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Medical errors are the third leading cause of death in the United States. The most common and fatal type of medical error is medication error. This quantity of medication errors costs hospitals $40 billion each year (Izadpanah, F, et al., 2018). The pediatric population is more likely than adult populations to have a healthy patient become significantly unwell in a short period of time. Correct timing and dosing of medication is important to ensure patients are able to survive. Weight based dosing is used in pediatrics to guarantee patients are receiving appropriate medication amounts. Medication errors are common in the Pediatric Intensive Care Unit (PICU) due to frequent use of hazardous drugs in conjunction with weight-based dosing (D'Errico, F, et. al., 2022). It has been estimated that the annual amount of medication errors in pediatric inpatient accounts for 7.5 million preventable mistakes (D'Errico, F, et. al., 2022). The quantity of medication errors in pediatrics are higher than other facilities, and medication errors in the pediatric population are more life threatening. Fourteen to 31% of these medication errors could result in death (D'Errico, F, et. al., 2022).

Potential medication errors can occur at any time: due to an incorrectly written prescription, incorrect entry into the computer system, errors in drug preparation and dispensation, or administration errors. Nursing staff are the final touchpoint and last check prior to drug delivery and administration. When nursing staff are appropriately educated with the use of hands-on learning or simulation on how to administer medications and correctly calculate drug dosages, medication errors can be prevented (D'Errico, F, et. al., 2022). An impactful method to prevent medication errors is through education of nursing staff and monitoring of practice changes (D'Errico, F, et. al., 2022).

The purpose of the quality improvement (QI) project is to evaluate the effects of a simulation on medication error occurrence in the pediatric ICU. The aim of this QI project is to reduce medication errors by 10% in pediatric patients 0-18 years of age over a three-month time period. The primary outcome measure will be nursing medication errors. Medication errors were tracked by the use of a hospital-based reporting system and events were filtered into medication errors. Provider based errors were excluded from the data collection. Following implementation, the secondary outcome measures will be the number of nursing staff who completed the simulation and the nursing medication errors following the implementation.

Literature Review

Medication errors are common in health care, and especially in the PICU. Data Search engines used were CINAHL, EBSCO, Summon, PubMed, and google scholar. The key search terms used to further find educational data was simulation training and medication errors. The inclusion criteria included full text, academic resources, children aged 0-17 years, hospitalized patients, and articles published between 2017 and 2022. The exclusion criteria were non-English, non-peer reviewed, and publication before 2017, unless the data was pertinent for a successful project. Since this topic is fairly new to research presently, the inclusion criteria were broadened to collect a larger dataset. The focus for this particular project is on pediatric population. The literature review was conducted on a larger population.

Data was collected from EBSCO and google scholar with assistance from a librarian from University on Missouri St. Louis. When collecting the information, the

information yielding was sectioned into two different groups. One particular study topic which was collected provided information on ways to reduce medication errors in the hospital setting. The second study topic which was collected provided information on simulation and reduction to medication errors.

Simulation Training Data

The literature collected provided information on simulation training and if the data showed a reduction in the number of medication errors. Daupin et. Al. provided information on a descriptive cross-sectional study, with the idea to determine if the simulation would reduce medication errors for each party involved in the medication system (medical team, pharmacy, and nursing staff). The sample size was large, with a total of 500 patients in a mother baby unit, which provided less bias and skewed results for the study. However, the descriptive cross-sectional study provided a low level of evidence for the reviewer. This study was able to conclude the use of simulation training had reduction in medication errors in a mother baby unit. The determinization of Dauphin et al's study revealed with medication systems becoming increasingly complex, the use of high technology simulation training will raise awareness for overall critical processes. To conclude, further research should be conducted to continue to provide simulation training education in the future, since the literature determined a positive outcome for this setting.

Sears et al., used a similar approach to Daupin et al. with a descriptive cross sectional study approach. The study collected data on whether simulation training effected new nursing student's medication errors in a medical surgical unit. The sample size was small with the use of two control groups, which provided skewed results for this

study. The study gathered strong data on simulation training to provide valid and reliable results. However, with the use of a sample size this small, the validity was affected. The recommendations for Daupin et al, and Sears et al., was to continue to create a larger sample size and gather more data to continue to make the study more reliable. This directly affected the validity and reliability for the study. These studies had similar strengths and provided good evidence that the use of simulation training directly provided positive results for reduction of medication errors.

LeBlanc, Lame and Woods., Safarti et al., study was created from the collection of data from multiple different databases, this particular study used as a systematic review approach. This creates a high level of evidence and provides strong validity in the collection. LeBlanc used a systematic review approach to determine if different types of simulation training effected medication errors. The different types of simulation used in LeBlanc's study was high fidelity, low fidelity, virtual simulation, and low cost immersive. With the data collected, it was a high level of evidence, but it was not clear which setting the simulation training was used in. Similarly, to other studies involving simulation training, further research needs to be conducted to increase the use of simulation training. Since the areas in which simulation training have been implemented have positive outcomes, further data collection will be in the apparent future. LeBlanc states with the optimal use of simulation training further understanding will occur and further understand of what exactly may be accomplished with the use of simulation.

Lame and Woods provided a literature review on the use of simulation training in health care to reduce medical errors. Lame and Woods used the review of descriptive theory testing, generation, and evaluation of interventions in their data collection. The

strengths in this study was the use of a systematic review, which would yield high levels of evidence and a strong validity. This study was similar to LeBlanc's because the information was broad and not focused on a certain age group of population to monitor medication errors. This study determined that with the use of properly employed simulation training, medical errors would be reduced.

Sarfati et al., also used a systematic review approach to determine if simulation training had a positive outcome in medication error reduction. The interventions used in this study were similar to LeBlanc's study, they determined different types of simulation training, and the effects it had on the reduction of medication errors. The conclusion to Saftari was difficult to determine based on the complexity to the study as stated by the author. The study being conducted over 5 years yielded a large quantity of data, but it was not supported that a simulation approach alone will decrease medication errors. It was determined the use of didactic alongside simulation training was the most powerful intervention.

The overall strengths to the studies provided from LeBlanc, Lame and Woods, and Safati et al. were similar because of the use of the highest level of evidence to gather data. The recommendations that would benefit these studies would be to gather information from a specific population of patients. With medication errors being more predominant in pediatric populations, this would be a good population to evaluate.

Each study provided data to support the use of simulation training to have a positive effect on the healthcare in general. Majority of the studies determined further data needed to be collected to truly evaluate the effects of simulation training on reduction of medication errors in the health care setting. Systematic reviews and

descriptive cross-sectional studies were implemented to collect data and produce the studies. There was not clear concise information to determine the use of simulation training alone was enough to decrease medication errors, but to increase critical thinking in nursing staff to overall decrease medical errors in general. The more this intervention is used, the further understand health care will have for the use of simulation training as a way of learning instead of the normal didactic approach. In summary, the literature review was inconclusive to whether medication errors were directly impacted due to the lack of control variable to determine the direct correlation. Each study had a reduction to medication errors following the medication error simulation. Majority of the studies were systematic review to collect reliable and valid data. The other two studies were level III and IV, which yielded high volume study data and determined the simulation training was effective in reducing medication errors in those particular facilities. Recommendations for the literature would be to continue to trial the simulation training for reduction of medication errors.

Methods

Design

This quality improvement project will be as descriptive observational design. Data will be collected via retrospective and prospective chart review. During this chart review, a quantitative design will be utilized to analyze the data. The data collect will be collected over a 4-week period, collecting nursing medication errors before the implementation of the simulation, followed by data collection over 4 weeks following the simulation.

Setting

The quality improvement project will take place in a midwestern, urban, hospital, with a large (40 bed) pediatric intensive care unit. Data collected will include children from 0 days old to 18 years of age. The staff entails 134 nurses, with additional contracted nurses. The members who will be included in this study are nursing staff, managers, and new gradate nursing who were recently hired.

Sample

The sample will be collected from the use of a convenience study in the pediatric intensive care unit. The sample will be determined based upon the census of the unit. The inclusion criteria will be patients who are inpatient in the pediatric intensive care unit. This included patients from 0 days old to 17 years of life, receiving medications in the unit. Exclusion criteria will be patient who are not receiving medications, non-nursing medication errors, and patients not admitted into the pediatric intensive care unit.

Data Collection/Analysis

Data will be collected with the use of a retrospective review of Safety and Environmental Management Systems (SEMS) of nursing medication errors. According to the Bureau of Safety and Environmental Management, SEMS is a performance-based integration and managing offshore operations. The purpose of SEMS is to enhance safety by reducing frequency and severity of incidences. Data will be deidentified and stored on the primary investigator's password-protected computer. Data will include patients aged 0-17 years, all gender, all race, and all diagnoses. Patient must have received at least one oral or intravenous medication administration in the hospital and will be inpatient in the pediatric intensive care unit. Data will be collected by the quality improvement team at the hospital. Data collected will be the number of medication errors per shift, time of day

medication errors occurred most, and the type of medication errors, and the route of administration.

Approval Process

Approval will be obtained for the hospital Instructional Review Board (IRB). Further, approval will be obtained from the university IRB. Following the chairs approval, the leadership team was informed of the quality improvement idea and verified by a signed contract. With the approval of the leadership team in the Intensive Care Unit, the quality improvement team was informed of the idea and asked for an approval.

Results

Demographic

This CPS project was utilized in a large urban hospital pediatric intensive care unit. In the first quarter of the year (January to March) there were a total of 820 patients. Within those 820 majorities of the population (64%) being white, secondary population was African American (28.6%), and other remaining populations included pacific islander and Asian were 12%. Among the populations the patients divided by sex, including male and female. Unfortunately, the hospital policy states that each patient be named by their biological sex, so transgenders were not recognized in this collection. Females were the prominent population at 55.6% and males were secondary to that at 44.4% of the PICU population. Finally, the demographics were able to be broken down by age. The majority of patients admitted in this first quarter were aged 0 years to 5 years old (51.2%). The second largest population was those greater than 10 years old (35.3%) and the smallest population were those aged 5 to 10 years of life (15.7%).

SEMS collection

Retrospective data was collecting using the PDSA cycle and determined that 12 documented medication errors were made in a 4-week time frame before initiation of the project. Nursing staff at SLCH's PICU had a weeklong opportunity to participate in the simulation which was limited because of lack of ability to make simulation mandatory for all staff. Only 50% of staff was able to complete the simulation training. Post-intervention data was collected using the PDSA cycle and determined the number of medication errors increased by 150%. The medication errors went from 12 documented in 4-week time frame to 28 collected in the post intervention time frame. The data which was collected using the SEMS tool included information on age, sex, and medication error location. Within the data which was collected. The data which was collected before and after the simulation suggested the medication errors were majority of those female and less than 5 years of age. The data also suggest medication errors were distributed evenly among the two location of the hospital (8100 and 8200) for pre intervention. For preintervention of the 12 medication errors 25% of them were patients aged 10 years and older, leaving 75% of the medication errors to be to those less than 10 years of life. Preintervention data collected involving sex of the patients were females 50% and males 50%. For postintervention data collection of the 29 medication errors 51.7% were less than 10 years of life and 48% being 10 years and older. The data collected for female medication errors was males being 41.3% and females 58.6%. The location for the post intervention had majority of the medication errors being 58.6% located in 8200 and 41.3% were location in the 8100 tower. There is no difference for acuity between the tower 8100 and 8200. There are fewer overall patients having 16 rooms verses 24 and the primary medical team is nurse practitioners.

Discussion

Implementation of this QI project accomplished the awareness to nursing staff of simulation training and the awareness of medication errors in the pediatric intensive care unit.

The data collected was surprising to suggest the medication error simulation not being successful at this point in time. With the overall increase in medication errors of 150%. The overall consensus can suggest the simulation needs to occur over a longer period of time and at an annual basis.

Limitations to this simulation training is not creating this simulation to be a mandatory check off for each nurse in the pediatric ICU. This created a smaller number of participants in the actual simulation. The study was limited to a small sample size due to not a large number of medication errors from the time frame of February 26th to April 1st. The study was limited to the medication error being under honor reporting system, meaning not all medication errors would be reported. Finally, the QI project was limited to a large quantity of new graduate nurses starting in the middle of my implementation of the simulation. Medication errors might be reflective of this.

Recommendations for this QI project is to gather future data on simulation training since it is a new way to teach nurses in the hospital setting. There have been reports of improved learning. Another recommendation would be to make this simulation training an annual competency for each nurse, with the purpose being to keep medication errors at low at all times. Implementation of make-up days for simulation training could invite a larger number of participants to be included. With the sample size being small, future

data collection after further implementation could help improve the ability of data analysis.

Conclusion

In this QI project implementation simulation training including medication errors did not impacted the number of medication errors to patients aged 0-18 seen in the pediatric intensive care unit at St. Louis Children's Hospital. Future implementation of simulation training should take place to gather further analysis of this QI project. The need for further information will need to be gathered to determine if simulation training will impact medication errors positively. The sample size being small was a large barrier to this project. The overall medication errors in the beginning of the project were limited to improve on. For further impaction of medication errors this simulation should be an annual compliance with initiation included during orientation training for new graduate nurses and new employees. The data that was collection for the project was helpful in determining one-time occurrences of simulation training is not impactful.

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Table 1:

Appendix A

Demographic Data of Participants *n*= 810 total		
Category	Total	SD (%)
Race:		
White	521	64
Black	232	28.6
Pacific Islander	4	0.4
Asian	7	0.8
Other	47	5.8
Age:		
0-5 years old	415	51.2
5.1-10 years old	127	15.7
<10 years old	268	35.3

Sex:		
Male	450	55.6
Female	360	44.4

Table 2:

Pre intervention medication errors	age	gender	harm
	1	0	0
	0	1	0
	0	1	0
	0	1	0
	1	1	0
	0	1	0
	0	1	0
	0	1	0
	0	0	1
	0	0	0
	1	1	0
	0	1	0
post intervention medication error occurrence			
	0	0	0
	0	1	0
	1	0	0
	1	0	0
	0	0	0
	1	1	0
	1	1	0
	0	0	0
	0	1	0
	1	1	0
	1	0	1
	1	0	0
	0	0	0
	1	1	0
	0	0	0
	0	1	0

0	0	0
1	0	0
1	0	0
0	0	0
1	1	0
0	1	0
1	0	0
0	0	0
0	0	0
1	1	0
1	1	0
0	1	0
0	0	0
1	0	0

Age: 0-10years =0
Age: 10-17 years =1
Gender: female= 0
gender: male = 1
no harm/ did not reach patient=0
harm/reached patient=1
8100 location= 0
8200 location= 1