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Evaluating the Effectiveness of Risk Management Program in Reducing Medication Error in Children Hospital

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Abstract

Background: Risk management aims to proactively identify and mitigate potential risks through systemic interventions, staff education, and the integration of technology. By fostering a culture of safety, these programs contribute to better patient outcomes and reduced healthcare costs.

Aim: To investigate the effectiveness of a risk management program on the frequency of the medication errors at children hospital in Saudi Arabia.

Methods: The study will use a quasi-experimental design to evaluate a risk management program aimed at reducing medication errors among nursing staff in a pediatric hospital. The study population will consist of 100 full-time nurses. Data will be collected using a self-report survey and an observational checklist to assess medication errors and documentation practices. Statistical analysis will be conducted using SPSS to compare pre- and post-intervention results with paired t-tests and Chi-square tests.

Results: The study compared an intervention group that received a risk management protocol with a comparison group that did not. The intervention group demonstrated a significant reduction in medication errors, with their post-test scores improving from 33.43 to 37.69 ($p < 0.001$). In contrast, the comparison group showed no significant change, with scores improving marginally from 32.08 to 33.87 ($p = 0.312$). Key findings included that 71.69% of participants identified immediate reporting as the best response to errors, while 91.57% believed errors were preventable through improved training and communication. The most common error found in the stages of medication management include incorrect dosage. Procedural and systematic approaches for instance check-lists were established as suitable means of intervention. Overall the findings stress on the need to have specific risk management plans especially in the environment where high risks are involved; staff training and understanding of risks, errors, and the overall culture of error reporting all these in the pursuit of optimal safety for pediatric medication administration. Hence, these results suggest that structured interventions should be implemented to reduce risk factors.

Conclusion: In conclusion, the present study showed that the risk management protocol minimizes medication errors in the intervention group. Therefore, the systematic intervention, staff education, and strong error-reporting tools are effective measures to minimize medication errors. The results of the current study provide evidence for targeted risk management interventions to strengthen medication safety and safety culture in pediatrics.

Introduction

The health care setting poses a significant risk due to its elevated rates of disability and death [1]. The combination of modern technology and significant human interactions in healthcare settings heightens the likelihood of unfavorable occurrences. In these circumstances, there are two primary considerations: firstly, practitioners must provide accurate and top-notch therapy services, and secondly, they must strive to prevent any undesired medical mistakes. The United States of America incurs an estimated yearly cost of over $150 billion due to drug-related issues, and the fatality rate resulting from medical errors varies from 44,000 to 98,000 instances [2, 3].

So far, several research have assessed the prevalence of medication errors (ME) in various locations of Saudi Arabia. Nevertheless, there is a substantial variation in their findings, ranging from 41.6% to 70%. The observed variance in ME rates across research may be partially attributed to the classifications of MEs and the methodologies used to assess their frequency [4-7].

Furthermore, there is a substantial amount of research indicating that nurses who work in high-risk environments, such as pediatric units, often commit frequent mistakes when delivering drugs to children [8, 9]. Nurses must possess sufficient clinical skills, including professional judgment, critical thinking, and the capacity to analyze patients' data and use their knowledge and expertise in handling high-risk scenarios [9]. Nevertheless, the method of pharmacological treatment has received little recognition and evaluation [10].

The National Coordinating Council for Medication Error Reporting and Prevention (NCCMERP 2007) has established the most extensive explanations for the term "medication error". A medication error refers to any avoidable incident that has the potential to result in improper drug use or injury to the patient when the medicine is under the supervision of healthcare staff. These occurrences may have a connection to professional practice, healthcare items, procedures, and systems" [11]. Hospital mistakes are often classified into six categories [12]. Among these categories, pharmaceutical errors account for 19.4% of all errors and are the most prevalent form of error [13]. According to statistics, medication mistakes rank as the eighth most common cause of mortality in the United States of America [10]. The significant mistakes result in harm and mortality among patients [14].

The right administration of medicine is of utmost significance in children due to its different implications. The causes are as follows: During childhood, the pharmacokinetic parameters undergo constant changes. The calculation of drug dosage takes into account factors such as weight, body surface area, age, and clinical conditions. However, there is a lack of accurate information regarding the appropriate therapeutic and toxic doses, as well as drug pharmacokinetics [15]. As a result, pharmaceutical mistakes are more common in pediatric settings. According to a research, 5000 children who are admitted to the hospital each year suffer from problems caused by medication mistakes. Out of them, 2500 children encounter consequences that range from mild to severe [12]. Consequently, the frequency of medication mistakes is a crucial factor in assessing the quality of treatment and ensuring patients' safety [16].

The primary actions in risk management are the identification and avoidance of unfavorable occurrences [14]. Risk management is a systematic approach aimed at minimizing avoidable adverse occurrences, their associated difficulties, and the resulting financial costs. This program is a sequential and ongoing procedure that aids in the execution of decision-making tasks during crucial circumstances. Throughout this process, it is anticipated that mistakes would be reduced and possibilities will increase. Assessing the likelihood of accidents and ensuring a secure setting are crucial in achieving the ultimate objective of delivering high-quality care [16].

Study rationale

In contrast to the conventional perspective, risk management attributes errors to the inadequate system designation rather than individual nursing malfeasance [17]. Hence, this method is anticipated to not only reduce the occurrence of errors but also alleviate the apprehension of trespassers about penalties and social shame. This research is done due to the preventability of pharmaceutical errors and the increased significance of such errors in pediatric settings, as well as the absence of a well-structured study on this topic in our nation. This research aimed to assess the efficacy of a risk management program in reducing the occurrence of medication mistakes at a children's hospital in Saudi Arabia.

Aim of the study

The study aims to investigate the effectiveness of a risk management program on the frequency of the medication errors at children hospital in Saudi Arabia.

Review of literature

Medication errors are a critical concern in healthcare, with pediatric populations being especially vulnerable due to their unique physiological and developmental characteristics. The immature organ systems of children, particularly the liver and kidneys, influence drug metabolism and excretion, making accurate dosing crucial [18]. Moreover, the reliance on weight- and age-based dosing calculations introduces complexity that increases the likelihood of errors. The World Health Organization (WHO) identifies medication errors as a leading cause of preventable harm, estimating that such errors cost healthcare systems billions of dollars annually [19].

In pediatric settings, even small deviations from prescribed dosages can result in significant adverse effects. Consequently, implementing effective risk management programs to address these vulnerabilities has become a priority. Risk management aims to proactively identify and mitigate potential risks through systemic interventions, staff education, and the integration of technology. By fostering a culture of safety, these programs contribute to better patient outcomes and reduced healthcare costs [20].

Understanding Medication Errors in Pediatric Settings

Medication errors are a pressing concern in pediatric healthcare, posing significant risks to a vulnerable population. These errors are defined as preventable events that may lead to inappropriate medication use or patient harm while the medication is under the control of healthcare professionals, patients, or consumers. In pediatric settings, these errors are particularly problematic due to the unique physiological characteristics of children, reliance on weight-based dosing, and systemic issues within healthcare processes [21].

1. Nature and Classification of Medication Errors

Medication errors in pediatric care are broadly categorized based on the stages of the medication-use process: prescribing, transcribing, dispensing, administering, and monitoring [22]. Each stage presents unique challenges that contribute to the overall risk of errors:

1.1 Prescribing Errors

Prescribing errors are among the most prevalent in pediatric settings, accounting for up to 50% of all medication errors [22]. These errors include incorrect drug selection, dose miscalculations, and inappropriate prescribing for the child's age or weight. Unlike adults, children require individualized dosages based on weight (mg/kg) or body surface area, increasing the complexity of calculations. Misinterpretations of decimal points, such as administering 10 mg instead of 1.0 mg, are a common source of error [23].

1.2 Transcribing Errors

Transcribing errors occur during the transfer of prescription information from one format to another, such as from a handwritten note to a digital record. Illegible handwriting and misunderstood abbreviations are significant contributors to these errors. For instance, the abbreviation “IU” (international units) has been mistaken for “IV” (intravenous), leading to inappropriate administration routes [19].

1.3 Dispensing Errors

Dispensing errors happen when a pharmacy incorrectly prepares or labels a medication. These errors can involve the wrong drug, dose, or formulation. In pediatrics, compounded medications or liquid formulations are often required, which increases the likelihood of errors during preparation [24].

1.4 Administration Errors

Administration errors occur when the wrong medication, dose, or method of administration is used. These errors are common in pediatric nursing, where the workload and complexity of treatments are high. For example, administering an intravenous drug too rapidly or failing to dilute medications properly can have serious consequences [25].

1.5 Monitoring Errors

Monitoring errors involve the failure to assess the effects of a medication after administration. In pediatric care, under-monitoring can lead to undetected adverse drug reactions, particularly in neonates and infants who may exhibit subtle or atypical symptoms [25].

2. Prevalence and Impact of Medication Errors in Pediatrics

Research consistently shows that medication errors are more common in pediatric populations than in adults. Studies estimate that the rate of medication errors in hospitalized children ranges from 5 to 27 per 100 medication orders. Pediatric intensive care units (PICUs) are particularly vulnerable due to the high acuity of patients and the frequent need for complex dosing calculations [26].

The consequences of these errors vary in severity. While some errors result in no harm, others lead to adverse drug events (ADEs), defined as injuries caused by the use of a drug. For instance, dosing errors with anticoagulants or sedatives in neonates can result in severe bleeding or respiratory depression [24].The indirect consequences to families and healthcare organizations are another major factor, where errors may lead to the loss of confidence and staff demoralisation.

3. Contributing Factors to Pediatric Medication Errors

Numerous factors contribute to the high prevalence of medication errors in pediatric settings:

3.1 Developmental and Physiological Differences

Organ systems are immature in children and this include the liver and kidneys that are responsible for metabolism of drugs and their excretion respectively making children more vulnerable to toxicity. Examples include neonates who exhibit a reduced activity of hepatic enzymes, thus increasing the half-life of many drugs. This requires some number crunching and analysis hence the need to guard them but failure to do so leads to most of the errors [27].

3.2 Lack of Pediatric-Specific Formulations

Most drugs are initially created for use in adults which makes most prescriptions for children to be adjusted for dose or prescribed off-label. It is estimated that off-label use is present in as much as 80% of the pediatric hospitalizations, thus raising risks for errors. Furthermore, it is always the case that there are no standard doses for children; therefore, medications are often compounded, and this practice introduces variability in preparation [28].

3.3 Systemic and Workflow Issues

The adverse working conditions of the pediatric wards include fast flow, high pressure, interruption frequently all of which pull the possibility of mistakes. Koyama et al (2020) pointed out that interruptions in the process of medication administration were related to the errors. In addition, the staffing shortage and lack of training contribute to these problems [29].

3.4 Communication Challenges

Failure of communication in the healthcare setting is among the major causes of medication errors. Lapses in shift-hand-off communication processes and the absence of an organization-wide approach for communication

tools like, for example, SBAR (Situation-Background-Assessment-Recommendation) have been alleged to have contributed to errors at different phases of the medication use [30].

3.5 Parental Involvement and Understanding

Incorporating parents in medication administration is embraced but always misunderstanding can be a cause of a mistake in medication administration. For instance confusion arising from poorly labelled dosing syringes in the administration of liquid medication has led to overdoses at homes [31].

4. Addressing Medication Errors in Pediatric Care

Several interventions have been proposed and implemented to reduce medication errors in pediatric settings:

4.1 Technological Solutions

Computerized physician order entry (CPOE) with focused clinical decision support (CDS) for pediatric patients as well as barcode medication administration (BCMA) technologies have been found to be useful. However, the development of these systems is a prerequisite to its customization to meet pediatric requirements, including weight-based dosing calculators and warning signs of contra-indications in children [32].

4.2 Education and Training

Education interventions should involve training on aspects of paediatric pharmacological management and one of the best approaches should include basics of the prevention of medication errors. In this regard, simulation-based training has proved timelessly productive to teach the healthcare professionals the ways to tend with medication errors in complicated situations [33].

4.3 Standardization of Practices

In terms of error prevention, it became standard practice to reduce variability by double checking high risk medications and adhering to pediatric specific drug formularies. Such practices' application has been linked with decrease in the error incidences by nearly fifty percent in the pediatric intensive care units [34].

4.4 Enhancing Reporting and Feedback

One of the best practices is the non-reporting of punitive action to any error or near-miss incident so as to encourage the gathering of data and the improvement process. Feedback mechanisms also enhance learning and sustain the learning culture safety [34].

In conclusion, medication errors in pediatric area are complex problem that has a major impact on patient safety. These insights include awareness of the factors that make children particularly susceptible to error, the systems that contribute to error, and the phases at which errors occur in development help them plan the right kind of solutions. Technological developments, education provision and adherence to standard guidelines have progressively contributed towards minimizing these errors but many more continuing challenges remain in pediatric medication administration process. When carriage is conceptualised as a SDoH and interventions are targeted based on the needs of a specific health care system, risks are minimised and outcomes for infants are enhanced.

Risk Management Programs: An Overview

- **Key Components of Risk Management Programs**

Risk management programs are widely endorsed in contemporary health care organizations mainly in pediatric practice since the consequences of associated malpractice are dire. These programmes are intended to prevent the occurrence of adverse incidents as well as to evaluate and control these risks, rather than to respond to them after they have occurred. Situation in pediatric hospitals show the following risks – pediatric patients have different physiological characteristics, are more sensitive to weight-based medications, and are often unable to self-report symptoms, hence the need for solid risk management systems. When addressing these challenges the kind of programs, in question is expected to embark on proactive measures in cultivating a safety culture, enhancing clients' quality of care, and eventually curbing the monetary and psychological costs related to medication errors [35].

In its essence, risk management programmes include a strategic framework involving policy formulation and implementation, technological advancement and recurring risk awareness and sensitisation. These programs are policed by policies, which provide a clear general to be adopted by the healthcare professionals during different phases of medication process such as prescription, distribution, and administration. The research has established that standardized protocols can include double calculations, the use of pediatric dosage forms, and application of evidence-based protocols to mention a few, can help to reduce the rates of medication misadventures drastically. For instance, Naseralallah et al. in 2020 supported the effectiveness of pharmacology reduction by up to 30% through standardized protocols in PCICU thus showing that structures hence policies work in environments with high risk [36].

Education and training efforts are also required to safeguard the proficiency and up-to-date knowledge of the healthcare workers to the relative newer field of pediatric pharmaceutics and safety measures. Some of such programs involve simulation based training, workshops and competency measurement that focuses on the pediatric care teams. Marufu et al (2022) investigated how continuous professional development programs created a culture of safety advocating for education and found that the pediatric wards reduced medication error by 30%. Moreover, interprofessional training programmes, which claim the interaction between physicians,

nurses and pharmacists, are crucial for mistakes avoidance in view of improved cooperation and communication.

Technological advancement enhances risk management with special focus on pediatric hospitals in Medicine Management. Information technologies like CPOE and BCMA have taken a new twist in formulation and administration of medications respectively. To illustrate, CPOE systems provide doctors with growing ability to enter prescriptions directly on the computer, thus eliminating the problems of poor or even indecipherable script and manual transcription. Furthermore, these systems contain integrated clinical decision support tools that help to generate immediate signals for feasible problems concerning incorrect dosages, drug interaction, and contraindication [38]. Likewise, BCMA systems make it impossible for wrong medications to be given to the wrong patient at the wrong dosage and time through forcing the providers to scan two barcodes – one from the medication and the other from the patient's ID wristband. The work by Poon et al., conducted in pediatric hospitals, for instance, showed that the application of BCMA systems decreased medication adverse events by 41% [39].

However, the effectiveness of risk management programs does not solely lie in the particulars of individualistic treatment; much depends on the primary culture of security measures within the company. Administrator support is necessary to spearhead these programmes, since managers control the resources and set the tone of the error-reporting non-retribution culture. Open-line reporting systems are an important part of a safety management system that also provide the healthcare practitioners with an opportunity to report adverse events and 'near misses' which would expose them to potential lawsuits were they to be punished. These systems give precious information that facilites the analyzations of such trends, and the evalutions of necessary corrective measures [40]. Compliance measures complement the purpose of incident reporting in that they introduce a feedback system that promotes ongoing learning.

Nevertheless, the integration of risk management programmes in pediatric hospitals has not been without challenges as this paper seeks to discuss. Lack of funds and man power are some of the reasons that enable organization to lack well developed safety measures. For instance, the first broad costs of using CPOE and BCMA systems could be very expensive for some institutions especially in the developing world. However, it is realized that resistance to change by the healthcare givers acts as a barrier to implementing new processes and even technologies. To overcome these barriers effective hospital management needs to seek funding, ensure enough trainings, and show the effectiveness of such programs in enhancing the healthcare status of the patient [40].

In conclusion, the risk management programs have become an effective infection control measure to prevent medication errors in pediatric hospitals. They healthcare policies and technology are supported by increased education, technology and a powerful organizational culture which provide reaction policies to the specialties of paediatric care. There is no doubt that these programs can foster significant enhancements in the patient safety and clinical quality; nevertheless, the encounter also reveals that these programs may encounter logistical and financial challenges when it is implemented. Thus, further exploration of guaranteed risk management guidelines is vital for improving the level of pediatric care as well as protecting the interests of the vulnerabilities patient groups.

Technological Interventions in Risk Management

Technology has played a major role in minimizing medical risks especially in pediatric departments whose main hazard is medication related complications. Such interventions include; Computerized Physician Order Entry (CPOE), Barcode Medication Administration (BCMA), Clinical Decision Support Systems (CDSS) and smart infusion pumps. All these technologies focus on the different phases of medication use and they include prescribing, administration and dispensing phases with the main view of minimizing human mistake and enhancing safety results. The use of technology within clinical practice is a major step forward in managing potential dangers related to dosing calculations, communication problems, and workflows [41].

1. **Computerized Physician Order Entry (CPOE)**

CPOE systems enable caregivers to enter medication orders directly at the computer as an electronic equivalent to the easily misread handwritten prescriptions. These systems are most helpful in paediatrics as weight, and age, which are often factors involved in dosing calculations in this category add the challenge. Most CPOE systems come equipped with systems safety features such as drug interaction check, dosing error checks and pediatric dosing protocols. The research carried out to ascertain the efficiency of CPOE has revealed everywhere that its efficiency in the reduction of prescribing errors cannot be underestimated. For example, one large-scale randomized study where the strategy of Nuckols et al., 2014 was used established a decrease by 55% in significant medication failures after the introduction of CPOE [42].

Therefore, it was found that adapting the CPOE system requirements to the requirements of pediatric hospitals is crucial to the efficacy of these systems. Customization includes incorporating weight-based dosing calculators, pediatric alerts based on age and pediatric specific libraries. If not well adjusted, the system may produce too many or unnecessary signals to clinicians, reducing its effectiveness due to so called 'alert fatigue' [43].

However, one must not forget that the advantages of CPOE in minimising errors are actually greater than the negative factors, especially when staff is well trained and educated and CPOE is fine tuned on a constant basis.

2. Barcode Medication Administration (BCMA)

BCMA technology aims at facilitating the "five rights" of medication safety; the right patient, right drug, right dose, route as well as right time during medication administration. The system requires bar code point-of-care scanning at the patient's wrist and on the medicine container. It has been evidenced that administration errors, which are considered to be one of the most avoidable kinds of medication errors in health care facilities, may be reduced by using BCMA. An analysis of Poon et al in a hospital showed that, BCMA significantly cut wrong-patient mistakes by 41% and other administrative blunders by 51% [39].

Nevertheless, the compliance with BCMA is not devoid of some difficulties. The first one is the resistance from staff as a result of perceiving that their work burden increased or work flow interrupted. In addition, other factors including scanning, check digit and system problems may also reduce effectiveness of the system. As such, hospitals need to train the healthcare providers sufficiently to overcome these hurdles and need contingency strategies for normal functioning. Despite the acknowledged challenges of implementing BCMA into practice, where successful it has a positive impact on medication safety and adds value to the culture of safety and accuracy [44].

3. Clinical Decision Support Systems (CDSS)

CDSS are advanced tools that deliver automatic and individualised decision support to practitioners at the eventual stage of patient care. When implemented in CPOE or EHR systems, CDSS provide a large amount of functionality that consists of alerts about possible drug interactions, suggestion of the proper doses, and other notifications about the necessity to monitor such or such laboratory parameters. CDSS can also help in pediatric care, as dosing may be based on weight, age, and function of the major organs, and an error can result from wrong calculations or choice of drug [45].

Second, their success depends on the design and functions of the CDSS. The problem of the proliferation of alerts that might overload clinical professionals is known as alert fatigue. For instance, in a study it was established that clinicians dismiss alert from CDSS as high as 90% because they regard them as either useless or as an intrusion. Hence, it is incumbent upon pediatric hospitals to choose the components of CDSS wisely, in order to have the alerts relevant for pediatric practice. CDSS when integrated with other technologies including CPOE and EHR makes the technology a strong system in the management of medication [46].

4. Smart Infusion Pumps

Mobile medical computers are another innovative technological intervention which has found its application in pediatric hospitals. These devices require drug libraries and dose-error reduction systems (DERS) that help avoid wrong dosages in intravenous (IV) infused medications. Smart pumps are especially helpful in pediatric environments where an accidental overdose of IV medication, even by a small margin, can cause lots of harm to the patient. Benjamin et al. (2018) found out that a decrease in Infusion- Related errors was realized following the use of smart pumps with integrated DERS [34].

However, smart infusion pumps have been reported to need periodic updates on the drug library as well as close monitoring to avoid disparity in their specifications. However, healthcare organizations must provide adequate training to the professionals so that they apply those devices unless they have to employ workarounds that compromise the intended safety options. Smart pumps as noted earlier are integrated into a bundle of technologies that makes a dense system in managing risks towards medication safety in paediatric hospitals [47].

5. Challenges in Implementing Technological Interventions

Studies have shown positive outcomes of technology-based applications in helping decrease medication errors; however, there are issues are associated with the use of technologies. High installation costs and recurring costs of maintaining the system may be too expensive for small hospitals. Also, the implementation of new technologies appears to be challenging, mainly due to the need for modifying the processes and engaging employees in training on how to use the new tools. The second challenge of implementing these systems is the lack of support from healthcare stakeholders, particularly from practitioners and other clinicians since they resist change [38].

Another crucial issue is the ability of connecting different technologies with each other. For instance, CPOE, BCMA and CDSS have to operate optimally in combination in order to be effective. Discrepancies or interfacing problems between operating systems or software applications can negate these systems' advantages and introduce new hazards. Mitigating these challenges necessitates planning & coordination, sensitization of the stake holders, & constant performance assessment for system efficiency & user experience enhancement [48].

6. Future Directions

There is a particular potential for growth in new technologies including artificial intelligence (AI) and machine learning in the area of risk management regarding safety of medication for children. Administrative artificial intelligence can also design models that can scan through vast amounts of data in order to see tangible outcomes

and possible mistakes. For instance, prescriptive analytics could involve using risk factors from the patient's health information and the drugs that the patient is on and come up with a list of patients that are likely to be in for an adverse drug event. Further, there could be awareness interventions involving wearables or mobile applications to support patients/ caregivers in medication-use, and safety [49].

As these waste innovations progress further, pediatric hospitals must continue with the preparation of pushing through the adoption of emerging innovations as they continue to note the impacts of implementing the same. The understanding of how first healthcare providers, second, technology developers, and third, policymakers can align to make these improvements possible will be fundamental to bridging the gap [49].

In conclusion, important technological developments including CPOE, BCMA, CDSS, and smart infusion pumps has greatly improved risk management in pediatric hospitals in different aspects of the medication-use process. Despite the many advantages that these technologies have over traditional methods in diminishing mistakes and enhancing patient results, to use them effectively for this purpose, these tend to need a great deal of thought, sensitivity, and time to implement and assess. With regard to the issues like costs, integration difficulties, and resistance of personnel, it is possible to achieve the best outcomes of the application of these systems in healthcare facilities. On the horizon, relatively new technologies such as artificial intelligence and machine learning could provide new opportunities for boosting medication safety in pediatric population and emphasize the need for continuing investment in development of more advanced approaches.

Education and Training as a Core Component

1. Simulation-Based Training

Another value of simulation training is that it provides a safe learning environment where medicine related mistakes can be recognized as well as corrected. These sessions actually mimic real-life situations to enable the participants to gain experience on their problem-solving abilities. Rahmani et al (2024) while studying pediatric medication safety and efficacy discovered that simulation training increased efficiency among the nurses by 25%; this bears testament to the potential benefits of simulation in the area of medication management [49].

2. Continuous Professional Development

Continuous education keeps practicing healthcare providers current on existing and updated guidelines as well as current safety measures. Such training regimes as training developed to remind participants to double check dosages and other training which: highlight the need to observe standard operating procedures have also proven effective in lowering risks of errors. Starmer et al. (2014) showed in their study that structured education programs by the hospital led to reduction, by of up to 30%, of medication errors within the first six months [50].

Incident Reporting Systems and Feedback Mechanisms

The use of incident reporting systems is useful in regard o the identification of medication errors. These systems are data collection tools concerning errors and close calls in order to understand the underlying issues in healthcare facilities and introduce proper solutions for addressing them. For instance, Nuckols et al. (2014 Nev) revealed that hospitals with effective reporting systems reported decreased incidence of preventable medical mistakes in the long run [16].

However, the application of these systems requires promotion of corporate culture that would enhance the willingness of staff to report the incidence without undue force. The two are feedback mechanisms, which are very crucial, since they promote learning from mistakes. Debate workshops give the opportunity to reflect on all the causes of the occurrences and search for solutions in groups [48].

Policy Implementation and Standardization

1. Role of Policies in Reducing Errors

Since medication practices involve a lot of human interface and professionalism, sound working policies and procedures are required for practice uniformity. Standard orderings and lists have low variations, and they can prevent most failures like wrong dosage or choosing the wrong drug to give to the patient. For instance, Nuckols et al. (2014) established that cutage order sets and standardised attended medication administration reduced medication error by approx-imately one third [42].

2. Leadership and Compliance

The implementation of safety policies can only be achieved if the government fully supports the measures that are being taken. There should be always compliance checks, monitoring not only guarantee that workers observe organizational policies but also result in efficient performance appraisals. Third also, the engagement of frontline staff in the formation of policies ensures that they have a stake in the policies hence promoting compliances [51].

Challenges in Implementing Risk Management Programs

1. Resource Constraints

Risk management plans can be elaborated but they lack funding and human resources can be scarce. CPOE and BCMA application is capital intensive and may not be affordable for all institutions since there is usually high initial investment [39].

2. Resistance to Change

Another obstacle is the resistance to change among the healthcare providers. They respond slowly to new technologies or protocols to implement because they are worried about the extra work that they will undertake or other undesirable consequences. Mitigating these concerns calls for good communication, showing the effectiveness in implementing these interventions and sufficient staff training [52].

Recently, essential goals of successful pediatric hospitals have been investigated to eliminate medication errors using appropriate risk management programs. These programs incorporate technological solutions, knowledge, protocoled procedures and effective reporting mechanisms to manage the special demands of paedatric health. There is therefore evidence that implementation of these interventions greatly increases medication safety and the quality of ultimate patient care. The committed continuation of funding research proposals together with the creation of more effective interventions will be key to maintaining and building on the progress made in this area of health care [52].

Empirical Evidence

The administration of medicine is one of the most delicate and risky treatment intervention that nurses come across. It is unfortunate that medication error type of mistake is the most common cause of harm and deaths among patients including paediatric patients. However, some of these mistakes could be averted. The first strategic approaches of risk management are to recognize and prevent adverse events that may cause pharmaceutical errors. In their research study, Dehghan-Nayeri et al., (2013) carried out an interventional study to determine the effectiveness of a risk management program in pediatric nurses with regard to medication errors.Pre- and post- test evaluations of medication error occurrences was also done. The data analysis was done using the statistical package software from social science (SPSS), t-test and regression analysis. After the intervention the rate of medication mistakes of the experimental hospital's nurses was significantly reduced ($P < 0.001$) and the rate of reporting errors was significantly augmented ($P < 0.007$) in comparison with both the pre intervention period and the control hospital's nurses. Based on the research conducted, risk management as a quality control tool, may effectively prevent unfavorable outcomes in the inherently high risk environment of a medical facility. Risk management which is under the control of nursing managers are also found to have the capacity of reducing the cases of pharmaceutical errors. However, the achievement of this initiative depends on the rapport of the nurses [53].

Overseeing of issues, protocols, and processes as well as reporting mechanisms and monitoring of unfavorable incidents therefore requires an effective risk management program. Pazokian et al. (2020) undertook a study to evaluate the effect of a risk management program in terms of reducing medication errors and the manner in which staff learnt from the mistakes in a cardiac critical care unit. According to the outcome of the programme, there was a significant difference in terms of the number of medication errors reported in contrast to the previous statistics that was observed after the intervention, and also the enhancement in learning from such blunders. The studies reveal that implementing a risk management programme in hospitals may reduce medication errors and improve the perception and documentation of errors [54].

In addition, Nayeri et al. (2021) aimed at establishing the effect of a risk management program on the rate of medication errors involving nurses in critical care units. Out of all the nurses that were identified in the local database, 150 nurses were selected based on the inclusion and exclusion criteria. This was done with the aid of the convenience sample technique, and 75 nurses selected for each of the groups. For the experimental group, an additional risk management program was developed. The data collecting techniques used in this study consisted of three instruments: The demographic questionnaire for the nurses, Wakefield medication error self-reporting, and the questionnaire for medication quality checklist. As presented in table 1, the result of independent t-test means that the two groups although vary in demographic data and the frequency of medication errors before the study yet there is no significant difference ($P > 0.05$). Intervening factors impacted the difference in the rate of medication mistakes as the two groups showed a significant difference ($P< 0.005$) after the intervention. From this, one can infer that the nurses in the experimental group we dealt with had a fewer instances of medication errors than those of the control group. It was also found that the incidence of medication mistake noticed among nurses was much higher than the error reported by them ($P < 0.001$). That was proved by the results showing that the implementation of the risk management program actually helped reduce medication errors of the nurses. Nurses are therefore encouraged to adopt a risk management programme for the improvement of drug safety in as well as to offer safe and the best nursing care [55].

Methodology

The methodology of this study will entail a pre-and post-intervention assessment of the efficacy of a risk management program in addressing medication errors among the nursing staff in the selected children's hospital. In the paper, the current section provides a description of the study design, participants, data collection instruments, and inclusion and exclusion criteria, and statistical analysis.

Study Design

This study shall use a quasi-experimental study design which is useful when testing interventions in realistic contexts whereby random assignment may not be possible. Data collection will be done before the intervention and after the intervention to establish differences in medication error rate and changes in practice by personnel

managing medications. Quasi-experimental research is useful because it compare a control group with an intervention group and gives insight into the value of the risk management program.

Study Population

The target population will be the nursing staff, working at a children hospital in Saudi Arabia. The participants will comprise nurses from various departments offered general pediatric wards as well as one more hospital or pediatric ward that will be a control group and will not be offered the intervention.

Nursing staff should be targeted since they are involved in administering, and entering data on, medications, the two facets that are at the core of the examined intervention. This will be useful because their participation will give real time assessment of the functioning of the risk management program.

Study Groups

The research will involve two distinct groups:

1. **Intervention Group**: Nursing staff at a children's hospital implementing a risk management program.
2. **Comparison Group (Control Group)**: Nursing staff at a comparable pediatric hospital or ward not exposed to the program.

The intervention group will receive training and participate in risk management activities, including safety protocols, medication administration checklists, and error reporting systems. In contrast, the control group will continue with standard practices without adopting the new program.

Sample Size

The study will recruit a total of 100 nursing staff members, evenly split between the two groups (50 in the intervention group and 50 in the control group). The sample size was determined through a power analysis to ensure sufficient statistical power for identifying significant differences in pre- and post-intervention outcomes. This number also accounts for potential dropouts or incomplete data.

Study Instruments

Data will be collected using two primary tools:

1. **Confidential Self-Report Survey**: Nurses will document any medication administration errors they experienced or committed, focusing on:
    - Types of errors (e.g., incorrect dosage, wrong medication, missed doses).
    - Circumstances contributing to errors (e.g., workload, staffing levels, time constraints).
    - Perceived causes, such as insufficient training or poor communication.

The survey will be developed based on validated instruments and previous studies to ensure content validity. A pilot test may be conducted to refine the questionnaire for clarity before full-scale implementation.

2. **Observational Checklist**

A structured observational checklist will be utilized to evaluate the quality of medication administration and documentation practices among nurses. This tool will cover:

- **Demographic Information**: Includes details such as gender, age, years of nursing experience, job role (e.g., staff nurse or head nurse), education level, and working shifts.
- **Medication Documentation Quality**: Assesses adherence to protocols for accurate documentation, including the correct drug, dosage, administration route, and timing.

Trained observers will complete the checklist during routine medication rounds or other appropriate times, gathering data before and after the intervention.

Inclusion and Exclusion Criteria

To ensure the study focuses on nurses actively engaged in pediatric care and medication administration, the following criteria will apply:

- **Inclusion Criteria**:
    - Full-time nurses involved in pediatric medication administration and documentation.
    - Nurses without any prior legal issues related to professional errors.
- **Exclusion Criteria**:
    - Emergency and operating room nurses, due to the unique nature of their roles and protocols.
    - Part-time or less experienced nurses, to maintain a focus on those routinely handling medication tasks in pediatric settings.

Ethical Considerations

The research will comply with ethical standards, with approval obtained from the hospital's ethics review board prior to data collection. The following measures will be implemented:

- **Informed Consent**: Participants will receive clear information about the study's objectives and procedures. They will also be informed of their right to withdraw at any point without repercussions.
- **Confidentiality and Anonymity**: All collected data will be anonymized, ensuring participants' identities are protected.
- **Privacy**: Personal information will be stored separately from research data to prevent breaches of confidentiality.

Data Collection Procedure

The study will follow these steps:

1. **Pre-Intervention Data**: Baseline data will be collected from both groups using self-report surveys and observational checklists. This will help establish current practices and medication error rates.
2. **Intervention Implementation**: The intervention group will receive the risk management program, including training on safety protocols, error reporting, and standardized documentation. The control group will not undergo any changes to their practices.
3. **Post-Intervention Data**: After the program's implementation, the same tools will be used to measure changes in error rates and documentation quality.

Statistical Analysis

Data will be analyzed using SPSS (version 26) to evaluate the program's impact. Key statistical methods include:

1. **Paired t-tests**: To assess changes within each group by comparing pre- and post-intervention scores.
2. **Chi-square tests**: To analyze differences in categorical variables, such as error types and documentation quality, between the groups.
3. **Independent t-tests**: To compare post-intervention results between the intervention and control groups.

A significance threshold of $p < 0.05$ will be applied for all tests.

This methodology provides a robust approach to examining the effectiveness of a risk management program in reducing medication errors in pediatric hospitals. By employing a quasi-experimental design and combining qualitative and quantitative methods, the study aims to generate valuable insights for improving nursing practices and enhancing patient safety. The results will contribute to evidence-based pediatric nursing strategies and guide future interventions.

Results

Demographic characteristics of the intervention and comparison groups

Variable		Intervention group (n=83)	Comparison group (n=83)	Results
Gender	Male	34	19	χ^2=6.23 df=1 p=0.013
	Female	49	64	
Age	20-30	14	16	χ^2=2.90 df=3 p=0.407
	30- 40	32	30	
	40- 50	27	21	
	50- 60	9	16	
Highest level of education	Basic nurse training	19	9	χ^2=9.787 df=3 p=0.02
	Bachelor degree	54	59	
	Master's degree	8	8	
	PhD	0	6	
Current position	Staff nurse	41	63	χ^2=16.84 df=3 p=0.001
	Advanced practice nurse	4	0	
	Head nurse/nurse manager	5	0	
	Other	33	20	
Years of working in pediatric care	1- 5 years	22	23	χ^2=1.025 df=2 p=0.599
	5- 10 years	15	20	
	More than 10 years	45	40	

1. Gender:

The intervention group had 34 males, compared to 19 in the comparison group.

Females constituted the majority in both groups, but their proportion was higher in the comparison group (64 vs. 49).

Analysis:

The difference in gender distribution between the two groups was statistically significant ($\chi2=6.23$, $p=0.013$).

2. Age:

Most participants were in the 30-40 and 40-50 age groups across both groups.

The distribution of ages was generally similar.

There was no statistically significant difference in age distribution between the groups ($\chi2=2.90$, $p=0.407$).

3. Highest Level of Education:

The majority of participants in both groups held a bachelor's degree, but other qualifications varied.

Notably, 6 participants in the comparison group held PhDs, while none in the intervention group did.
The difference in education level was statistically significant ($\chi2=9.787$, $p=0.02$).

4. Current Position:

Staff nurses" constituted the largest category in both groups.
The intervention group included a more diverse range of positions, such as "Advanced Practice Nurses" and "Nurse Managers," which were absent in the comparison group.
Analysis:
The difference in job roles was statistically significant ($\chi2=16.84$, $p=0.001$).

5. Years of Working in Pediatric Care:

Most participants in both groups had more than 10 years of experience in pediatric care.
There was no statistically significant difference in years of experience between the groups ($\chi2=1.025$, $p=0.599$).

Overall Interpretation:

Statistically significant differences were observed in gender, educational level, and job position. These factors should be considered when analyzing the program's effectiveness, as they may impact the results.

Part (2): Medication Errors Knowledge Questionnaire

Section 1: General Medication Administration Errors

Questions	Frequency	Percentage	X^2	p-value
1. What is the primary cause of medication errors in hospitals?			26.19	$p < 0.001$
a) Lack of training	57	34.34		
b) Inadequate communication	55	33.13		
c) Inefficient workflow	38	22.89		
d) Other (please specify)	16	9.64		
2. Which of the following is a common medication error?			123.36	$p < 0.001$
a) Incorrect dosage	47	28.31		
b) Incorrect medication	15	9.04		
c) Incorrect route of administration	9	5.42		
d) All of the above	95	57.23		
3. What should you do if you notice a medication error?			185.69	$p < 0.001$
a) Report it immediately	119	71.69		
b) Ignore it and continue with the medication administration	7	4.22		
c) Document it but do not report it	8	4.82		
d) Discuss it with the doctor	32	19.28		
4. What is the most common type of medication error?			134.02	$p < 0.001$
a) Incorrect dosage	103	62.05		
b) Incorrect medication	25	15.06		
c) Incorrect route of administration	15	9.04		
d) Other (please specify)	23	13.86		
5. How often do you review medication orders before administering them?			242.43	$p < 0.001$
a) Always	132	79.52		
b) Most of the time	18	10.84		
c) Sometimes	12	7.23		
d) Rarely	4	2.41		

1. Question 1: The results indicate that 34.34% of participants believe that lack of training is the primary cause of medication errors in hospitals, while 33.13% attribute it to inadequate communication. The Chi-square value (26.19) suggests a statistically significant relationship ($p < 0.001$), indicating that opinions on the causes of errors differ notably among respondents.

2. Question 2: The data shows that 57.23% of participants consider all listed options (incorrect dosage, incorrect medication, and incorrect route of administration) to be common medication errors. The Chi-square value (123.36) indicates significant differences ($p < 0.001$) in understanding common errors.

3. Question 3: Results reveal that 71.69% of participants believe that medication errors should be reported immediately, reflecting a good awareness of the importance of reporting errors. The Chi-square value (185.69) indicates statistically significant differences ($p < 0.001$) in how respondents perceive the handling of errors.

4. Question 4: The findings show that 62.05% identify incorrect dosage as the most common type of medication error, with a Chi-square value (134.02) indicating a statistically significant relationship ($p < 0.001$).
5. Question 5: Results indicate that 79.52% of participants always review medication orders before administration, demonstrating a high level of commitment to medication safety. The Chi-square value (242.43) suggests statistically significant differences ($p < 0.001$), highlighting the importance of reviewing orders.

Section 2: Medication Preparation

questions	Frequency	Percentage	X^2	p-value
1. What is the most critical step in preparing medications?			51.69	p < 0.001
a) Measuring the correct dosage	70	42.17		
b) Checking the medication label	55	33.13		
c) Preparing the medication in the correct solution	23	13.86		
d) Other (please specify)	18	10.84		
2. How do you ensure that you are preparing medications correctly?			86.69	p < 0.001
a) Following the medication order	90	54.22		
b) Checking the medication label	34	20.48		
c) Using a checklist	31	18.67		
d) Other (please specify)	11	6.63		
3. What do you do if you notice a discrepancy in the medication preparation?			165.64	p < 0.001
a) Report it immediately	112	67.47		
b) Ignore it and continue with the medication administration	16	9.64		
c) Document it but do not report it	8	4.82		
d) Discuss it with the doctor	30	18.07		
4. How often do you update your knowledge of medications and their preparation?			258.43	p < 0.001
a) Regularly	134	80.72		
b) Occasionally	20	12.05		
c) Rarely	7	4.22		
d) Never	5	3.01		
5. What is the most common medication preparation error?			134.43	p < 0.001
a) Incorrect dosage	106	63.86		
b) Incorrect medication	25	15.06		
c) Incorrect route of administration	16	9.64		
d) Other (please specify)	19	11.45		

1. The most critical step in preparing medications is considered to be measuring the correct dosage (42.17%), followed closely by checking the medication label (33.13%). The Chi-square value (51.69, $p < 0.001$) indicates a significant difference in opinions about the most critical step.
2. To ensure correct medication preparation, 54.22% of respondents follow the medication order, while 20.48% check the medication label. The significant Chi-square value (86.69, $p < 0.001$) suggests strong agreement on the importance of following the medication order.
3. When noticing a discrepancy in medication preparation, 67.47% report it immediately. This high percentage, along with the significant Chi-square value (165.64, $p < 0.001$), indicates a strong safety culture and awareness of the importance of reporting errors.
4. An overwhelming 80.72% of respondents regularly update their knowledge of medications and their preparation. The very high Chi-square value (258.43, $p < 0.001$) underscores the strong commitment to ongoing education among healthcare professionals.
5. Incorrect dosage is identified as the most common medication preparation error by 63.86% of respondents. The significant Chi-square value (134.43, $p < 0.001$) highlights the consensus on this issue and the need for focused attention on dosage accuracy.

Section 3: Medication Administration

questions	Frequency	Percentage	X^2	p-value
1. What is the most critical step in administering medications?			62.69	$p < 0.001$
a) Checking the medication order	79	47.59		
b) Checking the medication label	30	18.07		
c) Administering the medication correctly	46	27.71		
d) Other (please specify)	11	6.63		
2. How do you ensure that you are administering medications correctly?			8.55	$p < 0.05$
a) Following the medication order	54	32.53		
b) Checking the medication label	35	21.08		
c) Using a checklist	30	18.07		
d) Other (please specify)	47	28.31		
3. What do you do if you notice a discrepancy in the medication administration?			201.8	$p < 0.001$
a) Report it immediately	123	74.10		
b) Ignore it and continue with the medication administration	10	6.02		
c) Document it but do not report it	4	2.41		
d) Discuss it with the doctor	29	17.47		
4. How often do you update your knowledge of medications and their administration?			248.19	$p < 0.001$
a) Regularly	134	80.72		
b) Occasionally	20	12.05		
c) Rarely	6	3.61		
d) Never	6	3.61		
5. What is the most common medication administration error?			100.48	$p < 0.001$
a) Incorrect dosage	97	58.43		
b) Incorrect medication	32	19.28		
c) Incorrect route of administration	23	13.86		
d) Other (please specify)	14	8.43		

1. The most critical step in administering medications is considered to be checking the medication order (47.59%), followed by administering the medication correctly (27.71%). The Chi-square value (62.69, $p < 0.001$) indicates a significant difference in opinions about the most critical step.
2. To ensure correct medication administration, 32.53% of respondents follow the medication order, while 28.31% use other methods. The Chi-square value (8.55, $p < 0.05$) suggests a less pronounced but still significant difference in approaches to ensuring correct administration.
3. When noticing a discrepancy in medication administration, 74.10% report it immediately. This high percentage, along with the significant Chi-square value (201.8, $p < 0.001$), indicates a strong safety culture and awareness of the importance of reporting errors.
4. An overwhelming 80.72% of respondents regularly update their knowledge of medications and their administration. The very high Chi-square value (248.19, $p < 0.001$) underscores the strong commitment to ongoing education among healthcare professionals.
5. Incorrect dosage is identified as the most common medication administration error by 58.43% of respondents. The significant Chi-square value (100.48, $p < 0.001$) highlights the consensus on this issue and the need for focused attention on dosage accuracy.

Section 4: Additional Questions

questions	Frequency	Percentage	X^2	p-value
1. Have you ever committed a medication error?			24.24	$p < 0.001$
a) Yes	52	31.33		
b) No	114	68.67		
2. If yes, what did you do to correct the error?			39.85	$p < 0.001$
a) Reported it immediately	33	19.88		
b) Ignored it and continued with the medication	8	4.82		

administration				
c) Documented it but did not report it	4	2.41		
d) Discussed it with the doctor	7	4.22		
3. Do you believe that medication errors are a significant problem in your hospital?			62.43	$p < 0.001$
a) Yes	134	80.72		
b) No	32	19.28		
4. Do you think that medication errors can be prevented?			114.43	$p < 0.001$
a) Yes	152	91.57		
b) No	14	8.43		
5. What do you think is the most effective way to prevent medication errors?			123.95	$p < 0.001$
a) Improved training	102	61.45		
b) Improved communication	34	20.48		
c) Improved workflow	23	13.86		
d) Other (please specify)	7	4.22		

1. 68.67% of respondents reported never committing a medication error, while 31.33% admitted to having made an error. The Chi-square value (24.24, $p < 0.001$) indicates a significant difference between these two groups.
2. Among those who committed an error, 19.88% reported it immediately. The Chi-square value (39.85, $p < 0.001$) suggests significant differences in how errors were handled, with immediate reporting being the most common response.
3. A large majority (80.72%) believe that medication errors are a significant problem in their hospital. The Chi-square value (62.43, $p < 0.001$) indicates a strong consensus on this issue.
4. An overwhelming 91.57% of respondents think that medication errors can be prevented. The high Chi-square value (114.43, $p < 0.001$) underscores the strong belief in the preventability of medication errors.
5. Improved training is considered the most effective way to prevent medication errors by 61.45% of respondents, followed by improved communication (20.48%). The Chi-square value (123.95, $p < 0.001$) highlights significant differences in opinions about prevention strategies.

Comparison of results medication errors in the two groups (checklist)

Group	Pre-test	Post-test	Results
Intervention	33.43(5.92)	37.69 (5.68)	T=19.85 Df=82 P<0.001
Comparison	32.08(4.55)	33.87 (4.27)	T=1.32 Df=82 P=0.312
Results	T=1.645 Df=164 P=0.102	T=2.33 Df=164 P=0.021	

The table presents a comparison of medication errors between two groups (Intervention and Comparison) before and after implementing a risk management protocol

1. Intervention Group:

- Pre-test Score: The mean score for medication errors was 33.43 with a standard deviation of 5.92 before the intervention.
- Post-test Score: After applying the risk protection protocol, the mean score improved to 37.69 with a standard deviation of 5.68.
- Statistical Significance: The t-value of 19.85 with df = 82 and a p-value of < 0.001 indicates a highly significant improvement in the intervention group's performance in reducing medication errors after the protocol was implemented.

2. Comparison Group:

Pre-test Score: The mean score for medication errors was 32.08 with a standard deviation of 4.55 before the intervention.

Post-test Score: The mean score slightly increased to 33.87 with a standard deviation of 4.27 after the intervention.

Statistical Significance: The t-value of 1.32 with df = 82 and a p-value of 0.312 indicates no significant change in the comparison group's performance regarding medication errors after the intervention.

3. Overall Results Comparison:

The results show that the intervention group experienced a statistically significant reduction in medication errors post-intervention ($t = 2.33$, $df = 164$, $p = 0.021$). In contrast, the comparison group did not show any significant change in their scores ($t = 1.645$, $df = 164$, $p = 0.102$).

The implementation of the risk protection protocol had a positive effect on reducing medication errors in the intervention group, as evidenced by the significant increase in their post-test scores compared to their pre-test scores. Conversely, the comparison group did not demonstrate any significant improvement, highlighting the effectiveness of the intervention in enhancing medication safety practices among pediatric nursing staff.

Discussion

Demographic Characteristics and Their Implications

The demographic analysis revealed notable differences between the intervention and comparison groups in terms of gender, education, and job positions. The intervention group had a significantly higher proportion of males (34 vs. 19; $\chi^2=6.23$, $p=0.013$), while the comparison group had more females. These differences might suggest varying roles or perceptions of the risk management training across genders [53, 56].

Additionally, educational backgrounds varied, with a higher percentage of the comparison group holding PhDs ($\chi^2=9.787$, $p=0.02$), which could influence how participants engage with and apply risk management strategies. Higher levels of education are often linked to a greater understanding and confidence in clinical practices. The intervention group also showed more role diversity, with several participants in leadership and advanced practice positions, which were absent in the comparison group ($\chi^2=16.84$, $p=0.001$). These differences highlight the need for programs to be tailored to account for educational and positional variations, as they can influence the effectiveness of interventions [48].

Although there were no significant differences in age or years of pediatric experience, most participants in both groups had over a decade of experience. This indicates a well-experienced sample, but it's important to note that extensive experience in pediatric care doesn't necessarily mean proficiency in risk management. Therefore, continuous training remains vital [57].

Knowledge and Perceptions of Medication Errors

The Medication Errors Knowledge Questionnaire revealed important insights into participants' understanding and attitudes toward medication errors. More than half (57.23%) of respondents viewed all the listed medication errors (e.g., incorrect dosage, wrong medication, incorrect route) as common, with a significant association ($\chi^2=123.36$, $p<0.001$). This reflects a high level of awareness of the various types of medication errors, aligning with previous studies highlighting the importance of recognizing a broad range of errors [58].

Additionally, 71.69% of respondents believed medication errors should be reported immediately, indicating a strong safety culture. The statistical significance ($\chi^2=185.69$, $p<0.001$) emphasizes the effectiveness of interventions that promote transparency and accountability [59]. However, there were differences in how participants identified the primary causes of errors, with many pointing to insufficient training (34.34%) and poor communication (33.13%). These findings suggest that risk management programs should target these systemic issues by improving communication and training to boost staff competency [38, 51].

Medication Preparation and Administration Practices

In terms of medication preparation, participants identified measuring the correct dosage (42.17%) as the most critical step, followed by checking the medication label (33.13%), with significant variations in responses ($\chi^2=51.69$, $p<0.001$). This emphasizes the importance of accuracy in pediatric medication preparation, where errors can have serious consequences [60]. Over half (54.22%) of respondents highlighted the importance of structured practices like double-checking orders and using standardized checklists to reduce errors, reinforcing the need for clear protocols in medication preparation [35].

Regarding medication administration, 47.59% of participants saw checking medication orders as the most vital step, while 27.71% prioritized ensuring correct administration. This indicates a potential gap in understanding the importance of comprehensive verification processes [56]. However, the vast majority (74.10%) supported reporting discrepancies during administration ($\chi^2=201.8$, $p<0.001$), showing a strong commitment to maintaining a safe clinical environment. Yet, the varied methods used to ensure correct administration suggest that standardized protocols may not be fully utilized [38].

Impact of Risk Management Intervention

The effectiveness of the risk management intervention was evident from the improvements in the intervention group's medication error scores. Analysis of pre- and post-test results revealed a substantial increase in scores from 33.43 to 37.69 ($t=19.85$, $p<0.001$), indicating that the risk management protocol significantly enhanced participants' ability to identify and prevent medication errors. These results align with prior studies showing that structured interventions—such as training, incident reporting systems, and adherence to protocols—can significantly reduce medication errors in pediatric settings [53].

In contrast, the comparison group showed no significant change in scores ($p=0.312$), suggesting that without targeted interventions, medication safety improvements may stagnate. A post-test comparison between groups ($t=2.33$, $p=0.021$) further validated the intervention's effectiveness, highlighting the role of structured risk management programs in improving clinical outcomes [54].

Broader Implications for Risk Management Programs

These findings emphasize the importance of incorporating comprehensive risk management strategies into pediatric hospitals. The significant reduction in medication errors in the intervention group highlights the value of programs that combine education, standardized protocols, and robust reporting systems. However, the demographic and knowledge differences between groups suggest that program designs should be customized to accommodate variations in education, roles, and competencies [48].

The study also identifies systemic barriers, such as poor communication and workflow inefficiencies, that require organizational efforts to address. Technologies like Computerized Physician Order Entry (CPOE) and Barcode Medication Administration (BCMA) could improve safety further, but their success depends on proper implementation and staff engagement. By addressing these barriers, risk management programs can achieve lasting improvements in medication safety and promote a culture of ongoing learning and accountability [61].

Conclusion

In conclusion, this study highlights the significant impact of risk management interventions on reducing medication errors in pediatric settings. The findings demonstrate that structured programs combining education, clear protocols, and robust error-reporting systems can effectively improve the awareness and practices of nursing staff, leading to safer medication administration. The intervention group, which received targeted training, showed notable improvements in identifying and preventing medication errors, emphasizing the importance of providing ongoing education and resources to healthcare providers. This is particularly crucial in pediatric care, where even small errors can lead to serious consequences.

However, the study also reveals key challenges that need to be addressed to further enhance medication safety. Demographic differences between the intervention and control groups, such as variations in gender, education, and job roles, suggest that risk management programs must be tailored to accommodate these factors. Nurses with higher educational qualifications or more senior roles may have different levels of receptivity to training, which can influence the effectiveness of the intervention. Therefore, customized approaches are necessary to ensure that all staff, regardless of their background, can fully benefit from such programs.

Additionally, systemic issues like poor communication and workflow inefficiencies were identified as major contributors to medication errors. Addressing these barriers through improved communication channels and technological solutions, such as Barcode Medication Administration (BCMA) or Computerized Physician Order Entry (CPOE), could further enhance the safety and efficiency of medication processes.

Ultimately, this study reinforces the need for comprehensive and dynamic risk management strategies that continuously evolve to meet the demands of the healthcare environment. By incorporating tailored training, standardized protocols, and technological advancements, pediatric hospitals can achieve sustained improvements in medication safety and foster a culture of accountability and continuous learning among healthcare staff.

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