Pediatric Emergency Simulation Education in a Community Hospital

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Abstract

Pediatric emergencies are infrequent at small community hospitals, leaving staff without the opportunity to build comfort, skill competency, and understanding of their roles during this situation. Simulation training is a way to provide this experience and increase team preparedness prior to a live patient emergency. With support from leadership at the project site, the pediatric emergency response team and the staff members of the Maternal-Child Health unit were invited to participate in simulation sessions for a pediatric code. Pre-brief and debrief meetings were held for each session to provide feedback and identify common themes through the sessions. Participants completed surveys before and after the simulation, using a Likert scale to assess their perceived comfort, skill competency, and understanding of their roles during a pediatric emergency. Overall, staff reported an increase in all categories following the simulation session. Areas for protocol and policy improvement were reported and common themes for team enhancement were identified. The project was found to be cost effective and able to be replicated for future participants at the project site and other facilities.

Keywords: education, pediatric simulation, emergency, mock code

Table of Contents

Section I. Introduction

Background

The project site is a 135-bed non-profit community hospital with a four-bed general pediatric unit located in a small coastal town in North Carolina. The hospital's mission statement is to provide quality healthcare with exceptional compassion and respect ([redacted], 2022). The primary unit involved in this project was the Maternal-Child Health Department. The department includes pediatricians and nursing staff specializing in pediatrics, labor and delivery, post-partum, and Level I special care nursery. In addition, the emergency response code team also participated in this project. The emergency response code team for a pediatric emergency includes an Emergency Department registered nurse (RN) and physician, a critical care RN, a progressive care unit RN, the hospital nursing supervisor, respiratory therapists, the medical-surgical charge nurse, a pharmacist, and a laboratory technician.

Organizational Needs Statement

There is a need for education on and application of skills for pediatric code scenarios in a small community hospital. Healthy People 2030 objectives address this need, specifically with the Emergency Preparedness objective. This goal is to improve emergency preparedness and response by building community resilience (U.S. Department of Health and Human Services, 2020). As a small community hospital without a pediatric intensive care unit, pediatric codes and rapid responses are rare, and therefore staff feels unprepared for these emergencies when they arise.

Although the county served by this community hospital is rural and relatively small, there is a significant pediatric population. According to the United States Census Bureau (2021),

17.1% of the project site's county population is under 18 years old. The total population in this county is 68,541 people as of July 2021, making the pediatric population approximately 11,720. Although pediatric hospital admissions are relatively infrequent and pediatric emergencies are rare, the staff working with this population must be prepared and competent for when they occur.

Because this county is a coastal tourist destination, the number of people in the county increases during the summer for approximately four months, many of which are families with children (Carteret County Chamber of Commerce, 2022). There are also an increased number of pediatric hospitalizations in the fall and winter months, from the end of October through April. This increase is largely due to the increased incidence of respiratory illnesses, such as Respiratory Syncytial Virus (RSV) and influenza, during these months. RSV is the principal cause of respiratory tract infections in pediatric patients and is one of the leading causes of hospitalization among the pediatric population (Rose et al., 2018). Therefore, as the prevalence of respiratory illnesses such as RSV increases during the fall and winter, hospitalization rates of pediatric patients also increase.

There are approximately 15,200 pediatric cardiac arrests annually across the U.S. (Holmberg et al., 2019). Community hospitals without a Pediatric Intensive Care Unit (PICU) do not have pediatric emergency code situations as often as tertiary facilities. Typically, small community hospitals will transfer higher acuity patients to a hospital with a higher level of care, such as a PICU. However, patient status can change quickly and transport to a tertiary facility may take hours. Therefore, small community hospitals with general pediatric units can experience emergency codes. The project site had one pediatric code blue within the last year, which highlighted the discomfort and confusion among code team members in this type of emergency.

Without frequent pediatric emergencies, staff does not have the opportunity to improve their skills, confidence, and role understanding in these situations. Mock codes simulate emergencies to provide practice, identify process issues, and provide an opportunity for clarification. Although pediatric nursing staff and clinicians are required to take Pediatric Advanced Life Support (PALS), this class is only taken every two years. The length of time between reviewing pediatric code responses and algorithms might be too long to keep healthcare professionals' competency up to date. Conducting a simulated code scenario and subsequent debriefing showed statistically significant higher knowledge assessment scores for participating clinicians (Mariani et al., 2019).

The team leader's role and functions were not clearly understood during the pediatric code at the project site. Not having a clearly defined team leader led to confusion and disorganization during the pediatric emergency. Consequently, conducting frequent mock code scenarios, even as frequently as monthly or weekly in some hospitals, has increased team leader performance scores for pediatric providers (Doymaz et al., 2020). Currently, the project site is not conducting pediatric emergency or mock code simulations.

Problem Statement

Infrequent exposure to pediatric emergencies at the project site leaves the pediatric code team and Maternal-Child Health staff without preparation and appropriate teamwork to be competent during emergencies. Staff from the Emergency Department responds to pediatric codes but not adult codes. Therefore, with limited pediatric codes, they do not often work with the rest of the pediatric code team, such as the Maternal-Child Health unit staff, hospital nursing supervisor, critical care, progressive care, and medical-surgical staff. This leads to role confusion during emergencies.

Purpose Statement

This project aims to increase staff's comfort, competency, and teamwork in a community hospital through simulation and subsequent debriefing of pediatric emergency situations. A pediatric mock code blue scenario will serve as practice for staff to accomplish this goal. The quality improvement mock code will prepare the team to function at a higher level in emergency situations and to integrate into the interprofessional team. A functional team is less likely to make mistakes in an emergency that can cause adverse patient outcomes. In addition, simulations will highlight areas needing systematic improvements and policy updates.

Section II. Evidence

Literature Review

A preliminary database search for pediatric mock code education performed in healthcare facilities was conducted to gain information and support for the intervention in this project, simulation of pediatric code scenarios to increase staff comfort and competency. A search for the terms “simulation” and “pediatric code” garnered 141 results, with the exclusion criteria of publishing date greater than five years ago, full-text publications, and peer-reviewed. These results were further narrowed down to 16 by focusing on “pediatric mock code simulations.” Searches were primarily performed using the PubMed database, although a university library database search was also used. After narrowing down the results, each abstract was reviewed to determine the relevancy to the identified issue before reading them in their entirety. Ultimately, four citations were kept referencing the problem identified in this project.

A search was conducted using the PubMed database for full-text citations with the search terms "virtual simulation" and "mock code" for publications focusing on different types of simulations, such as in-person and virtual. This search garnered two results, both of which were kept for reference. Another search for "unannounced emergency simulation" provided information for comparing announced versus unannounced simulations. Twenty-four results were found in this search, and two were kept after reading titles, abstracts, and full articles to determine relevancy to this project.

Another search was conducted on the PubMed database for pre-intervention and post-intervention survey tools assessing self-perceived comfort and competency in emergency scenarios. This search was done using the terms “pediatric emergency simulation” and “pre/post survey," which provided 30 results with the inclusion criteria of being published in the last five

years, as well as full-text articles. Titles and abstracts were then reviewed to determine relevancy, and the surveys used within the studies and those determined to be relevant were read in their entirety. Three citations were kept to develop a survey tool for this project. Levels of evidence were evaluated with each search, and the articles were kept for reference using the Pyramid Model. Although a focus was placed on higher levels of evidence due to the quality improvement nature of this project, many were Level VI descriptive studies.

Current State of Knowledge

The literature supported using simulation as an educational tool in healthcare settings. For settings such as primary care or small community hospitals, simulation of infrequently experienced emergencies increased perceived comfort and competence among participants (Monachino et al., 2019). Simulation can be applied specifically to pediatric emergencies, with increased clinical preparedness and improved performance among inpatient providers following simulations (Hazwani et al., 2020). Pediatric Advanced Life Support is renewed every two years. However, the literature supports more frequent simulations, such as conducting simulations annually at a minimum, as skills in a pediatric code may decline eight months after re-certification (Doymaz et al., 2020). There are limitations in the literature available for simulations conducted outside of teaching hospitals with a larger pediatric population and Pediatric Intensive Care Units. However, the generalized benefit of simulated pediatric mock codes for healthcare providers has been established, as self-perceived comfort and competency were increased following these simulations (Doymaz et al., 2020; Hazwani et al., 2020).

Current Approaches to Solving Population Problem

Medical education through simulation uses several methods. The COVID-19 pandemic led to an increase in virtual simulations offered to medical staff. Virtual simulations have similar

results to in-person simulations for benefiting nurses' self-confidence in pediatric emergencies (Lyman, 2022). There are varying types of simulated patients for in-person simulation, including standardized patients, who are live people trained to act as a patient, and patient simulators or mannikins. Although high cost, some mannikins have programmable heartbeats, lung sounds, and other physiologic activity (Hepps et al., 2019), whereas standardized patients can more readily adapt as the scenario evolves, but without the ability to provide measurable changes in assessment findings.

Announced simulations allow for a pre-brief discussion, and the staff is aware of the scenario and what is expected of them during the simulation. However, they are also conducted unannounced, without staff being forewarned or briefed before the simulation. A study conducting sixteen simulations, eight announced and eight unannounced, found no difference in self-perceived learning and stress between these two approaches (Freund et al., 2019), and unannounced simulations can increase realism and improve fidelity. Unannounced simulations elicit authentic reactions to an emergency scenario because the staff has not internally prepared for it and how they will react. Unannounced simulations also encourage staff to identify patients with impending decompensation without prior knowledge that it will occur. (Harwayne-Gidansky et al., 2019).

Evidence to Support the Intervention

At the project site, there are mannikins available that can be programmed to provide real-time vital signs, designated areas for intravenous catheter placement, and to speak. Therefore, using these for simulated codes provides a more realistic experience when compared to standardized patients self-reporting changes in vital signs or assessment findings (Hepps et al., 2019). Mannikins are also more realistic as pediatric patients, as standardized pediatric patients

are not typically available. In-situ simulations allow for team dynamics and identifying systemic weaknesses within the code team and the hospital. As pediatric codes are infrequent, simulations are the few opportunities to make system improvements and more clearly define team dynamics (Hazwani et al., 2020). Therefore, in-situ simulation is favored over individualized virtual simulation for this project site.

The project site is a small community hospital with a fluctuating patient census. Due to this, staffing does not allow for unannounced simulations, as staff will likely not be available to participate without planning ahead. Therefore, a scheduled simulation with a pre-brief meeting would allow more staff participation. A study by Freund et al. (2019) conducted both announced and unannounced simulations and did not find a difference regarding benefits reported by the participants. Therefore, an announced in-situ simulation with a mannikin patient was conducted at the project site to maximize convenience for staff participants without hindering outcomes.

A systematic review of studies about advanced life support skills showed a benefit in team performance from debriefing after simulation (Dewolf et al., 2020). This gives an opportunity for discussion about what went well and where there is room for improvement in skills and team dynamics. In addition, a randomized cohort study by Tudor et al. (2019) found that reviewing a video of the simulation is also beneficial for constructive feedback and can be viewed during the debrief session.

Evidence-Based Practice Framework

This project was developed and executed using the Plan, Do, Study, Act framework, developed by Dr. Edward Deming and his mentor, Walter Shewhart (The W. Edwards Deming Institute, 2022). This model is a systematic approach to learning and quality improvement. The cycle is to Plan-Do-Study-Act (PDSA) when addressing a problem or developing a theory.

During the "Plan" stage, a problem is identified, a theory or intervention is developed, and details for implementation are outlined. During the "Do" stage, this theory or intervention is implemented. The outcomes of the intervention are evaluated, and problems or limitations are identified during the "Study" stage. The final step of the cycle, "Act," integrates information and data from the previous steps. This information is then used to adjust the theory or methods or expand from a small-scale to a large-scale plan (Deming, 1993). The cycle can be repeated to continue to make improvements or develop new theories.

Using the PDSA framework, the need for pediatric emergency simulations at the project site was identified, and a plan was made for implementation. The implementation of the pediatric emergency simulation was evaluated for efficacy by reviewing survey results and the feedback collected during the debrief. If necessary, the simulation could then be modified or adjusted for continuation by the project site champion.

Ethical Consideration & Protection of Human Subjects

The project site does not have an internal review board, and the project was required to go through a review process to determine if it was a quality improvement project. Collaborative Institutional Training Initiative (CITI) modules were used to prepare for the formal review and approval process. A quality/Institutional Review Board (IRB) self-certification form describing the project was completed and submitted through the university review process. The project was deemed quality improvement, and no further IRB review was required.

Every unit staff member caring for the pediatric population was invited to participate. Simulation sessions were offered three times on three different days to allow for flexible scheduling. Staff did not provide their names on the survey responses or debrief notes in order to protect their privacy. Although the pediatric population is vulnerable, there was no potential

harm, as live patients were not involved. Staff members were made aware of the nature of the simulation during the pre-brief. This educational environment was not punitive against staff if mistakes were made, and open discussion was welcomed along with constructive feedback.

Section III. Project Design

Project Site and Population

The project site is a 135-bed not-for-profit community hospital with approximately 1200 employees in a suburban town in eastern North Carolina. A mock pediatric code simulation was held on the pediatric unit in the Maternal-Child Health Department of this hospital. The participants in this simulation were the clinical staff of Maternal-Child Health and the emergency response team.

Description of the Setting

The project site primarily serves Carteret County, with a small number of patients from Onslow and Craven counties. The pediatric unit is a four-bed unit for general pediatric care within the Maternal-Child Health Department, with an average of one to two pediatric inpatient admissions per week. The simulation was held in one of the rooms on this unit to encourage a natural response from staff. The participating staff were within their own departments and responded as they would in a live emergency scenario.

Description of the Population

Participants in this simulation included registered nurses, licensed practical nurses, certified nursing assistants, and pediatricians from the Maternal-Child Health Department. The emergency response team included an emergency room physician and registered nurse, at least one respiratory therapist, the hospital supervisor, a laboratory technician, and a pharmacist. This group responds when the primary staff calls for a “pediatric code blue” as the patient has a respiratory arrest. There are currently 43 nurses and four certified nursing assistants in the Maternal-Child Health Department, four pediatricians, one pediatric nurse practitioner, and five emergency medicine physicians.

Project Team

The primary team for the project consisted of the project team leader, the project site champion, and the simulation committee for the Maternal-Child Health Department. The project team leader was responsible for reviewing pertinent literature, developing, and implementing the project. The project site champion was the director of the Maternal Child Health Department and provided support and unit resources for the development and implementation of this project. The simulation committee develops and implements quarterly simulations for the staff of this unit and provided assistance with implementing this project. In combination with this team, the support from the administration, and the cooperation of the emergency response team, this pediatric simulation expanded beyond the unit to the remainder of the hospital. The project was guided by the project faculty advisor at the University.

Project Goals and Outcome Measures

The goal of the simulation project was to increase the confidence and competency of the staff during a pediatric emergency. Staff confidence and competency were measured using a pre- and post-intervention survey. A secondary goal was to identify gaps in the emergency response process.

Description of the Methods and Measurement

A pre-brief was held prior to the simulation to discuss common causes of pediatric emergencies and common medications used in this population. Visual aids, including an educational poster and written hand-outs with pertinent information, were used to reinforce this information (Appendix A). Following this, a simulation of a pediatric emergency ran from the start of the patient decompensating to the end of the code when the patient had been stabilized (Appendix B). Standardized questions to prompt discussion during the debrief session were

open-ended, including "What went well during this simulation" and "What can be improved on in the future."

Discussion of the Data Collection Process

Prior to starting a pre-brief discussion for the simulation, each participant completed the pre-intervention survey, rating their initial self-perceived confidence and competency using a three-statement, four-point Likert Scale from strongly disagree to strongly agree (Appendix C), as well as providing their job title and the department that they work in to track participation. Following the simulation and debrief, each participant completed the same three-question Likert Scale survey. The responses were recorded in a table and the averages of these responses were evaluated for changes in pre- and post-survey Likert Scale ratings. The post-survey also provided a free-text section for participating staff to leave comments and a fourth Likert Scale statement that the simulation was relevant and helpful (Appendix D). The information gathered during each debrief discussion were compiled in a document to identify any consistencies between simulations, and comments were reviewed for common themes.

Implementation Plan

Staff from each department on the emergency response team and in Maternal-Child Health were invited to sign up for a simulation time and date. Participation was mandatory for Maternal-Child Health staff per the director’s request. An email was sent to inform staff to sign up on the project site's education portal by December 1, 2022, or they would be assigned a time slot. Emergency response team members were emailed and invited to participate and select a date and time slot listed in the email. This was used to ensure that staff in each role were present for each simulation, making it more realistic and running more smoothly.

Following the pre-brief and completion of the pre-survey, the primary pediatric nurse cared for the simulated patient until the patient decompensated, and the nurse called for assistance from her team on Maternal-Child Health. As the patient's condition worsened, a Pediatric Advanced Life Support (PALS) code blue was called to get assistance from the emergency response team and the pediatrician on call. The team ran the code until the patient stabilized, at which time the simulation ended. All participants then met for the debrief session and completion of the post-survey. Following each simulation, a PDSA cycle review was conducted to evaluate for improvements to be made prior to the next simulation.

Timeline

The planning process for this project began in June 2022. Staff were notified in October 2022 to ensure availability for one of the offered sessions. Three simulations were conducted on one day in each month, January, February, and March 2023, for a total of eight simulations (Appendix E). Following each simulation, the data from the survey results, comments, and debrief discussion notes were compiled for evaluation for improvement.

Section IV. Results and Findings

Results

Over the course of the eight sessions, there were 78 participants across all invited professional groups. Of the 39 nurses invited from Maternal Child Health, 38 (98%) participated, with three additional nurses assisting as part of the simulation team and one as the team lead. One nurse from the unit was on medical leave and exempt from participating. There was also 100% participation from the four certified nursing assistants on Maternal Child Health. Three of the five (60%) pediatric providers and two of the five (40%) emergency department physicians participated. In addition, 14 of the 19 (74%) pharmacists and 13 of the 14 (93%) respiratory therapists participated.

There were pre-intervention and post-intervention surveys available to all participants for completion. Sixty-eight responses were received for both the pre-intervention and post-intervention surveys. All (100%) of certified nursing assistants and pharmacists who participated provided responses. However, not all participants completed these surveys. Thirty-six (95%) nurses and 11 (85%) respiratory therapists provided responses. Two of the three participating pediatric providers responded, and one of the two emergency department participants responded. Those who did not complete the surveys did not complete either survey.

Overall, there was improvement among the participants on the first statement, “I clearly understand my role during a pediatric emergency” from the pre-intervention to the post-intervention survey, with an average of 3.7 out of 4 on the post-intervention survey compared to 3.4 out of 4 on the pre-intervention survey (Appendix F). There was improvement among nursing staff for this statement with an average response on the post-intervention survey of 3.35 out of 4 compared to 2.8 out of 4 on the pre-intervention survey. There was also improvement

among the pharmacists for this statement, with an average response on the post-intervention survey of 3.5 out of 4, compared to 2.9 out of 4 on the pre-intervention survey. No change was noted among respiratory therapists, and emergency department or pediatric providers, with an average of 4 out of 4 on both the pre- and post-intervention surveys.

The responses to the second statement, "I feel confident in my ability to participate in a pediatric emergency," also showed overall improvement among the participants, with an average response on the post-intervention survey of 3.6 out of 4 compared to the average pre-intervention survey response of 3.2. A major difference was noted among the nursing staff and pharmacists. The average response on the post-intervention survey was 3.35 out of 4 for nurses on the post-intervention survey compared to 2.6 out of 4. The average response on the post-intervention survey was 2.95 out of 4 for pharmacists compared to the average response on the pre-intervention was 2.3 out of 4. There was minimal improvement noted among respiratory therapists, with an average post-intervention survey response of 4 out of 4, compared to an average pre-intervention survey response of 3.8 out of 4. There was no change noted in both emergency department and pediatric provider responses, with an average of 4 out of 4 on both the pre- and post-intervention surveys.

The responses on the third statement, "I am competent in my clinical skills during a pediatric emergency," also noted an overall improvement among the participants, with an average response on the post-intervention survey of 3.6 out of 4 compared to the average pre-intervention survey response of 3.2. There was notable improvement among the nursing staff and pharmacists, with the average response on the post-intervention being 3.3 out of 4 compared to 2.65 out of 4 for nurses. The average response for pharmacists on the post-intervention survey was 2.95 out of 4, compared to the pre-intervention survey average response of 2.2 out of 4 on

the pre-intervention survey. Little improvement was noted among respiratory therapists, with an average post-intervention survey response of 4 out of 4, compared to an average pre-intervention survey response of 3.9 out of 4. There was no change noted in both emergency department and pediatric provider responses, with an average of 4 out of 4 on both the pre- and post-intervention surveys.

On the post-intervention survey, participants were asked to respond to the statement, "I feel that this simulation was helpful and relevant to my job." Of the 68 responses received from all role groups, 67 (99%) participants indicated that they either agreed or strongly agreed with this statement. One member of the Maternal-Child Health staff responded "disagree" with this statement.

Participants were also able to provide feedback during debrief sessions. Common themes for what went well during the simulation were identified. These included using callouts and callbacks with closed-loop communication, calling for assistance quickly, giving a report to the responding code team, staying calm during the emergency, and stabilizing the patient. One common theme noted for improvement in future emergencies was that the Pediatric Advanced Life Support (PALS) trained nurse remain the code team leader with the physician, rather than performing hands-on skills. Other common themes identified were to clearly announce roles when entering the room, to ensure the code is called correctly on the overhead system by the operator, and to know where supplies and medications are located.

The comment section of the post-intervention survey and the debrief sessions identified opportunities to address hospital policies and procedures. These included the lack of a pediatric rapid response policy and the lack of an intraosseous injection kit on the Maternal Child Health unit or a policy that the responding code team will bring this. Another area to be addressed

within the hospital was the lack of medication commonly used during pediatric emergencies, such as intubation medications, in the emergency bags that the pharmacists bring to codes.

Discussion of Major Findings

The evidence in the literature supported the findings of this project. The simulations provided a non-judgmental learning opportunity to practice and iron out problems in a code and the debrief sessions allowed for active discussion without fear of penalty. Dewolf et al. stated that there was a benefit in team performance from debriefing after simulation (2020), which was noted in this case by the fruitful debrief discussions. The literature also identified announced simulations with a mannikin patient as a successful method for education (Freund et al., 2019; Hepps et al., 2019). In this project, this method allowed for high participation percentages from the invited departments, as the simulations were announced and staff chose a time and date to participate. The mannikin allowed for participants to practice their clinical skills (IV placement, oxygen placement, and intubation), rather than verbalize what they would do to a live standardized patient.

On average, participants felt more confident in their abilities, more clearly understood their roles, and felt more competent in their clinical skills during a pediatric emergency after the simulation. By making these improvements, the interdisciplinary team will work more effectively and is more prepared for a live patient emergency. Identifying areas to address within the hospital during a simulation also allows the team and the hospital itself to be more prepared and have access to necessary resources during a pediatric patient emergency.

Section V. Interpretation and Implications

Costs and Resource Management

Costs were considered for this project with an overall estimate of $5085.37 (Appendix G). Most of these costs were for the wages of participating staff, both as the simulation team and those who participated in the simulations, and the required supplies. However, the education department at the organization provided the necessary supplies. These supplies were stored as they expired and were already taken out of circulation for patient use. Examples of expired supplies included intubation supplies, a pediatric ambu bag, a pediatric non-rebreather, a pulse oximeter, intravenous catheters and placement kits, intravenous fluids and administration tubing, and a nebulizer kit. Therefore, only the few supplies not available from the education department were taken from the Maternal Child Health unit stock with an added cost, such as a pediatric nasal cannula and a pediatric blood pressure cuff. The estimated cost of supplies for this project was $622.87, and the estimated cost for labor was $4462.50.

The cost of wages was offset because the Maternal Child Health department already budgeted for quarterly simulations. The pediatric-specific simulations were added to the rotation of scenarios, so there were no additional increases in hourly wages required for their staff. Other interdisciplinary team members including the physicians and pharmacists participated in the simulation during work hours.

The cost of future simulations would be lower than the initial cost of this project. All supplies and equipment used during the simulations have already been collected and saved for future use. The various departments continue to collect expired supplies that could be used to replace outdated or broken supplies at no additional cost. The visuals and educational material created for this project could be used in the future, requiring less time for planning. The project

site also offers clinical ladder advancement for those with volunteer hours, and therefore staff may be willing to assist with future simulations at no cost. Future costs of wages would be required for the simulation team for the time spent revising simulation scenarios, setting up and cleaning up on simulation days, and coordinating meetings with stakeholders. Costs associated with wages would also include participants during the simulations and members of the simulation team who did not choose to volunteer. Additional costs include printing costs for educational materials and replacement supplies if no longer functional and unavailable from the education department.

Not only are the costs of continuing these simulations low, the benefits are high. Increasing staff competence and confidence can increase job satisfaction and therefore decrease staff turnover (Woda et al., 2019). Replacing staff comes with costs, including paying for an orientation process, as well as the loss of knowledge and experience on the unit, which exemplifies the benefit of reducing turnover. The pediatric simulations have the capability of increasing collaboration which leads to more effective teamwork and improved patient outcomes (Doymaz et al., 2020). Identifying the institution's policy and procedure gaps before live emergencies also improves patient outcomes. Therefore, the benefits of this project extend from staff to patients, to the organization while being associated with a small cost.

Implications of the Findings

Implications for Patients

By improving staff competency and comfort in pediatric emergencies, as well as improving the collaboration within the emergency response team and identifying gaps in the organization, patient care is improved. Having a more prepared interdisciplinary healthcare team with improved communication, collaboration, and understanding of team member roles during

an emergency situation, can lead to a decrease in mistakes, foster patient safety and improve patient outcomes. Identifying the need for a pediatric rapid response policy and addressing this need allows for quicker identification and intervention for a decompensating pediatric patient, which also improves patient care. By ensuring staff are familiar with the availability and location of emergency supplies and medications, patient care can be provided in a timelier and more efficient manner leading to better outcomes.

Implications for Nursing Practice

The simulations showed benefits for the participating staff, increasing their comfort and competency during an emergency, and assisting with their growth and knowledge in their nursing role. The simulations also allowed for collaboration between nursing and other involved departments, including respiratory therapy, pharmacy, and physicians to create a cohesive team dynamic. This provides the opportunity for nurses to serve as a successful co-lead of the multidisciplinary team with the physician during a pediatric code. Exemplifying the benefit of these simulations encouraged the Maternal Child Health Department leadership to continue pediatric emergency simulations for departmental nursing staff, which will help maintain nursing competency and confidence in less frequently used skills.

Impact for Healthcare System(s)

This project supported the use of simulation for education and interdisciplinary collaboration within small community hospitals. Simulation training is a method to allow teams to practice and iron out problems prior to real-life scenarios, which was demonstrated during the simulations conducted in this project. This project also showed how simulations could be used to identify policy and protocol changes that are needed within a healthcare system prior to a real-life scenario. The overall impact of these factors is improved patient and staff satisfaction,

patient outcomes, and lower costs from decreasing staff turnover and sentinel events. This helps the hospital to align with the Healthy People 2030 aim of improved emergency preparedness.

Sustainability

This project is sustainable at the project site because quarterly simulations are currently required for the Maternal-Child Health Department staff. Prior to the project, all simulations focused on maternal care. Moving forward, pediatric emergency code scenarios will be included annually in the simulation training session rotation. Staff members have been identified as the simulation coordination team to continue with future simulation training sessions. The staff who participated in these simulations voiced their support for continuing the simulations and found them beneficial, according to the post-intervention survey. With positive feedback from staff and stakeholders, and support from Maternal Child Health Department leadership, simulation training with a pediatric code component will likely continue.

Policy change is being addressed by the administration from the respiratory therapy department, which coordinates the emergency response teams. Policy change will include the addition of a pediatric rapid response and will be incorporated in subsequent simulation training. Overall, simulations will continue to be required for these staff members every quarter, but there is further discussion about how often pediatric emergency scenarios will be included in these quarterly simulations.

Dissemination Plan

This project was presented at the College of Nursing on July 11, 2023 for an audience of faculty, administration, students, and stakeholders. The project paper was submitted to the University Scholarship Repository, a digital archive for scholarly work at the institution, for public access. At the project site, the information from this project is being included in a binder

for submission to Joint Commission by the code team administration during a review at an unknown date in 2023. A meeting was conducted with the project site champion to discuss the project outcomes on April 27, 2023. A presentation was offered to the administration as well as stakeholders in the emergency department in order to garner continued support and increased participation in future simulations. Beyond the institution and project site, a manuscript will be sent to the Journal of Doctoral Nursing Practice and an abstract will be sent to ProQuest. This project is being submitted to these publications because they promote the value of education in nursing.

Section VI. Conclusion

Limitations and Facilitators

Limitations

There were limitations associated with the project. Emergency department staff showed some resistance to participation. Management in the emergency department did not require mandatory participation, which led to only a few staff members participating. Although individuals staffing on the unit made an attempt to respond, due to time constraints and high census, they were rarely able to participate. Those who did participate did not complete pre-intervention or post-intervention surveys or attend the debrief session to provide feedback, except for one physician. A barrier to data collection was that some staff members forgot to include job titles or departments on the pre-intervention or post-intervention surveys, making it difficult to aggregate responses into role groups. The data collected was self-reported survey responses from participants and therefore was influenced by individual perception rather than objective information.

A limitation of the project as it relates to real-life scenarios was the unrealistic nature of the preparation, awareness of the scenario, and the use of a mannikin. Staff was provided time and information to prepare prior to the event, and were made aware that the patient in the simulation would decompensate, which may have changed their actions during the simulation. In using a mannikin, real-time vital signs and responses to interventions were not available and had to be provided by the project lead as the scenario progressed. Staff were reminded frequently to treat the scenario as a real-life situation and to perform interventions as they typically would, rather than simply pretending to or verbalizing that they would complete them.

Facilitators

A facilitator in this project included support from Maternal-Child Health, pharmacy, and respiratory therapy leadership, as well as from the Chief Nursing Officer at the organization. With their support, there was participation from majority of the staff in these departments, creating a realistic emergency response team. Another facilitator was the cooperation from the simulation team on Maternal-Child Health and from two PALS instructors, who assisted with coordinating and running the simulations. The medical director in the emergency department permitted the team lead to present the simulations during a provider staff meeting to attempt to encourage participation, from which one provider agreed to sign up.

A facilitator to the PDSA process was the real-time feedback from participants on how to improve the simulation prior to the next sessions. Some feedback included creating an airway box for respiratory therapists after the first simulation because they use this in real-life scenarios. Another adjustment during the PDSA process was adding supplies that participants were looking for during the simulation, such as having both a non-rebreather mask and a nasal cannula available.

Recommendations for Others

In order to replicate this project, close collaboration and discussion with management is required to continue to involve all relevant departments. This communication should be done as early in the planning process as possible in order to give the stakeholders time to coordinate their staff and cover the needs of the units. When doing so, encouraging staff to attend when they are not staffing on their unit is encouraged to ensure census constraints do not limit their participation. This would also ensure that staff are able to participate through the completion of the simulation and participate in the debriefing sessions.

At the project site, the project is sustainable and easily replicated due to the support structure that is currently in place, as the Maternal-Child Health simulation team currently conducts quarterly simulations. The education requirements for the unit include attending these quarterly simulations, making participation in future simulations compulsory for this staff. In order to increase participation from the emergency department staff, it would be recommended to identify a site champion to provide support within this department to promote and foster participation.

Recommendations for Further Study

Future simulations should focus on varying pediatric emergency scenarios, including cardiac arrest requiring cardiopulmonary resuscitation with compressions and future medications. There are several causes of decompensation in a pediatric patient, with the case in the project, a respiratory arrest due to asthma, being only one. By conducting simulations with varying causes of the emergency, staff will have to alter their course of treatment and the skills and interventions employed. Once a pediatric rapid response policy is created at this organization, the need for which was identified in this project, a simulation can be used to activate this team and ensure this runs smoothly.

The pediatric code simulation project can be replicated both at community hospitals and larger medical centers using their own pediatric emergency response team and common patient scenarios. Emergency simulation can also be applied to other patient populations, including adults, which require the adult code team. Other specialized populations require a different code team than both adult and pediatric codes. For example, maternal patients require coordination with obstetricians and both the adult and neonatal code teams, and a simulation can be performed with this population.

Final Thoughts

The aim of this project was to work with the Maternal-Child Health and emergency response staff to develop and implement a simulation for a pediatric mock code. This was done to increase staff competency and comfort, as emergency situations do not often arise in a small community hospital. In addition, these simulations allowed staff to practice their response in emergencies, collaborate with other departments where they typically do not work, and provide real-time feedback during debrief sessions. Overall, the participants reported improved understanding of their roles during a pediatric emergency and perceived comfort and competency in the situations. Also, the participants overall reported that these simulations were beneficial and relevant to their job responsibilities.

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Appendix A

Simulation PowerPoint Education

Common triggers

- Allergens
  - Animal dander
  - Mold
  - Outdoor plants/pollen
  - Dust
  - Cockroaches
- Viral illness
- Irritants
  - Air pollution
  - Cigarette smoke
- Weather
  - Hot, humid air
  - Thunderstorms (increased mold, pollen, etc.)
- Physical activity (exercise-induced asthma)

Presenting Symptoms

- Increase WOB
  - Retractions/accessory muscle use
  - Increased respiratory rate
  - Wheezing
  - Prolonged expiratory phase
  - Cough
  - Oxygen desaturation is a late sign
- Chest tightness
- LOC changes
  - Agitation, confusion, lethargy
- Tachycardia (bradycardia is a sign of impending arrest)

Key Exam Elements (PASS: Pediatric Asthma Severity Score)				
	Moderate	Severe	Critical	Impending Respiratory Arrest
Wheezing	Moderate (1) Throughout expiration	Severe(2) Inspiratory & expiratory or absent due to poor aeration	Severe (2) Inspiratory & expiratory or absent due to poor aeration	Diminished or absent due to poor aeration
Work of breathing	Moderate (1) Intercostal retractions	Severe (2) Suprasternal retractions, abdominal breathing	Severe (2) Suprasternal retractions, abdominal breathing	Tiring, inability to maintain work of breathing
Prolonged expiration	Moderate (1)	Severe (2)	Severe (2)	Severe, difficult to assess in setting of poor aeration

Other Exam Elements (not assessed in PASS)				
	Moderate	Severe	Critical	Impending Respiratory Arrest
Breath sounds/ Aeration	Decreased at bases	Widespread decrease	Widespread decrease	Absent/minimal
Talks in	Phrases	Words	Words/refuses	
Alertness	May be agitated	Agitated	Agitated or drowsy	Obtunded or combative
GCS: Eyes	Normal spontaneous (4) If sleeping, responsive to voice may be normal (3)	Normal spontaneous (4) If sleeping, responsive to voice may be normal (3)	Normal spontaneous (4) If sleeping, responsive to voice may be normal (3)	Responsive to pain (2) Unresponsive (1) Decline in score most worrisome

Symptoms				
	Moderate	Severe	Critical	Impending Respiratory Arrest
Breathlessness	While at rest For infants: Soft or shorter cry Difficulty feeding Prefers sitting	While at rest For infants: Stops feeding Sits upright	While at rest Tripod positioning For infants: Stops feeding Sits upright	

FiO_2 Requirement for SPO_2 > 90% (Hypoxemia)				
	Moderate	Severe	Critical	Impending Respiratory Arrest
FiO_2 Requirement	≤ 50%	≤ 50%	Variable	Variable

Summary of Exacerbation

- **Mild** – Normal alertness, slight tachypnea, expiratory wheezing, a mildly prolonged expiratory phase, minimal accessory muscle use, oxygen sat >95 percent.
- **Moderate** – Normal alertness, tachypnea, wheezing throughout expiration with or without inspiratory wheezing, an inspiratory-expiratory ratio of approximately 1:2, significant use of accessory muscles, oxygen sat typically 92 to 95 percent.
- **Severe** – Lethargy or agitation, inability to repeat a short phrase, extreme tachypnea, inspiratory and expiratory wheezing, an inspiratory-expiratory ratio exceeding 1:2, very poor aeration, significant use of accessory muscles, oxygen saturation typically <92 percent.

Pulmonary Index Score (PIS)

Score	Respiratory rate		Wheezing	Inspiratory/ expiratory ratio	Accessory muscle use	Oxygen saturation
	<6 years old	≥6 years old				
0	≤30	≤20	None*	2:1	None	99 to 100
1	31 to 45	21 to 35	End expiration	1:1	+	96 to 98
2	46 to 60	36 to 50	Entire expiration	1:2	++	93 to 95
3*	>60	>50	Inspiration and expiration	1:3	+++	<93

The total score ranges from 0 to 15. The PIS is interpreted as follows:

- Mild exacerbation: <7
- Moderate exacerbation: 7 to 11
- Severe exacerbation: ≥12

However, the PIS may underestimate the degree of illness in an older child. Older children, with prolonged expiratory phases, may become bradypneic with a moderate-to-severe attack. As such, their score for respiratory rate may be falsely reassuring.

* A score of 3 is given for "wheezing" if there is no wheezing due to minimal air entry.

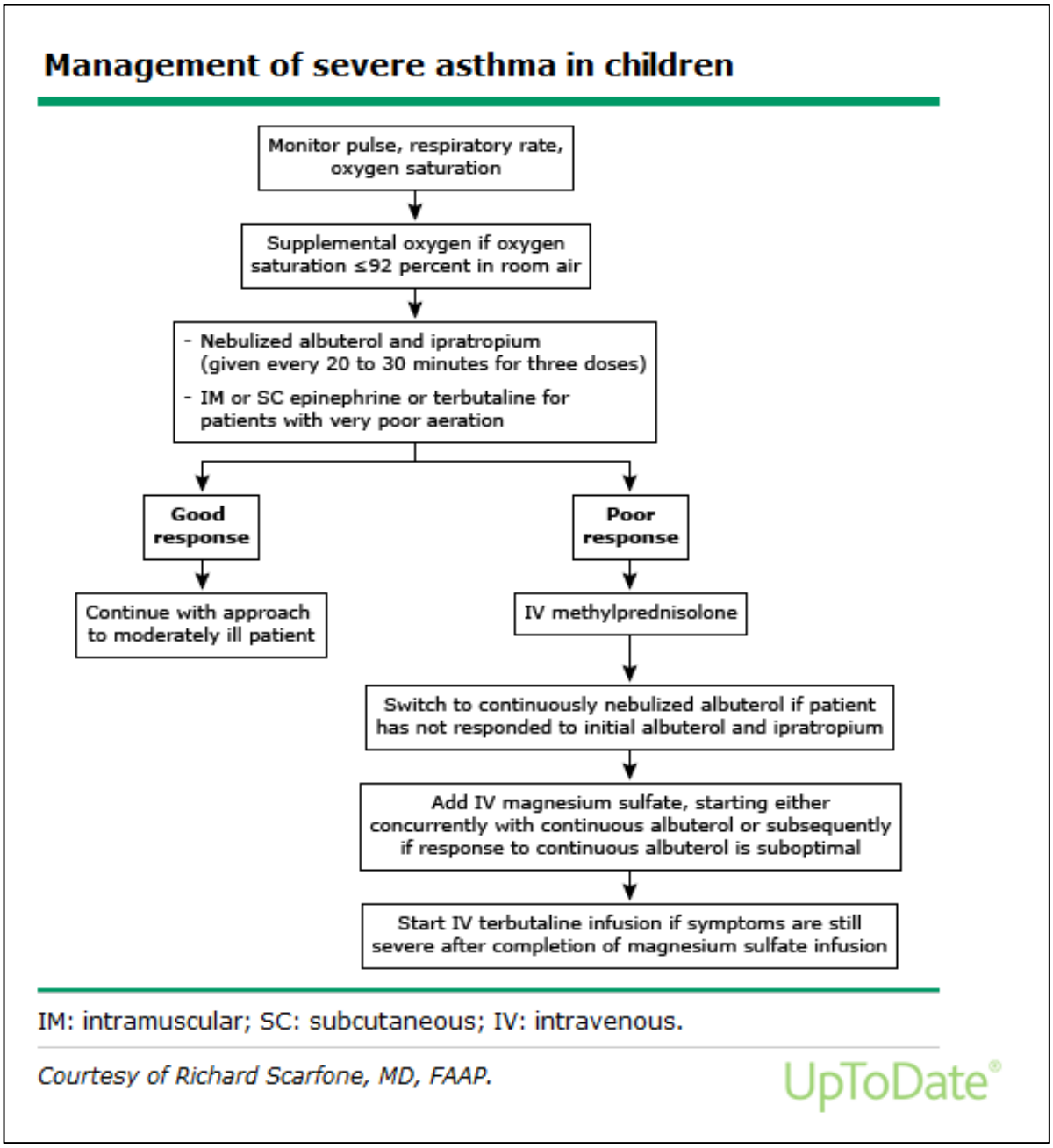
Evaluating Asthma Exacerbation

Common Inhaled Medications

- Albuterol:
  - Intermittent: 0.15mg/kg/dose (min 2.5mg/dose; max 5mg/dose) q20min x3 doses
    - THEN: 0.15-0.3mg/kg/dose (max 10mg/dose) q104hrs PRN
  - Continuous: 0.15-0.5mg/kg/hr. (max dose 30mg/hr.)
- Ipratropium Bromide
  - <20kg: 250mcg/dose
  - >20kg: 500mcg/dose
  - Q20min x3 doses, then PRN (can combine with albuterol for intermittent or continuous nebulizer treatment (DuoNeb)

Common Systemic Medications

- Systemic Glucocorticoids
  - Prednisolone: 1-2mg/k (max 60mg/day) PO x1, then 0.5-1.0mg/kg BID
  - Dexamethasone: 0.6mg/kg (max 16mg/day) IV/IM/PO
  - Methylprednisolone: 1-2mg/kg (max 125mg/day) IV
- Magnesium Sulfate
  - 50mg/kg standard dose (25mg/kg-75mg/kg) over 20min



Medications for Severe Exacerbation with Poor Aeration

- Epinephrine
  - 0.01 mg/kg IM or SC (maximum 0.4 mg/dose = 0.4 mL of 1 mg/mL solution). May be repeated every 10 minutes as needed
- Terbutaline
  - 0.01 mg/kg SC or IM (maximum 0.4 mg/dose = 0.4 mL of 1 mg/mL solution). May be repeated every 10 minutes as needed or IV terbutaline is initiated.
  - IV bolus 10mcg/kg over 10min, continuous 0.4-2.0mcg/kg/min
- May give IM or SC epinephrine **OR** terbutaline, but not both.

Appendix B

Simulation Scenario

Hand-off report: 6-year-old male, admitted from the ED for URI with asthma exacerbation, arrived to the floor approximately 30min ago in fair condition. History of asthma, previously using albuterol PRN at home, no daily medications. Family history significant for childhood asthma. Reports 2-day history of cough and congestion with worsening SOB today. On admission to the floor, had some mild to moderate intercostal and subcostal retractions. Admission vitals: O2 sat 94% on RA, RR 24, axillary temp 100.2, HR 115, BP 108/54. Weight 21kg. Diffuse expiratory wheezing bilaterally on auscultation. Received two albuterol nebs back-to-back just prior to arrival to the floor, improvement noted per ED report. No other medications given thus far. No IV access.

Patient Condition	Expected Intervention
Patient is sitting up in bed, not currently connected to any monitors.	Begin physical assessment, results given as performed. Place on continuous pulse ox.
HR 130bpm, RR 36, O2 sat 87% on room air, BP 110/50. Awake, alert, can give short verbal response. Scattered, diffuse wheezes bilaterally, moderate subcostal, intercostal, and substernal retractions	Initiate oxygen on the patient, re-position, suction if needed. Page RT and pediatrician (verbalize if not present). Call for assistance from MCH team. Re-assess VS. Place on cardiopulmonary monitor.
HR 138. RR 39, O2 sat 88%, BP 111/54. Tracheal tug noted, retractions worsening. Decreased air movement on auscultation. Patient becomes unresponsive and respirations begin to fall.	Place on non-rebreather, have BVM on hand. Call a PALS code blue as RT and the pediatrician have not arrived. Place IV access if not done so already, blood work as indicated (CBC, blood cultures, electrolytes, VBG). Await arrival of code team.
HR 160. Respirations 20 and shallow, BP 100/55, O2 sat 85% on 100% O2.	Initiate albuterol nebulizer, consider ipratropium (duoneb). Give IV steroids and start magnesium sulfate.
Patient experiences respiratory arrest. HR begins to fall, now 90s. BP 90/50.	Begin bagging the patient and call for intubation. Prepare equipment for intubation. Check tube placement post-intubation (auscultate, CO2 detector). Call for STAT x-ray for placement.
Chest rise noted bilaterally, lung sounds auscultated but with decreased air entry and wheezing bilaterally. Tube placement is confirmed via X-ray. VS HR 80, RR bagging, O2 sat 82% on 100% oxygen but rising. BP 80/50.	Begin continuous nebulized albuterol via ETT. Suction ETT PRN. Insert 2nd IV and repeat labs if ordered (repeat blood gas). Initiate IVF bolus.

Appendix C

Pre-Intervention Survey

Pediatric Code Blue Pre-Intervention Survey

Job title and department:

I clearly understand my role during a pediatric emergency

1	2	3	4
Strongly disagree	Disagree	Agree	Strongly Agree

I feel confident in my ability to participate in a pediatric emergency

1	2	3	4
Strongly disagree	Disagree	Agree	Strongly Agree

I am competent in my clinical skills during a pediatric emergency

1	2	3	4
Strongly disagree	Disagree	Agree	Strongly Agree

Comments:

Appendix D

Post-Intervention Survey

Pediatric Code Blue Post-Intervention Survey

Job title and department:

I clearly understand my role during a pediatric emergency

1	2	3	4
Strongly disagree	Disagree	Agree	Strongly Agree

I feel confident in my ability to participate in a pediatric emergency

1	2	3	4
Strongly disagree	Disagree	Agree	Strongly Agree

I am competent in my clinical skills during a pediatric emergency

1	2	3	4
Strongly disagree	Disagree	Agree	Strongly Agree

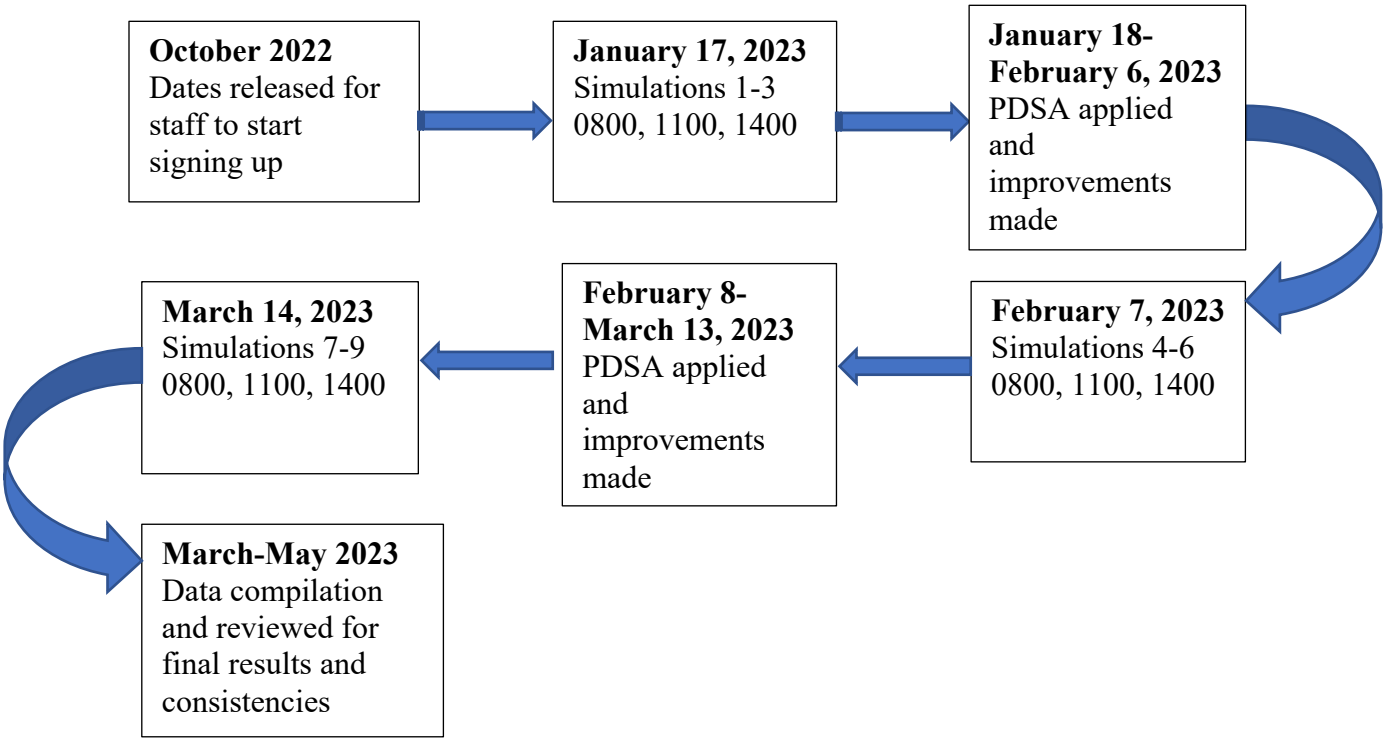
I feel that this simulation was helpful and relevant to my job

1	2	3	4
Strongly disagree	Disagree	Agree	Strongly Agree

Comments:

Appendix E

Project Timeline



Appendix F

Data Findings

Average Response for All Participants

	Pre-intervention	Post-intervention
"I clearly understand my role during a pediatric emergency	3.4	3.7
"I feel confident in my ability to participate in a pediatric emergency"	3.2	3.6
"I am competent in my clinical skills during a pediatric emergency"	3.2	3.6

Average Response for Maternal-Child Health Nurses

	Pre-intervention	Post-intervention
"I clearly understand my role during a pediatric emergency	2.8	3.35
"I feel confident in my ability to participate in a pediatric emergency"	2.6	3.35
"I am competent in my clinical skills during a pediatric emergency"	2.65	3.3

Average Response for Pharmacists

	Pre-intervention	Post-intervention
"I clearly understand my role during a pediatric emergency	2.9	3.5
"I feel confident in my ability to participate in a pediatric emergency"	2.3	2.95
"I am competent in my clinical skills during a pediatric emergency"	2.2	2.95

Appendix G

Project Budget

Wages

Item	Cost	Total
Participation wages	$35/hr x 1.5hrs x 68	$3570.00
Simulation team wages	$35/hr x 8.5hrs x 3	$892.50

Total: $4,462.50

Supplies

Item	Cost	Total
IV fluids • IV fluid bag • IV start kit • IV catheter	$305.58 + $8.86 + $12.55	$326.99
Respiratory supplies • Nasal cannula • Non-rebreather mask • ETT tube • Nebulizer kit • Ambu bag • Laryngoscope	$47.80 + $14.59 + $6.50 + $146.79 + $25.94 + $27.99	$269.61
Patient monitoring • Blood pressure cuff • Pulse oximeter	$11.27 + $15.00	$26.27

Total: $622.87