninvasive positive pressure, any children who are perceived to be decompensating have a transfer initiated while still requiring nasal cannula oxygenation. Anecdotally, this strategy results in delayed implementation of NIPPV and an earlier and greater quantity of transfers than is necessary.

The organization is focused on providing service to the community and wants to use advanced non-invasive positive pressure ventilation modalities with general pediatric patients rather than transferring them to a tertiary care facility. They hoped to explore best practice methods to improve nurse's competency and self-efficacy for caring for patients with bronchiolitis.

PICOT Question

A thorough review of the literature has led to the clinically relevant question. In acute care nurses caring for patients with impending respiratory failure (P), how does education with simulation (I) compared to education alone [no simulation] (C) affect assessment of respiratory decompensation, communication with healthcare provider teams, and perceived self-efficacy (O)?

Search Strategy

A thorough review of the literature was conducted to evaluate this PICO question using the COCHRANE database, PubMed, and CINHAL. Concepts were developed for the PICO that included nurses caring for patients admitted with pending respiratory failure, education with simulation, knowledge for recognizing respiratory failure, communication of assessment findings, and perceived self-efficacy in managing acute decompensation. These databases are highly regarded in the medical community for their inclusivity of quality medical publications. Databases were selected for their relevance in acute decompensation, medical management of bronchiolitis, and impacting nursing efficacy via simulation. Primary research was the focus of the initial searches, and high level (I-IV) was the concentration in the initial phases of this literature review.

Keyword Selection

Cochrane

Initial Cochrane database search included the keywords: high fidelity simulation training AND nurses AND self-efficacy with limitation to title, abstract, or key word. This search yielded 14 trials and no other resources. Subsequent search used keywords: Nurse or nurses or nursing or registered nurse or healthcare professional or healthcare worker or acute care AND respiratory or code or CPR or cardiopulmonary or acls or resuscitation or emergency AND high fidelity or mock code or simulation training or simulation education or simulation learning or simulation or “education with simulation” AND confidence or self-esteem or self-efficacy or competence or self-sufficiency. This search denoted these words to be in the title, abstract, or keywords. Limitations included publication date from January 2019 to present. Return parameters included Cochrane reviews, Cochrane protocols, trials, clinical answers, editorials, special collections, word variations were allowed. This search yielded 76 trials, and no other returns. Subsequently, Cochrane database search was applied with keywords: Simulation training OR simulation education. Limitations set to 2019 to present and limited to Cochrane reviews, Cochrane protocols, trials, clinical answers, editorials, or special collections with word variations enabled. This strategy yielded two applicable Cochrane reviews and 1700 trials. Finally, Cochrane search was applied using keywords: high-fidelity OR mock code OR simulation training OR simulation education OR simulation Learning OR simulation OR "education with simulation" in resource keyword, limited to publication date January 2019 to present. Literature type limited to Cochrane reviews, protocols, trials, clinical answers, editorials, or special collections. This search yielded 5,958 trials and three applicable Cochrane reviews.

Pubmed

Pubmed search strategies included initial keyword search for CPR AND nurses AND simulation AND self-efficacy with no limiting parameters. This search yielded 16 articles. With the application of "in the last five years" parameters, yielded 8 articles. Search strategy was expanded to include keywords: Nurse or nurses or nursing or registered nurse or healthcare professional or Healthcare worker or acute care AND respiratory or code or CPR or cardiopulmonary or ACLS or resuscitation or emergency AND high fidelity or mock code or simulation training or simulation education or simulation learning or simulation or "Education with simulation" AND confidence or self-esteem or self-efficacy or competence or self-sufficiency with limitations to articles in the last 5 years, and yielded 715 articles. This strategy was further limited to NOT include keywords student or students, further narrowing the findings to 168 articles. Finally, this final combination was further limited to randomized controlled trials and yielded 15 articles.

CINAHL

CINAHL search strategy mirrored the PUBMED strategy with initial search strategies including keyword search for cpr AND nurses AND simulation AND self-efficacy with no limiting parameters. This search yielded four articles. Search strategy was expanded to include keywords: Nurse or nurses or nursing or registered nurse or healthcare professional or Healthcare worker or acute care AND respiratory or code or CPR or cardiopulmonary or ACLS or resuscitation or emergency AND high fidelity or mock code or simulation training or simulation education or simulation learning or simulation or "Education with simulation" AND confidence or self-esteem or self-efficacy or competence or self-sufficiency and NOT student OR students without publish date restrictions yielded 181 articles. Applying restrictions to publish dates 2019-present yielded 80 articles. Finally, this final combination was further limited to full text availability and yielded 25 articles.

Limitations, Inclusion, and Exclusion Criteria

Limitations were placed on searches to exclude keywords *student* from the search strategy because this project concentrated on nurses, at least at the novice level of practice. Research on this subject is ongoing and up to date; therefore, time parameters of articles published from 2019 to 2024 were applied. Other database-specific inclusions are discussed in the search strategy.

Critical Appraisal and Synthesis of Evidence

Articles were appraised for inclusion in this investigation. The strength of evidence included one level II randomized controlled trial, two level III well-designed non-randomized but controlled trials, and seven level IV well-designed cohort studies. The evidence was appraised using standard rapid appraisal tools (Melnyk & Fineout-Overholt, 2019). The studies selected were all peer-reviewed and of significant power (see Table A1). All studies selected had replicable processes and a high degree of detail provided in their processes. All studies demonstrated the feasibility of replication in this environment. Some evidence evaluates simulation with standard communication separately from the utility of a standard assessment score to understand the best practice strategies within these multiple components (See Tables A1 and A2). For some studies, the subject is a nurse learning a new professional strategy; for others, the subject is a pediatric patient suffering an ailment that benefits from a standard assessment score and a systematic approach to care (See Table A1). All studies share the theme of critical patient decompensation and the strategies and actions a clinician can employ to stabilize the patient rapidly. (See Tables A1 and A2).

Discussion

Based on the evidence reviewed, one can conclude the unpredictability of this patient disease process, the importance of nursing staff preparation, and the morbidity associated with uncoordinated or ineffective response to respiratory decompensation in the pediatric population. Nursing preparedness impacts patients' morbidity, especially in the event of decompensation. Simulation is a critical nursing strategy to increase bedside efficacy. Measuring self-efficacy and essential tasks taken in a simulation indicate skill maturation. Few validated tools are available for the pediatric population, but using scores that evaluate respiratory decompensation provides objective data. This strategy benefits nursing staff caring for increasingly ill and unpredictable patient populations as they grow their experiential decision-making skills. In synthesizing evidence, this issue will benefit from this multi-pronged intervention.

Theory/Theoretical Framework Application

Experiential learning theory and Jeffries model of simulation education apply cohesively to this intervention (Jeffries, 2015). Clinical persons experience scenarios through their expertise, culture, and clinical exposure. By immersive exposures, either in actual or simulated encounters, clinical personnel can realize the intellectual and psychological aspects of a patient scenario and bring these experiences with them as tools throughout future exposures (Mukhalalati & Taylor, 2019; Kolb & Kolb, 2013; Lavoie et al., 2018). The experiential learning theory emphasizes that learning is done continuously through experiences and relearning in synergy with the environment (Kolb, 1984; Kolb & Kolb, 2013). The experiential learning cycle (Figure B1) depicts this process as a repeating cycle of concrete experience, reflective observation, abstract conceptualization, and active experimentation (Kolb & Kolb, 2013). The National League for Nursing supports the Jeffries simulation model and emphasizes context, background, design, and the dynamic process of delivering the experience to learners within an environment of trust and collaboration (Figure B2). The Jeffries model and the experiential learning model are synergistic because, while the experiential learning model focuses on the individual behind the intervention, the Jeffries model further details the environmental control and outcomes aspects. These models are a framework for experience growth via simulation as an educational tool for new skills in this unit. By allowing nurses to experience new problems in a safe learning environment, they will grow skills, test innovative ideas, and identify workplace problems without the pressure of human lives being at stake.

Implementation Framework

The ACE Star quality improvement model is widely used in healthcare initiatives and clinical education and thus works well with the above-stated theories (Schaffer, 2013). The implementation framework is appropriate because it has foundations in education and bedside nursing practice change, focusing on change adoption, nursing competency, and self-efficacy growth (Schaffer, 2013). Congruent with the model, the implementation will consist of the discovery of best practice evidence regarding the intervention, summarizing the evidence, translating the evidence into unit culture-appropriate interventions, integrating the new practice into the culture, and evaluating the outcomes of the intervention in this practice setting (Kring, 2008; Schaffer, 2013; Dang et al., 2019). (See Figure B3.)

Methods

Ethical Considerations and Human Subject Protection

Institutional approval for the project was achieved via the Hospital Innovation Council Advisory Board and was deemed exempt from Institutional Review Board (IRB) review. IRB approval was achieved through the Arizona State University standard review process before project initiation.

In compliance with the Belmont Report (National Commission, 1979), four ethical principles guided this project: Autonomy, justice, beneficence, and non-maleficence.

Autonomy is the right of patients to determine their goals and decide if participation in the project aligns with those goals. It entails the right to self-determination (Barrows et al., 2023). The project adhered to this principle by recruiting voluntary subjects via non-coercive methods and ensuring adherence to standard informed consent procedures (Barrow et al., 2023). Attention to the principle of autonomy is pertinent to this project because the project takes place in the workplace, and issues of subject vulnerability exist for this population (Rose & Pietri, 2018).

Justice pertains to the equally distributed benefits and risks a person may endure (National Commission, 1979). The project adhered to this principle by offering participation to all staff members with attention to the risk of injustice lying with subjects working varied shifts or infrequently. Justice is pertinent to this project because the population benefits from the intervention equally and did not miss the opportunity to share the benefits based on their work schedule.

Beneficence is ensuring the wellness and safety of a person while acting to help them (Barrow et al., 2023). The project adhered to this principle by focusing the interventions on positive learning strategies that foster growth, acceptance, and safety for learning, innovating, and trialing mistakes. Beneficence is pertinent to this project because the wellness of subjects is essential to the intervention’s overall effectiveness and the unit’s potential growth.

Non-maleficence ensures that no harm is done and that a person is not exploited (Barrow et al., 2023). The project adhered to this principle by analyzing potential risks to subjects. Non-maleficence is pertinent to this project because simulations can be stressful, and subjects could experience embarrassment or anxiety related to scenarios. Project leaders ensured minimizing these risks by fostering a safe learning environment and building on subjects' previously learned experiences and skills per the frameworks employed in this project (Jeffries et al., 2015; Kolb & Kolb, 2013). Non-maleficence also applies to this project's sensitivity in the workplace. Confidentiality and privacy of subject data were strictly ensured, and participation in the project carried no employment consequences (Rose & Pietri, 2018).

Consent by the subjects was obtained via standard institutional protocols for this type of project as determined by the internal review board. The standard process of informed consent consisted of proving necessary information to subjects in a manner understandable to them, answering questions, ensuring subjects had time to consider their decision for participation, and then giving voluntary agreement. The process of informed consent concluded with documenting affirmation. (Hicks, 2019). Subject rights consist of the right to self-determination (Barrow et al., 2023). Ensuring these rights are met, subjects were informed of their right to participate or opt out of this study. The confidentiality and privacy of subject data was strictly ensured, with attention to the sensitivity of this project in the workplace (Rose & Pietri, 2018).

Population and Setting

In a rural Arizona community hospital, frequent emergency transfers to a higher level of care negatively impact patients, families, staff, and the hospital. The hospital's capacity includes 406 acute care beds, a 42-bed adult intensive care unit, adult surgery, and a comprehensive cardiovascular care program. The hospital served predominantly minority, underserved, underinsured, and transient populations. Additionally, the hospital maintained general pediatric surgery, a newborn nursery, and a neonatal intensive care unit with 20 beds. Acute care pediatric services in this community consisted of a general pediatric ward licensed for 22 beds. The hospital had no PICU, and this service line was being developed. Between October 2021 to October 2022, 37 patients were admitted with bronchiolitis. Any patients diagnosed with bronchiolitis requiring oxygenation using more than the standard nasal cannula were transferred via fixed-wing or helicopter to the nearest urban PICU, 185 miles away.

The general pediatrics ward in this hospital was the setting of this intervention. The ward was a self-contained unit with bedside monitoring available in each room, pediatric-appropriate biomedical equipment, adequate space, and emergency equipment appropriate for pediatric patients. The ward employed dedicated pediatric nurses. Respiratory therapists were competent with this population and in advanced airway management, including managing invasive airways in the neonatal intensive care unit and adult critical care.

Stakeholders included pediatric department nurses, respiratory therapists, staff from clinical and departmental education, critical care, and medical staff who contributed to developing the didactic education module and the simulation scenarios, assisted in running the simulations, and contributed to re-education as identified by simulation results. Unit and organizational leadership personnel supported this project. The medical directors of the pediatrics ward and the pediatric emergency department supported this intervention and consulted on didactic education. Indirectly, patients and families that receive care on this unit are stakeholders in this project.

Subjects in this project included twelve pediatric registered nursing staff in this hospital. All registered nurses, including full-time, part-time, and per-diem nurses, and all nurses, regardless of experience level, were invited to participate. Registered nurses in all shifts, including day, night, and weekend shifts, were included in didactic and simulation experiences. Deliberate inclusivity was essential to ensure equal distribution of the benefits of this intervention.

Project Description

The objective of this project was to answer the question: Do nursing self-efficacy and response to pediatric patient respiratory decompensation improve with disease-specific education and simulation? Key stakeholders worked with the doctoral student to develop didactic content and simulation scenarios pertinent to this disease process and appropriate for the stated population in July/August 2023. Planning included constructing education content, simulation scenarios, subject recruitment, data collection, and follow-up with department leadership.

The project began with measuring nurses' perception of self-efficacy for caring for decompensating patients who need emergency actions using a validated self-efficacy scale (Hernandez-Padilla et al., 2016). Baseline self-efficacy measurement was deployed in October 2023, immediately before any other project component.

Following baseline self-efficacy measurement in October, registered nurses engaged in an in-person, interactive, didactic education module delivered by the doctorate student regarding bronchiolitis pathophysiology, nursing care, possible disease progression, and assessment and care of patients in respiratory decompensation. The education module also introduced a validated and reliable objective respiratory assessment scoring system (Kim et al., 2022; Kim et al., 2021) used during the simulation. Education was provided to nurses on structured communication strategies to employ during the simulation and practiced using the situation, background, assessment, and recommendation(s) (SBAR) format (Noh et al., 2021; Al-Kalaldeh, 2022).

On the same day and following didactic education, nurses engaged in a small group simulation encounter (Sim-A) that entailed an infant experiencing respiratory decompensation. During the simulation, nurses encountered a patient with declining vital signs, were asked to assess and intervene in the patient assessment, apply a standardized assessment score, and communicate patient findings to either the physician or the respiratory therapist using the SBAR format. The doctoral student gathered information, including critical actions taken in the simulation encounter, perceptions, workflow barriers, and education needs. The simulation concluded with a debriefing of the encounter, action planning for unit-based readiness, and a plan for repeat simulation. Repeat simulations occurred in late October (Sim-B) and again in early November (Sim-C), following the same format as Sim-A but with increasing decompensation, destabilizing vital signs, and advancing airway support needs. Simulation-C also consisted of a crash-cart scavenger hunt and practice with a defibrillator.

Immediately following Sim-C in November, nurses were asked to complete the self-efficacy survey as a follow-up measurement to the intervention cycle, and a standard post-education written survey (Figure B5) measured the delivery and value of this information and informed the content of future nurse education (Centers for Disease Control and Prevention, 2019).

Data Collection Plan

The project consisted of three types of data collection. Demographic data was collected to analyze age, gender, and ethnicity. Additional demographics specific to the interests of the population and intervention consisted of the number of years a subject has been a registered nurse, the time since the last simulation training, the time since the last pediatric advanced life support (PALS) instruction, and the time since last actual patient respiratory decompensation scenario in which they were the nurse (Figure B6). Data was collected on nurse self-efficacy for confidence in caring for patients in cardiopulmonary distress using a reliable and validated tool. These data were collected via paper format filled in by the nurse before the didactic training phase of the project. The doctoral student also collected anecdotal data during the project’s simulation phases, including critical actions taken by the nurses participating during the simulation, obstacles, workflow barriers, and education needs. Finally, the measurement of nurse self-efficacy for confidence in caring for patients in cardiopulmonary distress using a reliable and validated tool was collected following the last simulation scenario.

Instrument Reliability and Validity In the rural acute care environment where clinical decompensation is infrequently encountered, clinical staff may experience apprehension, lack clinical skills, and have sub-optimal confidence due to unpracticed skills. Self-efficacy and confidence in actions taken are essential for clinical effectiveness, especially in new or high-stakes situations (Al-Kaladeh, 2022; Bennett et al., 2021; Rockoff et al., 2019). Measuring confidence in oneself is made possible by validated questionnaires. The Basic Resuscitation Skills Self-Efficacy Scale (BRS-SES) is an 18-item linear score questionnaire developed and validated for measuring nurse confidence in caring for patients during crises (Hernandez-Padilla et al., 2016). This doctoral project aimed to evaluate nursing self-efficacy for caring for patients who are in unstable pulmonary decompensation via didactic, simulation, and unit readiness interventions. The BRS-SES was applied to the evaluation of self-efficacy for caring for patients and was used before and in follow-up to education and simulation interventions. BRS-SES is cited in a study by Al-Kaladeh (2022), whereby researchers evaluated self-efficacy changes for nurses who engage in simulation during acute cardiac life support training.

The instrument was developed by a panel of 15 experts in emergency care and resuscitation training in Europe, and items on the scale were agreed upon by this panel for inclusion or exclusion from the tool (Hernandez-Padilla et al., 2016). The instrument underwent psychometric testing for validity and reliability via sampling 768 nursing students at two European universities. Cronbach's alpha showed an overall internal consistency of 0.96, with 0.95 at University A and 0.96 at University B on the initial test, then 0.94 at each location on retesting. These data identify excellent reliability of the 18 items, and researchers elected to keep all items. Paired t-test showed no significant difference between the test and retest scores at each university (A) t=0.83, p=0.408; (B) t=-1.74, p=0.088). Content validity was tested using the I-CVI and scored 0.98 indicating excellent content validity (Shi et al., 2012). Statistical significance was noted for individuals who had recently taken a basic life support (BLS) class compared to those who had not. The 18-question self-efficacy scale further delineated and tested self-efficacy rating into three factors with six items representing factor 1 'recognition and alertness' (assessment), factor 2 'CPR' (resuscitation), and factor 3 'safe use of an AED' (defibrillation) with the 18 questions segmented into these three factors.

Multiple authors confirm that self-efficacy is an essential component in care for nurses working in multiple healthcare venues (Bennett, 2021; Al-Kaladeh, 2022; Raab, 2024) and the reliability of this tool to measure self-efficacy changes during the DNP project interventions. Components of the experiential learning theory (Kolb & Kolb, 1999) and Jeffries Simulation Theory of Learning (2015) emphasize the essential step of self-reflection as necessary in learning. By encouraging nurses to reflect on their level of self-efficacy in caring for patients under the tested circumstances, we fulfill the recommendations of self-reflection advised by these learning theories. The instrument, demographics survey, and post-education survey took participants less than ten minutes to complete.

Data Analysis Plan

Data analysis was completed using Intellectus statistical software to organize, manage, and analyze the data. The relationship between demographic factors, initial/post-intervention self-efficacy, and simulation performance were analyzed. An analysis of the longitudinal change in self-efficacy from before didactic and simulation interventions was compared to self-efficacy following interventions.

Budget

Direct costs associated with this project included the cost of printed materials used in didactic training classes and the cost of salaries for the staff who participated in the training. Additionally, participants who completed the study were provided with an incentive for project completion (See Figure B4).

Indirect costs apply to this project as lost productivity occurs due to the project while nurses are participating in training instead of working productively at the bedside. Intangible costs pertain to nurses experiencing some stress during simulation scenarios. A hospital education allowance provided funding for staff salaries during training. The doctoral student provided the cost of materials and incentives.

Results

Intellectus Statistics ™ is a statistical software package that stores, manages, and analyzes data. Descriptive statistics were run, and the population consisted of twelve registered nurses who worked in the pediatrics unit, all of which were female; 50% (6) had a bachelor's degree in nursing, 8% had a master's degree in nursing, and 41% (5) had an associate's degree in nursing. Experience as an R.N. consisted of 16% (2) having less than 1 year of experience, 33% (4) having 1-5 years' experience, and 50% (6) having greater than or equal to five years. Previous experience in a critical care environment comprised 75% (9) without experience, and 25% (3) endorsed 5 years or greater experience. Recent simulation training consisted of less than one year ago for 67% (8), greater than 1 year ago for 25% (3), and never for 8% (1). Last Neonatal, advanced cardiac, or pediatric advanced life support training was less than 1 year ago for 58% (7), greater than 1 year ago for 17% (2), and never for 25% (3). Experience with participation in a resuscitation consisted of 25% (3) never having participated and 75% (9) having experience in a resuscitation (see Table 1).

Self-efficacy for factor 1 'Assessment' data was analyzed and identified a pre-intervention average of 503.92 (*SD* = 125.73, Min = 230.00, Max = 600.00, *Mdn* = 540.00). Post-intervention self-efficacy averaged 553.00 (*SD* = 69.45, Min = 350.00, Max = 600.00, *Mdn* = 575.50) (see Table 2). A two-tailed Wilcoxon signed rank test was conducted to examine whether there was a significant difference between pre-intervention assessment and post-intervention assessment, and the results were significant based on an alpha value of 0.05, $V = 6.50$, $z = -2.14$, $p = 0.032$ indicating this difference was not based on random variation. The median of the pre-intervention Assessment (Mdn = 540.00) was significantly lower than the median of the post-intervention Assessment (*Mdn* = 575.50), indicating a perceived improvement in self-efficacy for this skill. (See Figure 1.) Skill improvement in this area impacts the nurse's ability to critically assess a decompensating patient and identify features of the patient presentation necessitating intervention.

Self-efficacy for factor 2 'Resuscitation' was analyzed, and a pre-intervention average of 330.83 was identified (*SD* = 80.04, Min = 130.00, Max = 400.00, *Mdn* = 360.00). The observations for post-intervention self-efficacy in resuscitation had an average of 360.33 (*SD* = 55.19, Min = 215.00, Max =

400.00, *Mdn* = 376.00) (see Table 3). A two-tailed paired t-test was conducted to examine the difference between pre-and post-intervention mean difference in self-efficacy, and the result of the two-tailed paired samples *t*-test was significant based on an alpha value of 0.05, $t(11) = -2.51$, $p = 0.029$ suggesting the null hypothesis can be rejected. The mean of pre-intervention self-efficacy for resuscitation was significantly lower than the mean for post-intervention self-efficacy. The effect size was analyzed using the Cohens-d test, which was 0.72, indicating that this intervention significantly affected self-efficacy for resuscitation. The results are presented in Table 4, and a bar plot of the means is presented in Figure 2. Skill improvement in this area enables nurses to initiate actions necessary for the resuscitation of decompensating patients.

Self-efficacy for factor 3, 'Defibrillation' was analyzed and identified a pre-intervention average of 653.00 (*SD* = 176.72, Min = 280.00, Max = 800.00, *Mdn* = 714.50) and a post-intervention average of 732.92 (*SD* = 102.63, Min = 445.00, Max = 800.00, *Mdn* = 775.00) (see Table 5). A two-tailed Wilcoxon signed rank test was conducted to examine whether there was a significant difference between pre-intervention self-efficacy for defibrillation and post-intervention defibrillation, and the results were significant based on an alpha value of 0.05, $V = 5.50$, $z = -2.45$, $p = 0.014$ indicating this difference was not based on random variation. The median of pre-intervention use of the defibrillator (*Mdn* = 714.50) was significantly lower than the median of post-intervention use of the defibrillator (*Mdn* = 775.00), indicating perceived improvement in self-efficacy for this skill (Figure 3). Skill improvement enables nurses to use the defibrillator appropriately during cardiopulmonary decompensation.

Table 1

Demographics

Variable	*n*	%
Gender		
Female	12	100.00
Highest_Education		
Bachelors nursing	6	50.00
Associates nursing	5	41.67
Graduate degree nursing	1	8.33
Missing	0	0.00
Time_as_an_RN		
1- 4 years	4	33.33
5+ years	6	50.00
0-1 years	2	16.67
Critical_Care_Experience		
Never	9	75.00
5+ years	3	25.00
Last_Simulation_Training		
1+ years	3	25.00
0-1 years	8	66.67
Never	1	8.33

Last_NRP_ACLS_or_PALS		
0-1 years	7	58.33
1+ years	2	16.67
Never	3	25.00
Participation_in_a_Resuscitation		
No	3	25.00
Yes	9	75.00

Note. Due to rounding errors, percentages may not equal 100%.

Table 2

Summary Statistics for Assessment self-efficacy

Variable	*M*	*SD*	*n*	Min	Max	*Mdn*
Pre-Intervention Assessment	503.92	125.73	12	230.00	600.00	540.00
Post-Intervention Assessment	553.00	69.45	12	350.00	600.00	575.50

Figure 1

Ranked values of pre and post intervention for Assessment

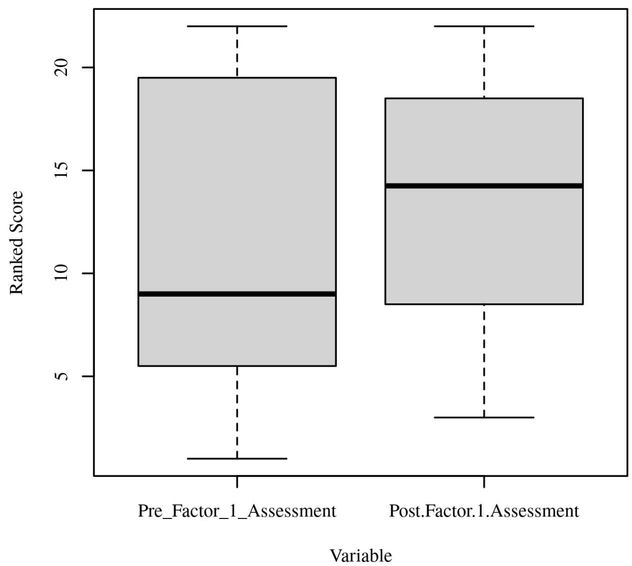


Table 3

Summary Statistics for Resuscitation self-efficacy

Variable	*M*	*SD*	*n*	Min	Max	*Mdn*
Pre-intervention Resuscitation	330.83	80.04	12	130.00	400.00	360.00
Post-intervention Resuscitation	360.33	55.19	12	215.00	400.00	376.00

Table 4

Two-Tailed Paired Samples t-Test for the Difference Between Pre-intervention Resuscitation and Post-intervention Resuscitation

Pre-intervention Resuscitation		Post-intervention Resuscitation				
M	*SD*	*M*	*SD*	*t*	*p*	*d*
330.83	80.04	360.33	55.19	-2.51	.029	0.72

Note. N = 12. Degrees of Freedom for the *t*-statistic = 11. *d* represents Cohen's *d.*

Figure 2

The means of Pre-intervention and Post-intervention Resuscitation

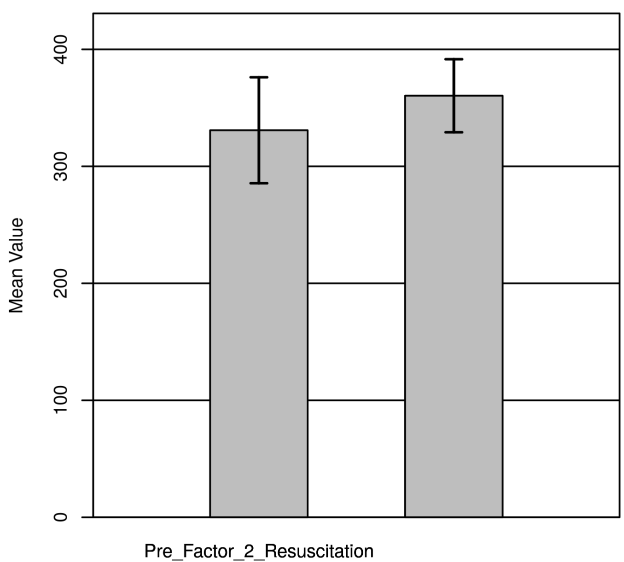


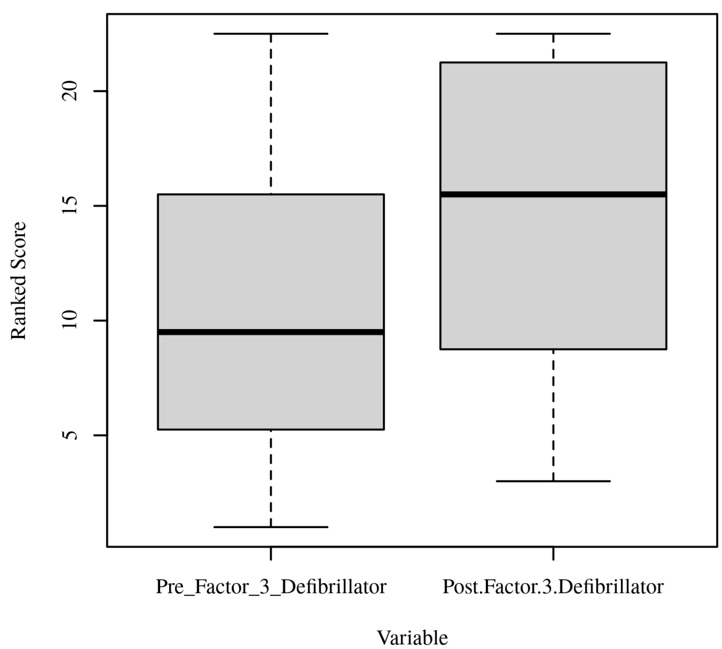
Table 5

Summary Statistics for Defibrillation self-efficacy

Variable	*M*	*SD*	*n*	Min	Max	*Mdn*
Pre-intervention Defibrillator	653.00	176.72	12	280.00	800.00	714.50
Post-intervention Defibrillator	732.92	102.63	12	445.00	800.00	775.00

Figure 3

Ranked values of Pre-intervention and post-intervention for Defibrillator use



Project impact

These data indicate statistically significant improvement in nurse self-efficacy following didactic instruction in caring for the pediatric patient with ARF and practicing learned skills during progressively higher acuity simulation experiences. Skills in assessment, resuscitation, and defibrillation were evaluated, and practicing these skills in simulation improved knowledge and self-efficacy. Gained skills impact the patient as they are cared for by more knowledgeable nurses who practice the skills necessary to care for them should they experience ARF during their disease. The project impacted participants by improving their knowledge and self-efficacy for assessment skills, resuscitation actions, and familiarity and use of the defibrillator in their work environment. Bronchiolitis is a significantly more common condition in the fall months. The project's design ensured complete delivery of these interventions just before the beginning of the fall season, during which participants would expect to see a higher influx of patients with bronchiolitis and, therefore, may be more likely to require skills in caring for them. This design strategy was intended to impact nursing staff and patients for the upcoming season but also ensured skill practice that would carry them through to future seasons, generating long-term benefits to self-efficacy.

This project applies to all nursing units and endless education needs. While this project focuses on pediatric nurses caring for patients with a respiratory system diagnosis, the project is easily replicated in critical care units, general medical-surgical wards, procedural units, operative departments, and outpatient settings and across all disease pathologies. The long-term benefits of this project include improved interdepartmental cooperation with running simulations. The positive results on self-efficacy, key actions, and staff satisfaction prove the efficacy of this intervention and encourage the hospital to continue simulation education in the standard education plan, thereby elevating the competency and self-efficacy of nursing staff in all units and the long term.

Sustainability

The site champions for this project were the director of the pediatrics department, the clinical educator, and the manager of the respiratory therapy department in the hospital where the project took place. These people were involved in conceptualizing, planning, organizing, and networking. They had administrative oversight and were vested in continuing new unit processes. The project leaves the organization with twelve nurses prepared to care for patients with bronchiolitis, respiratory decompensation, and escalating oxygenation and ventilation needs. The project emphasized simulation's benefits and left the unit and the hospital with gained competency for running simulations on the nursing units. The unit has access to reuse any didactic information provided in the project, and the DNP student and site champion created a plan to continue simulation training quarterly. Continued sustainability is augmented by presenting the project results to the hospital clinical education department and other departmental clinical nurse educators for consideration in other hospital units.

Discussion

Summary

While the didactic delivery in this project was designed for pediatric patients with bronchiolitis, the project design is easily transferable to multiple pathophysiologic processes and venues of care, including inpatient, outpatient, home-based, and ambulatory settings. While the projected tested registered nurse self-efficacy, other disciplines can benefit from timely and pertinent education with hands-on practice of new skills that test their understanding and access to resources.

Valuable learning points during the simulations included some participants being unable to demonstrate bedside suction setup despite verbalizing acumen. 75% (9) of participants initially accessed the incorrect unit crash cart, 75% (9) participants had not ever used a pressure monometer on an ambu-bag, and staff realized that ambu-bags are not routinely stocked in the supply room where they initially attempted to access them. Didactic learning points participants expressed as applicable consisted of assessments pertinent to ARF, including signs of respiratory distress (retractions, head bobbing, grunting), neurologic status, and the physiologic meaning related to the disease process. Participants expressed value in bronchiolitis education timing before starting the seasonal influx. Participants expressed value in a crash-cart scavenger hunt in simulation in which a fully stocked pediatric crash cart and defibrillator were available and open for exploration. A mannequin was available, and nurses were allotted a set of defibrillation pads and ambu-bags to practice these skills. All participants were encouraged to have hands-on interactivity for each skill. The didactic and simulation encounters were built in collaboration with the unit educator and the manager of the respiratory therapy department, who provided valuable input on unit dynamics, education needs, obstacles, and previous clinical issues.

Limitations and Barriers

The project has several limitations. It was conducted in a single setting with a small sample size. While the project intended to incorporate respiratory therapists and pediatric medical staff into the simulation, none of these disciplines were recruited to the didactic or simulation encounters. Limitations to staff availability and scheduling conflicts contributed to this barrier, and staff buy-in and managerial support from these disciplines may have affected staff engagement. A barrier to respiratory therapist involvement existed with scheduling for didactic and simulation encounters. Scheduling strategies maximized convenience for participants to engage in encounters. However, the timing of encounters took place during times that were busier for R.T.s than R.N.s, which could have contributed to a deficit in availability for this discipline. In this organization, respiratory therapists are shared between multiple departments. The training location was in the pediatric unit. It was convenient for the pediatric nurses but less convenient for respiratory therapists who may be assigned to another department, potentially creating a barrier to access or engagement.

Staff engagement to participate created a limitation in the project. While participants expressed interest in the learning opportunities and signed up for sessions, they frequently did not attend appointments. This issue necessitated further appointment times, more frequent and smaller cohorts during an education or simulation encounter, and a lack of interprofessional feedback and support for some participants during their simulation. Clinical educators may experience this barrier in delivering staff education related to time constraints and conflicting priorities. There is value in multidisciplinary cohorts and learning cohorts with multiple participants (Watters et al., 2015; Bennet et al., 2021; Al-Kaladeh, 2022), and further study regarding in-service engagement and burnout may be beneficial. It is worth noting that active engagement and positive feedback were apparent for every didactic or simulation encounter, even for participants who may have previously canceled a session. Once the engagement was achieved, it was sustained throughout the encounter and included in post-project value surveying.

Recommendations

Regularly incorporate short-duration, timely, and pertinent education into clinical education. Because staff availability to initiate an education session was the biggest obstacle, strategies that maximize convenience for clinical staff should be explored and could include huddle education, virtual simulation, or 10-minute roving didactic lessons delivered on a portable device. There is value in extra-disciplinary involvement, including medical providers, physical therapy, dietary therapy, case management, behavioral health, and infection control education. Encourage participant interactivity even when a participant verbalizes competency for a skill. Further study into clinical education engagement and motivation could be beneficial.

Conclusion

Didactic education with simulation training positively impacts self-efficacy. Education within the care environment, along with the resources, equipment, and obstacles common to the patient scenario and the nurse workflow, contributed to the best learning outcomes in this project. Expanding nurses' critical thinking incrementally with patient scenarios built on complexity, skill use, and critical thinking contributed to both interest and advanced skills. The best engagement and cooperative learning occurred in cohorts of 3-4 participants sharing ideas, experiences, and resources. Nursing skills and self-efficacy can deteriorate rapidly in the rural community pediatrics department that does not experience frequent patient decompensation situations. The evidence is clear that simulation training and standard practices for assessment and communication are vital components of efficacy in caring for patients in decompensating situations.

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Appendix A

Evaluation and Synthesis Tables

Table A1

Evaluation Table for Quantitative Studies

Citation	**Theoretical/ Conceptual Framework**	**Design/ Method/ Purpose**	**Sample/Setting**	**Variables**	**Measurement/ Instrumentation**	**Data Analysis**	**Results/ Findings**	**Level of Evidence; Application to practice; Generalization**
Walker, M.D. et al., (2020), Comparing the efficacy of resuscitation educational modalities: A	Adult and Constructivist learning theories	**Design:** Quantitative experimental comparison study **Purpose:**	**N=** 43 **Demographics: (Scored on likert scale)** Age Gender Experience Work setting	**IV1:** Online led instruction (OLI) **IV2:** Instructor led instruction (ILI) **DV1**: Identify Causes	**Tools:** MCQT ACLS standardized test **Validity/ Reliability:**	**Statistical Tests Used:** Wilcox-mann-whitney	**DV1: Identify Causes** OLI: Median 2 ILI: Median 6 P value significance= 0.004 U=114.500	**Level of Evidence**: Randomized controlled trial Level II **Strengths**: Strengthens evidence for high

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randomized control study **Country**: United States of America **Funding**: None **Bias**: None		Identify the most effective way for nurses to learn skills and improve efficacy in high-stress high-stake situations	Education level Pretest score **Setting:** 400 bed academic level 1 trauma and certified comprehensive stroke center with eight ICUs **Exclusion:** Participants that had been previously ACLS certified and participants that verbalized a preferred education model **Attrition:**	**DV2:** Pharmacologic intervention **DV3:** Megacode testing score **Definitions:** N.A.	Internally validated by the American Heart Association		Effect size R= .43 **DV2: Pharmacologic intervention** OLI: Median 4 ILI: Median 6 P value significance= 0.000 U=85.000 Effect size R= .59 **DV3:** Megacode testing score	fidelity simulation environments **Weakness**: Small sample size, Convenience sample **Feasibility**: The application of this study findings would be easily translated into practice because standard education models were used.

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			None reported				OLI: Median 71.1 ILI: Median 85.7 P value significance= 0.000 U=59 Effect size R= .63	**Application**: In-person and simulation-based learning is important for high-stakes scenarios
Mount, M.C., et al., (2021), Derivation and validation of the critical bronchiolitis		**Design:** Retrospective database study **Purpose:** Validation of illness severity	**N=** 14,407 **Demographics:** Male: 8,623 Female: 5,784 Age: (months) <1: 1,187 1-23: 13,220	**IV1:** Critical bronchiolitis score **DV1:** Duration of ICU-LRS (Time) **DV2:** Pediatric intensive care unit length of stay	**Tools:** Critical Bronchiolitis Score "R" version SigmaPlot **Validity/**	**Statistical Tests Used:** Simple linear regression	**DV1:** Use of the CBS has better predictive value for duration of ICU-LRS **CI 95%**	**Level of Evidence**: Retrospective database study Level III **Strengths**: Large study size; Quality ensured data

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score (CBS) for the PICU **Country**: United States of America **Funding**: Breas Medical, Vapotherm, and Elsevier. **Bias**: Discussed in article, methods		score tool to aid clinicians in assessing morbidity in bronchiolitis patients	**Setting:** 128 North American PICU's **Exclusion:** 1) Pre-existing tracheostomy 2) Admission from another PICU 3) Admission from general ward more than 7 days after hospital admission	**Definitions:** Duration from time a subject received ICU-LRS until ICU-LRS was successfully discontinued- defined as free of ICU-LRS for 12 hours	**Reliability:** R2 value of 0.29-0.3 for the CBS score R2 value of 0.03-0.18 for comparative tool Calculated the root mean squared error and absolute mean error		**DV2:** Use of the CBS has better predictive value for duration of ICU-length of stay **CI 95%** Range:	points; Largely applicable to ongoing research **Weakness**: Reports may not be useful on per-patient interactions **Feasibility**: The data points collected in the tool are widely available in any patient encounter and

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to ensure not present.			4) Initiation of ICU-LRS more than 6 hours prior to PICU admission 5) Incomplete records **Attrition:** none reported					could easily be built into an EMR or APP **Application**: Applicable to the assessment and risk stratification of this population of patients
Noh, G.O. et al. (2021), Effectiveness of assertiveness training, SBAR, and combined		**Design:** Non-equivalent, quasi-experimental pretest-postest **Purpose:** improve communication	**N=** 93 **Demographics:** Third year nursing students Male: 17 Female: 76	**IV1:** SBAR with assertiveness training **IV2:** SBAR alone (no assertiveness training)	**Tools:** Likert scale **Validity/ Reliability:**	**Statistical Tests Used:** Paired t-test: Changes in dependent	**DV1:** No difference between IV groups with results $p<0.001$ in all groups	**Level of Evidence**: Quasi-Experimental Level III **Strengths**: Consistent amount of training in each

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SBAR and assertiveness training for nursing students undergoing clinical training: A quasi-experimental study **Country**: South Korea **Funding**:		skills, clinical practice stress, and clinical competency	Religion: Yes: 42 No: 51 Satisfaction with Major: Yes: 42 Neutral: 51 Academic performance (measured) Difficulties Communicating: Yes: 25 Neutral: 44	**IV3:** Assertiveness training alone (no SBAR) **DV1:** Communication clarity **DV2:** Clinical stress **DV3:** Clinical competence **Definitions:** None	Valid scale for pre-post intervention measurements	variables between pre and post interventio n ANCOVA Differences among groups	**DV2:** Significant improvement to clinical stress for IV3 group ($p<0.0001$) Compared to (p 0.154) in IV1 and ($p=0.752$) for IV2 **DV3:** IV1: $P<0.001$ IV2: P 0.007 IV3: $p <0.001$ With significant intergroup	group Random assignment to intervention Training format and agenda's clearly described **Weakness**: No control group Convenience sample **Feasibility**: The feasibility of repeating this test is high, the study was

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Research grant Kangwon National University **Bias**: No control group			No: 24 **Setting:** Nursing schools of two universities in South Korea **Exclusion:** a) prior experience with communication training b) inability to participate in training **Attrition:** Three participants: Invalid response				comparison showing IV1 better then other groups for this variable p 0.023	well outlined, could be easily replicated. **Application**: Can be applied to this intervention to improve communication skills for nurses in high-stakes scenarios
Al-Kalaldeh (2022) Promoting nurses' self		**Design:** Pre-test/post-test Quasi-experimental	**N=** 62	**IV1:** High fidelity simulation for	**Tools:** Resuscitation self-efficacy scale	**Statistical Tests Used:**	**DV1:** Self efficacy measurement	**Level of Evidence**: Cohort Level IV

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efficacy in advanced cardiac life support through high-fidelity simulation **Country**: Jordan **Funding**:		**Purpose:** To measure self-efficacy changes with simulation-based training for resuscitation efforts	**Demographics:** At least 1 year experience in critical care Age: Mean 33 years Clinical experience mean 10 years Gender: 54% male Education: bachelors degree: 64% Prior resuscitation experience: 64% **Setting:**	advanced cardias life support **DV1:** Self efficacy score Four dimensions of self efficacy: recognition, debriefing and recording, responding and rescuing, and reporting **Definitions:**	(Hernandez-Padilla et al., 2016) **Validity/ Reliability:**	Paired T-test for differences in self efficacy pre- and post-intervention, ANOVA to determine differences in testing amongst	improved after the intervention *t* = 4.89, *SE* = 1.84, *p* < .001, confidence interval [-12.7, -5.33 No difference from pre-post test based on demographic factors Self efficacy improved r=0.303 and p= 0.017	**Strengths**: Could identify skill decompensation from previous ACLS training to this intervention **Weakness**: Participants with previous ACLS training, not controlled No randomization **Feasibility**:

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Bias: Study center is certified in simulation training in this model			Accredited ACLS training facility **Exclusion:** Physical activity limiting medical conditions **Attrition:** 8 participants out of original 70 enrolled			demographic measurements		They used high fidelity mannequins supplied by and AHA certified training facility, may not be replicable for other sites without this equiptment. **Application**: Scoring self-efficacy tools are supported in the literature and positions a useable model for this

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								intervention measurement
Takashiki et al. (2022) Improving performance and self efficacy of novice nurses using hybrid simulation-based mastery learning **Country**: Japan	Mastery Learning Theory And Social Cognitive Theory	**Design:** Single site/single cohort **Purpose:** Improve clinical skill mastery and self-efficacy in new nurses treating patients with acute chest pain via simulation	**N= 37** **Demographics:** Age: Mean 24 +- 2.3 Gender Male:3, Female, 32 Education level: Diploma: 4 Associates: 0 Bachelors: 30	**IV1:** Four part training session to care for patients with acute chest pain, 3 parts included asynchronous e-learning platform Fourth component was 20 minutes of simulation training	**Tools:** Percentage-based self-rating scale and Prism software **Validity/ Reliability:** Simulation scoring tool developed and used by simulation leads based off the	**Statistical Tests Used:** Wilcoxan Signed Rank test Friedmans non-parametric used for self efficacy perceptions	**DV1:** Percent pass: Pre: 20% Post: 100% F.U.: 100% Scores Mean Pre 12.73 Post: 24.34 FU: 23.25 SD Pre: 3.33 Post: 1.82	**Level of Evidence**: Cohort design Level IV **Strengths**: Stable results in follow-up testing, consistent with other studies using SBML

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Funding: Aikita Medical Doctor Support Center **Bias**: Perception bias			Masters: 1 Ward Cardiac: 3 Internal: 3 Critical Care/E.R./Surgery: 23 Pediatric: 3 Other: 3 **Setting:** Acute Care Hospital **Exclusion:** **Attrition:**	with immediate feedback **DV1:** Performance of chest pain assessment and care Measured pre-post, and in 6 month follow-up **DV2:** Self efficacy **Definitions:**	online content, 30 items assessed and described construct validity determined by using mean rating scores of the expert nurses		FU: 2.44 P (Versus pre) Post: <0.0001-0.617 FU: <0.0001-0.617 P (Versus post) 0.943-0.277 These data identify the large effect (>0.5) when compared to pre-intervention but small effect size when F.U. testing compared to post score	**Weakness**: Small n, no control cohort Inconsistent sampling for specialty Single medical center **Feasibility**: Clearly described simulation strategy that could easily be

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			2 dropped				**DV2:** **<u>Mean:</u>** Pre: 19.84 Post: 49.35 FU: 50.32 **SD:** Pre: 20.02 Post 19.01 FU: 20.25 P: (Versus pre) Post: <0.0001-0.578 FU: <0.0001-0.589 P: (versus post)	incorporated into this project **Application**: Structure of this hybrid simulation training in acute events is directly applicable to the intervention proposal and included components of SBAR

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							FU: >0.9999-0.049 Identifying a significant impact to self efficacy (>0.5)	
Hansen et al. (2019) Pediatric early warning score and deteriorating ward patients on HFNC **Country**: Canada		**Design:** Retrospective chart review **Purpose:** Review ward algorithm for utility and effectiveness of predicting HFNC failure in respiratory distress	**N=** 240 reviewed 18 on HFNC 10 non-responders 8 responders **Demographics:** Age: 3.47 Sex: Male (83%) Comorbidity: 11	**IV1**: Initiation of HFNC on the ward **DV1:** HFNC responder **DV2:** HFNC non-responder **Definitions:**	**Tools:** PEWS score **Validity/ Reliability**: lacks international validation	**Statistical Tests Used:** Chi-squared	**DV1:** Change to pre-post HFNC PH 0.04 (+- 0.06) PCO2 -6.4 (+-6.9) PEWS score -0.1 (+-0.4) **DV2:** Change to pre-post HFNC	**Level of Evidence**: Cohort Level IV **Strengths**: The score and algorithm were familiar to the facility staff. The small cohort allowed analysis of

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Funding: none **Bias**: none		patients using PEWS	**Setting:** A single acute care hospital **Exclusion:** Advanced care directives, HFNC initiated in E.D., PICU, or during interfacility transfer **Attrition:** None				PH 0.3 (+- 0.5) PCO2 -2.8 (+- 4.3) PEWS score 0.3 (+- 0.5) **Significance** Pews score: P-value 0.05 PH: P-value 0.13 pCO2: P-value 0.20	process and variables **Weakness**: Small sample size decreased statistical analysis, limited to one hospital PEWS Scale lacks validation **Feasibility**: Algorithm is supported and beneficial to this intervention as it

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								aides objectivity and structure in assessment **Application**: Informs protocol or score system that can guide the clinical staff in this intervention
Bennett et al., (2021), Optimizing nursing response	Adult Learning Theory	**Design:** Operational simulation checklist used to assess XXX during repeat	**N=** 44 **Demographics:** Female (40) 90% Registered nurses (31) 70.4%	**IV1:** Simulation testing	**Tools:** Observational Simulation checklist	**Statistical Tests Used:** Paired t-test	**DV1:** P: 0.022 indicating statistically significant	**Level of Evidence**: Cohort study Level IV **Strengths**:

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Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
to crisis events through in-situ simulation **Country**: United States **Funding**: None **Bias**: None		simulations to evaluate task completion **Purpose:** Decrease nursing response time for recognition and escalation during crisis events. Improve role confidence	Avg experience 3-10 years Experience with 3 or fewer codes: (36) 81.8% Experience with simulation training: (28) 63% **Setting:** 900-bed level 1 trauma center in North Carolina, medical surgical floors **Exclusion:** None **Attrition:** None	**DV1:** Time to recognition and escalation **DV2:** Initiate ventilation **Definitions:**	**Validity/ Reliability:** Not a validated tool		improvement of recognition of decompensation in pre/post measurements **DV2:** p: 0.004 indicating statistically significant improvement of initiation of ventilation in pre/post measurements	Multiple time point measurements **Weakness**: Small cohort size **Feasibility**: The intervention is feasible because it informs to onsite simulation delivery, does not require high-fidelity equiptment of ancillary trained personnel.

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Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
								Application: Application of their checklist for emergency response actions is useful in this intervention. The study also discusses re-teaching as a method of improving skills.
Hernandez Padilla et al., (2016), Development and	Bandura's self-efficacy theory	**Design:**	**N= 768**	**IV1:** Scale application to participants	**Tools:** This developed the tool	**Statistical Tests Used:**	**DV1:** Showed excellent reliability	**Level of Evidence**: Cohort study Level IV

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Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
psychometric Assessment of the basic resuscitation skills self-efficacy scale **Country**: England		**Questionnaire developed by expert panel** **Purpose:** To validate a scale for measuring self-efficacy for basic resuscitation skills	**Demographics:** Age M=22.7 Gender 78% male Education level 98% "A-level" Exposure to cardiac arrest scenario :14% Last resuscitation training Never: 24.5 <1yr 25.8% 1-2 yr: 23.3% Recent: 26.4% **Setting:** Two London university nursing programs	**DV1:** Self-efficacy measurement **Definitions:**	**Validity/ Reliability:** Lawshe's method, expert panel to identify scale validity validity	Cronbachs coefficient alpha and paired t-test	for determining self efficacy at a=0.96 And individual subscales in the tool: Recognition: a-.85 Cardiopulmonary resuscitation a-0.92 AED: a=0.96	**Strengths**: Well tested and validated tool **Weakness**: Validated against European guidelines, may not be applicable to other country and guidelines. Validated versus nursing students self efficacy, may

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Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
Funding: Department of adult, child, and midwifery at Middlesex University **Bias**:			**Exclusion:** **Attrition:**					need re-validation for licensed practicing clinicians **Feasibility**: This is a well validated tool that would be easily employed in measuring perceived self-efficacy in this intervention **Application**:

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Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
								It is applicable to the project's aims to improve self efficacy for cardiopulmonary decompensation
Kim et al., (2022), S/F and ROX indices in predicting failure of high-flow nasal cannula in children		**Design:** Retrospective review. Classified as hypoxic versus non-hypoxic respiratory failure **Purpose:**	**N=** 152 **Demographics:** Age 2.3 Sex male 89 Weight z-score -1.5 Comorbidities 138 Diagnosis 47% bronchiolitis	**IV1:** High flow nasal cannula application of predictive scoring **DV1**: Hypoxic respiratory failure **Definitions:**	**Tools:** S/F ratio and modified ROX **Validity/ Reliability:**	**Statistical Tests Used:** Shapiro-wilk	**DV1:** S/f successful wean versus failure with P value <0.001, sensitivity 0.62 and specificity 0.71 Rox-m score with P value 0.008,	**Level of Evidence**: Cohort Level IV **Strengths**: Sufficiently powered, builds on other evidence,

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Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
Country: Korea **Funding**: None reported **Bias**: Potential misclassification bias		Evaluate various indices predicting HFNC failure in children as early warning to inform decisions regarding invasive positive pressure ventilation	**Setting:** A national university hospital in Seoul Korea **Exclusion:** Patients that refused intubation, elective intubation for procedures/bronchoscopy, SPO2 targets below 92%due to cyanotic heart disease, or were discharged or transferred while maintaining HFNC support **Attrition:**	S/F is ratio of oxygen saturation to fraction of inspired oxygen ROX-M is ratio of S/F to RR/RR age median	Validated by Roca, 2016 for Acute respiratory failure		sensitivity of 0.53 and specificity of 0.7 Rox scoring is sensitive and specific for predicting hfnc failure	scoring is easy to use, is objective **Weakness**: Did not factor HFNC flow rate into failure **Feasibility**: Realistically can be used by bedside nurses to communicate assessment findings **Application**:

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Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
								Directly applicable to this intervention for its objectivity and ease of use
Dadlez et al., (2019), Safety of HFNC outside of the ICU for previously healthy children with bronchiolitis		**Design:** Retrospective study **Purpose:** Examine the safety of use of HFNC outside the ICU setting in children	**N=** 80 **Demographics:** Gender Female 36 Age median 4.6 **Setting:** Acute tertiary care hospital	**IV1:** HFNC use outside the ICU **DV1:** Transfer to the ICU **DV2:** Negative outcome **Definitions:**	**Tools:** None **Validity/ Reliability:**	**Statistical Tests Used:** **Wincoxan ranked sum**	**DV1: 41% required ICU transfer** Median time on HFNC for group not transferred was: 3 days Group transferred, 91% were within first	**Level of Evidence**: Observational Cohort Level IV **Strengths**: Adequately powered, describes education on

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Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
Country: United States of America **Funding**: National intitute of health grant **Bias**:			**Exclusion:** Concomitant pneumonia, complex comorbidities Direct admission to the ICU prior to HFNC initiation **Attrition:**	Negative outcome: Intubation, pneumothorax, aspiration, death			24 hours of HFNC use, 58% required escalation of respiratory support, none required intubation **DV2:** No adverse outcomes in study population	initiation required for staff. Escalation decisions were blinded to the prescense of the study **Weakness**: Single center Had established on-floor HFNC use 5 years prior to study Does not discuss the assessments,

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Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
								criteria, or ICU level support that warranted the transfer **Feasibility**: Easily replicated or employed as it did not use technology that would be unavailable in this setting **Application**: Applicable in this setting as it clearly

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Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
								delineated HFNC settings.

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Table A2

Synthesis Table

Study (Author, year)	Walker et al., 2020	Mount et al., 2021	Noh et al., 2021	Al-Kalaldeh, 2022	Takashiki et al., 2022	Hansen et al., 2019	Bennett et al., 2021	Hernandez Padilla et al., 2016	Kim et al., 2022	Dadlez et al., 2019
Design	Quantitative Experimental Comparison RCT	Retrospective Study Cohort	Quasi-Experimental Cohort	Quasi Experimental Cohort	Single site, single cohort educational intervention	Retrospective Chart Review Cohort	Operational Simulation Cohort	Expert panel validation study Cohort	Retrospective review Cohort	Retrospective Cohort
LOE	II	III	III	IV	IV	IV	IV	IV	IV	IV
Sample										

Key **RCT** Randomized controlled trial **OL** Online **IP** In person **V** versus **HFNC** High flow nasal canulla **<** less than **>** greater than **ACLS** Advanced cardiac life support **N/A** not applicable **NIPPV** Non-invasive positive pressure ventilation **SBAR** Situation background assessment reccomendation **CC** critical care **PEWS** Pediatric eary warning score **ROX (**oxygen saturation/ fration of inspired oxygen)/ respiratory rate **CBS** Critical bronchiolitis score **MCQT** multiple choice question test **MCTS** megacode testing scenario **RSES** resuscitation self efficacy score **X** yes

Study (Author, year)	Walker et al., 2020	Mount et al., 2021	Noh et al., 2021	Al-Kalaldeh, 2022	Takashiki et al., 2022	Hansen et al., 2019	Bennett et al., 2021	Hernandez Padilla et al., 2016	Kim et al., 2022	Dadlez et al., 2019
n subjects	43	14,407	93	62	37	18	44	768	152	80
Subject type	Nurses	Patients	Nurses	Nurses	Nurses	Patients	Nurses	Nurses	Patients	Patients
M-Age (years)	25-26	<2	na	33	24	3.47	na	22.7	2.3	4.6
Nurse's Experience level	<1 year			>1 yr in CC	Novice		<3 codes	<professional		
Critically Ill	X	X		X	X	X	X	X	X	
Bronchiolitis		X				X			X	X

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Low weight		X							X	Emphasizes importance of nutrition
High CO2		X				X			X	
Setting										
Multiple center		X	X					X		
HFNC on the ward		No				X			X	X
Tertiary care facility	X	X			X	X	X		X	X
Rural										

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Study (Author, year)	Walker et al., 2020	Mount et al., 2021	Noh et al., 2021	Al-Kalaldeh, 2022	Takashiki et al., 2022	Hansen et al., 2019	Bennett et al., 2021	Hernandez Padilla et al., 2016	Kim et al., 2022	Dadlez et al., 2019
Community location			X	X			X	X		
Interventions										
Simulation Training	X		X	X	X		X			
Didactic training	X		X	X	X		X			
SBAR training			X		X					
Self-efficacy training			X	X	X		X	X		

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Tools	MCQT/MCTS ACLS	CBS		RSES/ACLS		PEWS	Simulation checklist	Self efficacy scale	ROX	
Unit based protocol or algorithm	X			X		X				
HFNC		X				X			X	X
Fed while on NIPPV										X
Outcomes/ Themes										
Self efficacy	↑ OL < IP		↑	↑			↑	↑		

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Clinical Competence	↑		↑	↑		↑	↑	↑		
Patient outcomes								↑	↑	
Score validation valid/reliable		+						Self-efficacy scale validation +	ROX +	

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Reassessment emphasized						X	X		X	X
HFNC safe						+			+	+

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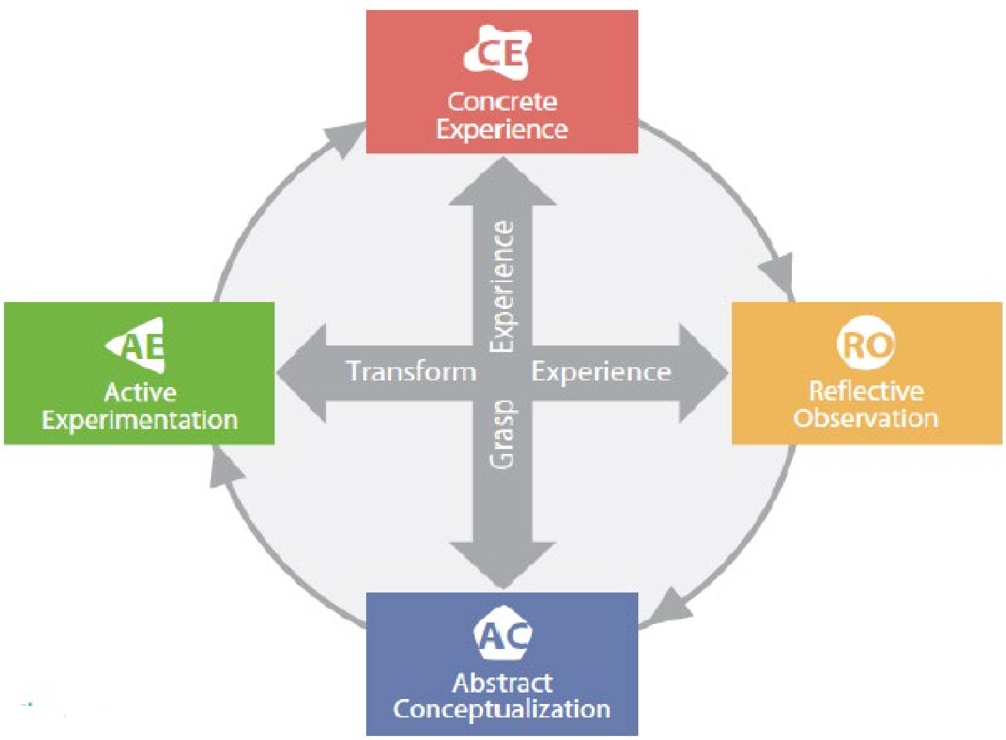
Appendix B

Models and Frameworks

Figure B1

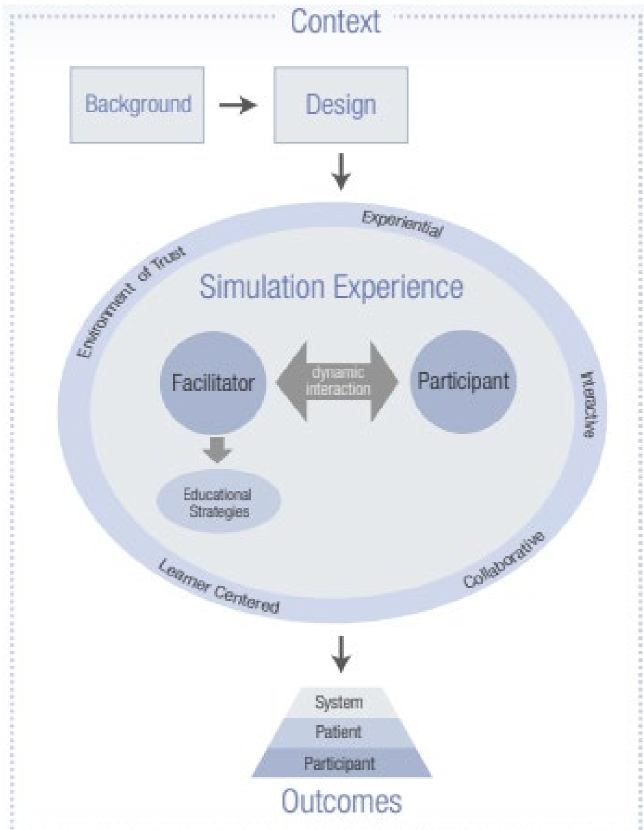
The Experiential Learning Cycle



(Kolb & Kolb, 2013)

Figure B2

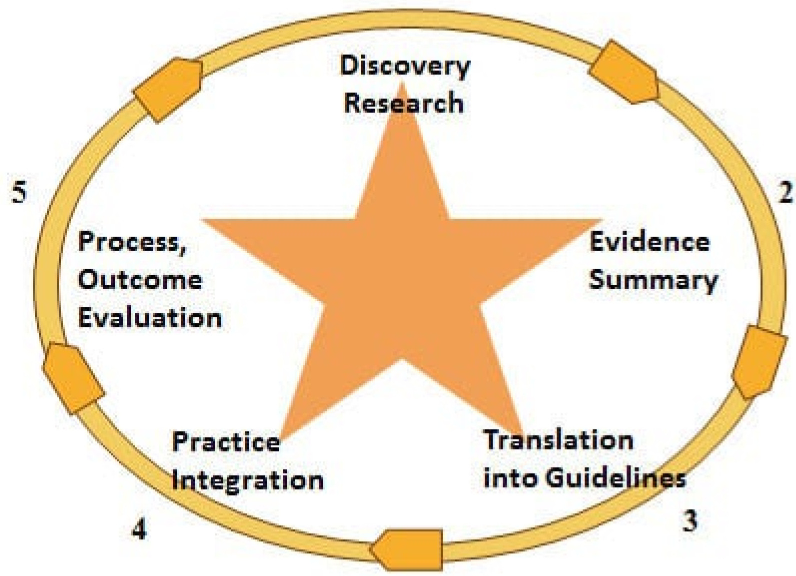
NLN Jeffries Simulation Theory



(Jeffries et al., 2015)

Figure B3

Ace Star/ Stevens Star model of evidence-based practice change



(Dang et al., 2019)

Figure B4 Budget

Phase	Activities	Cost	subtotal	Total
Implementation	Design and print educational materials (20 participants, $10 per participant)	$10	$200	$200
	Survey completion incentive (12X $25)	$25	$300	$300

	Staff training time (avg salary $40 X 20 participants X 1 hour didactic and 2-hour total simulation)	$40 per staff hour	$2400	$2400
				$2900

Figure B5 Post education survey

Rate your knowledge of (or skill in) the course topic before the course. ❑ Not at all knowledgeable ❑ Slightly knowledgeable ❑ Moderately knowledgeable ❑ Very knowledgeable ❑ Extremely knowledgeable
Rate your knowledge of (or skill in) the course topic now after the course. ❑ Not at all knowledgeable ❑ Slightly knowledgeable ❑ Moderately knowledgeable ❑ Very knowledgeable ❑ Extremely knowledgeable
How relevant is this course to your current work? ❑ Not at all relevant ❑ Slightly relevant ❑ Moderately relevant ❑ Very relevant ❑ Extremely relevant
What is your opinion of the balance of lecture and interactivity in this course? ❑ Too much lecture and not enough interactive learning ❑ Right amount of both lecture and interactive learning ❑ Too much interactive learning and not enough lecture
Will you use what you learned in this course in your work? ❑ Definitely not *[if selected, go to question on barriers]* ❑ Probably not *[if selected, go to question on barriers]* ❑ Possibly *[if selected, go to question on barriers]* ❑ Probably will ❑ Definitely will ❑ Not applicable—I did not learn anything new from this course
Barriers: ❑ I need additional training in the subject matter ❑ I will not have the resources I need ❑ I will not be provided opportunities to use what I learned ❑ I will not have the time to use what I learned ❑ My supervisor will not support me in using what I learned ❑ My colleagues will not support me in using what I learned ❑ The course content is not relevant to my current work ❑ Other (please specify):

What, if anything, do you plan to use from this course?
How could this course be improved to make it a more effective learning experience?
What part of this course was most helpful to your learning?

Figure B6. Demographics survey

Gender	
Male	
Female	
Decline to answer	
Education (may select more then one)	
Associate's degree Nursing or Respiratory Therapy	
Bachelor's Degree Nursing or Respiratory Therapy	
Graduate Degree Nursing	
Bachelor's or Graduate Degree non-nursing or RRT	
Time as an RN or RRT	
0-<1 years	
1-<5 years	
5+ year	
Do you have experience as a nurse or RRT in a critical care environment?	
Never	
0-<1 years	

1-<5 years	
5+ years	
Last Simulation Training	
Never	
0-<1 years	
1-<5 years	
5+ years	
Time since last NRP, PALS or ACLS training	
Never	
0-<1 years	
1-<2 years	
>2 years	
Have you ever participated in the resuscitation of a patient in cardiopulmonary arrest? YES NO DECLINE	