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# Medication Errors by Novice Nurses in a Pediatric and Neonatal Care Setting of Pakistan: Analysis of Problems and Proposed Solutions

**Shela Akbar Ali Hirani[1,*], and Judith McFarlane[2]**

[1]*University of Alberta, Faculty of Nursing, Edmonton, Canada*

[2]*Texas Woman's University, Houston, Texas, USA*

[*]**Corresponding author:** Shela Akbar Ali Hirani, University of Alberta, Faculty of Nursing, Edmonton, Canada, Tel: +1-780-707-5997; **E-mail:** shela.hirani@gmail.com

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## Abstract

**Background and Aim:** The pediatric setting and associated dispensing of small qualities of medications presents an opportunity for medication errors that can result in serious consequences for children. Pediatric medication administration is more risky in clinical settings without unit dosage, a common situation in developing countries such as Pakistan. To propose solutions to pediatric medication errors, this paper uses a problem solving approach.

**Methods:** The clinical issue of pediatric medication errors was analyzed and solutions derived through a three step systematic process beginning with examining case examples of medication errors followed by a review of the literature to determine causes of pediatric medication errors followed by an informal discussions with pediatric nurses, nurse managers, and nurse educators to seek their opinions when comparing the case examples to published literature to nurse opinion.

**Results and Conclusion:** The primary causes of pediatric medication errors were lack of nurse knowledge, inadequate training, high workload, distraction, and complexity of procedures in pediatric medication administration. The literature review and nurse discussions indicated that the incidents of medication errors among pediatric nurses could be minimized by offering the nurses information on the skills of correct pediatric medication administration. The results indicate the need to better connect nursing theory to nursing clinical practice.

**Keywords**: Medication Errors; Pediatric Setting; Pediatric Nurses; Theory-Practice Gap

## Introduction

In today's world of emerging technology, major advances have been made to improve the delivery and quality of health care including the unit dosage system of medication delivery that ensures correct dosage from pharmacy dispensation to nurse delivery at the bedside. However in developing countries and smaller health care systems, medication type and dosage is usually selected, calculated and administered by the nurse. Medication error is a common concern and unfortunate occurrence. The risk of medication error is equally great in pediatric settings.

In Pakistan, a study of pediatric, medical, surgical, obstetrics and gynecology units in a private tertiary care hospital revealed an overall medication error rate of 5.5%, with 1.9% of the errors made by nurses [1]. Regarding medication errors, literature reports that young children are the most vulnerable group due to their limited capability to communicate the initial symptoms of drug errors or reactions, and due to their body mass ratio less capable to "buffer error" as compared to adults [2,3]. A review of the international literature indicates that among all nurses, new graduate nurses are at the greatest risk of making a medication error [4-6].

Every pediatric hospital is vulnerable to medication errors7. In Pakistan, where most hospitals do not have unit dosage, the risk for pediatric medication error is very high. In pediatric settings of Pakistan, newly graduate nurses are routinely observed committing or on the brink of committing a medication error. To determine the reasons for the medication errors and to suggest solutions, a review of the literature was initiated followed by informal discussions with nurses at various levels of management, including new graduates working in pediatric and neonatal care settings, pediatric nurse managers, head nurses, case managers and nurse educators. To analyze the problem of medication errors by pediatric nurses, the observed clinical case example scenarios were examined to isolate the cause of the errors using the literature as a guide followed by a review by expert nurses and managers for final recommendations.

## Clinical Case Example Scenarios

**Scenario # 1:** A three-year-old child with Congestive Cardiac Failure (CCF) was brought to the tertiary hospital by his mother for Intravenous (IV) cannulation. On assessment the child's IV line was completely blocked and red. Forty-eight hours previous to the IV cannulation admission, the child had been discharged from the community hospital with medications including Syrup Lasix and IV antibiotics. Following cannulation and further assessment, the mother revealed she placed the Syrup Lasix in the IV as she had been instructed to do by the nurse at the community hospital. When that nurse was contacted and asked about the Syrup Lasix administration route, the new graduate nurse reported her only prior experience was with Injection Lasix.

**Scenario # 2**: During medication preparation, a new graduate registered nurse was going to dilute an IV antibiotic with Calcium Gluconate. When the new graduate was stopped and asked her reason for using Calcium Gluconate, the nurse stated she was unable to distinguish between an ampoule of water compared to an ampoule of Calcium Gluconate as both these drugs appear similar.

**Scenario # 3**: A newly graduate nurse prepared Paracetamol syrup 250 mg per 5 cc instead of the Paracetamol syrup of 125 mg per 5 cc as

prescribed. When questioned about her actions, the nurse responded that she assumed that all Paracetamol Syrups are of the same strength.

**Scenario # 4**: An antiemetic was sent by the Pharmacy indicating its route as an IV route, which is commonly followed in adults. The novice nurse was about to give that drug via IV but, by chance, she decided to confirm its dilution from an experienced nurse. As a result, she came to know that the medication was only indicated *via* intramuscular in pediatric clients, and if it were to be given *via* IV then the patient would go into septic shock.

## Analysis of Case Scenarios with Literature

All three pediatric medication error scenarios had potential adverse outcomes for the children. A closer look at the above scenarios reveals that errors were taking place at the preparation and administration level. Errors were due to use of wrong dose, route, and dosage. Literature reveals that errors concerning dose, route and time are the top medication errors in pediatric settings [1,2,7,8]. Besides adversely affecting the well-being of the pediatric patients, potentially these errors can result in frustrations, powerlessness, and anger among patients and their family members. The specified scenarios of missed and near-miss events of medication errors were reflective of compromised quality of health care offered by nurses who are morally obliged to provide safe, high quality and ethically sound nursing care to their patients.

In the light of the above scenarios, terminating these nurses might not have a high impact on improving the situation. In the Pakistani context, where child morbidity and mortality is high, families need effective and efficient pediatric health care professionals who provide quality care. A pressing need is to realistically and critically solve the issue by identifying and eliminating the root cause of the medication errors.

After reviewing literature and discussing the issue with pediatric nurses, nurse managers, and nurse educators, factors that were identified as potential causes of medication errors among novice pediatric nurses are discussed below:

### Complex Procedure

One of the primary causes of medication errors is the complex nature of procedure required for preparation and administration of pediatric medications. As compared to other clinical areas, some of the complexities in administering pediatric medications are: drug calculation for small unit doses; age differences and dosing per weight; diversity in dosages for the same name medication, like Paracetamol syrup; use of sophisticated syringe pumps and electronic equipments; dilution process for drawing micro doses; availability of medication for varied routes; and handling of tiny babies during medication administration8. Several other studies support the idea that uncommon and complex preparation and administration of drug increases the chances of medication errors [2,9,10].

### Gaps in Knowledge

Another cause for error could be gaps in knowledge of novice pediatric nurses. The scenarios show that the nurses admitted that they were unfamiliar with pediatric drugs, dose, and route. One of the case example scenarios showed that the nurse was unable to distinguish between look-alike drug i.e. Calcium Gluconate in a 20 ml ampoule and water for injection in a 10 ml ampoule. One of the studies on novice Registered Nurses (RN) reveals that novice nurses' unfamiliarity with procedures often results in adverse events and errors [11]. Several other studies have identified lack of knowledge and gaps in knowledge about preparation, administration, handling of infusion pumps, and drug knowledge as the most common causes of errors among novice and experienced nurses [5,8,10]. A study undertaken at a tertiary care hospital of Pakistan also reported gaps in nurses' knowledge regarding medication indication, medication compatibility, side effects, and the Computerized Physician Order Entry (CPOE) system in the units of tertiary care hospital as causing errors [1].

### Gaps in Training

Gaps in knowledge and lack of beginning level competency among novice pediatric nurses indicate possible gaps in training that require top-level action and commitment. Literature highlights the gaps in training as a latent condition that could potentially lead towards medication error [10].

On analyzing potential causes of medication errors among newly graduate nurses in Pakistani pediatric setting, gaps in training at the level of nursing school and at the level of orientation programmes by hospital's nursing education services was identified. On reviewing the pediatric nursing curriculum, the identified concern was one time teaching of child health nursing course during the entire three or four years of the undergraduate programmes. It was analyzed that this course has four weeks (20 days) of clinical experience for the nursing students. Out of these 20 days, 2 days are devoted to teach pediatric skills, and the rest of the 18 days are utilized for the clinical experience at the pediatric settings. During the entire clinical experience rotation, students get two to three opportunities to utilize their medication skills on patients. Also, other than the pediatric course, no other clinical course covers pediatric medication. Another concern is that pharmacology courses that are taught across the programme give more weightage to adult drugs and dosage calculations. So, the main gap in curriculum could be viewed as less weightage to the pediatric component as compared to adult focused course content.

Similarly, at the level of hospital's nursing education services the gap is that the medication skills module for the orientation nurses does not hold a specialty focused medication teaching module. This indicates that those new graduates who select pediatric specialty are not offered a separate medication module for their specialty area. During first year of the internship period at hospital, novice nurses are offered a two-week post basic pediatric nursing course by pediatric management team and hospital's nursing education services, however, during this course more focus is placed on nursing care aspects of pediatric patients having medical and surgical diagnosis as compared to on drug-dosage calculations, look-a-like drugs, and hands on practice of pediatric medication skills by considering that nurses have already learnt pharmacology during their nursing training and orientation programme. Hence, these gaps in training by the nursing school and hospital's nursing education services during orientation and internship programme were well highlighted by the Pediatric nurse managers, head nurses and pediatric nurses.

### Workload

Another identified cause at the unit level is the workload of the novice nurses. It is a common observation that during the three months probationary period, the clinical nurse instructors mentor newly graduate nurses by supervising their medication for the initial few weeks. Later, considering the shortage of staff, new graduate nurses are expected to manage patients care area by themselves. In other words, the novice nurses are supposed to take charge of all medications for 20-25 pediatric patients. Additionally, the new graduate nurses must deliver all patient treatments in addition to the medications. Additionally, during the evening and night shifts, novice nurses are expected to handle emergencies and administer the emergency medications. Emergency situations increase the chances of error. The literature also supports that multiple responsibilities and workload issues can result in medication errors [1,10].

### Distraction

Another cause for medication error is the distractions in the pediatric settings. For example, voice paging for nurses is quite common. Another

issue is the distraction at the medication preparation site, as this room contains the lockers of the staff. Also the refrigerator and the microwave are kept in the medication area. Additionally, patient attendants come to the medication area frequently to seek assistance from the medication nurse. Medication nurses are also assigned to patient care; therefore, in a case of call bell or shifting orders for patients, medication nurses must stop medication preparation and attend to the situation. Literature has also highlighted distraction as one of the most common causes for medication error [5,12,13].

## Strategies to Resolve the Problem

In the light of the above analysis, gaps in training and workplace vulnerability have been identified as the top most areas of concerns with respect to novice nurses, so following solutions are proposed:

### Bridging the theory-practice gap in the curricula

As training gaps were considered as the top concern, the proposed solution is to ensure that the current Pediatric curriculum for nursing students is in alignment with practice based issues. One possible solution for bridging the preparation-practice gap in pediatric curriculum is with a partnership between the pediatric faculty member preparing the new nurses and experienced pediatric nurses working in health care system. This partnership approach can lead to richness and a practical approach in the pediatric curriculum within the existing credit hours. The importance of collaboration between "educators" and "practice partners" has been highlighted as the key solution for better adjustment of novice nurses [14]. The literature further shares, "Neither practice nor academia can accomplish the transition alone, but together they can improve the quality and safety of patient care" [14].

As currently offered nursing courses in the undergraduate curriculum focuses on adult mediation administration, therefore, a need is viewed to add pediatric medication administration and skills content in the pharmacology courses. This strategy will enable nursing students to realize the difference between drug dose calculation for the adult and pediatric patients. Another strategy for bridging the theory-practice gap is to include the safety and risk management approach in the nursing curriculum. The key benefit would be that the students would be able to identify and develop an insight regarding risks associated with medication errors. Supporting this notion, review of literature highlights the need for instilling and integrating quality and safety content in clinical teaching and in the nursing curriculum [14,15].

### Using innovations in teaching strategies

Another solution is utilization of innovative teaching strategies within the existing credit hours of the pediatric nursing curricula and in the orientation programme for novice nurses. Currently, at the nursing school and in nursing services, medication and other skills are taught *via* lab-based simulation and then students are required to give a demonstration during skills evaluation. Student demonstration of skills is effective to teach techniques but demonstrations do not evaluate critical thinking or problem solving skills. Therefore, the innovation in the teaching strategy could be the introduction of case based learning, by offering two to three clinical case oriented problems to students and asking them to work out the solutions and perform the skills accordingly. It is expected that this strategy will enable students to integrate concepts and respond to the scenario by using the critical thinking and problem solving approach [16]. Supporting the effectiveness of this type of lab based simulation exercise, a pilot study on 47 junior level baccalaureate pediatric students revealed that provision of case based scenarios enabled nursing students to significantly increase their recognize of clinical errors [17].

Additionally, it is suggested that innovation in teaching strategies could also be introduced while teaching drug dosage calculation at the hospital's department of nursing education services. In such hospital teaching departments, conceptual and computation based word problems could be given to students instead of offering simple mathematical based calculations as this strategy will enable graduate nurses fulfill the demands of the clinical situations. Moreover, it is anticipated that this strategy could enhance critical thinking among students and would help them to resolve the issue of complicated drug calculations at the clinical setting. While supporting this notion, literature highlights the importance clinical effectiveness in teaching through promotion of critical skills and fundamental arithmetic skills among nursing students [18].

### Offering advanced pediatric clinical course as an elective

As one of the case examples identified errors caused by the complexity of and the unfamiliarity with pediatric medications, a possible solution for the nursing school could be to look at the misbalance between the adult and the pediatric clinical components. For this purpose, just like the Advance concept in Adult health nursing course, an advanced concept in pediatric nursing based clinical course could be offered as an elective in the final year of the undergraduate programme. The benefit would be that it would enable nursing students to get hands on experience and to get a grasp of pediatric clinical skills, including medication skills, handling of the CPOE system, etc. Literature also highlight the importance of enhancing students' exposure at the clinical setting by assuring prolonged clinical placement and by giving students access to the CPOE system to facilitate them to sharpen their clinical skills [15]. It is viewed that this clinical course would enable new graduate nurses to sort out the major differences in clinical practices for adult versus pediatric clients.

### Introducing the pediatric medication module at the orientation phase

Considering the gap in the beginning level competency for medication among novice pediatric nurses, pediatric and neonatal medication focused modules could be offered to the novice pediatric nurses in the hospital as part of required orientation education. During the orientation phase, this strategy could facilitate novice pediatric nurses knowledge regarding recent advances in pediatric medication. During hospital orientation, along with further medication instruction, assessing the competency of novice nurses is equally important by conducting pediatric medication based competency tests. Citations in the literature highlight that competency tests identify nurses who are at risk of medication errors in clinical settings [19].

### Utilizing the Primary Care Team (PCT) care model

Analysis of medication errors indicate that increased workload during the probationary period contributes towards medication errors. Therefore, to correct this issue, pediatric clinical settings could adopt the PCT care model [20]. This model is utilized in many developing countries and has proved to be effective in reducing medication errors among novice nurses, because, as per this model, work is distributed on the basis of licensure, experience, and mentoring needs [20]. Literature further indicates that through this model, nurses are offered ongoing support and mentorship from novice level to competent level [20]. This indicates that implementation of such models in our clinical setting could contribute towards successful transition of novice nurses to competent nurses and could ensure risk reduction and quality assurance.

### Promoting culture of reporting medication errors

Discussion on the topic indicates that medication errors are not uncommon among novice nurses and such incidents are only reported when harm occurs to patients or someone observes the error. Literature indicates that frequently nurses do not report medication errors due to fear of disciplinary action against them [1,21]. Hence, because of

underreporting, it appears as if medication errors do not exist. Therefore, it is proposed that at the level of nursing education, orientation, and during on-job supervision, the culture of reporting for medication errors must be promoted. Literature supports that anonymous reporting of such errors promotes a culture of safety that is of benefit to staff morale and patients' safety [4,12,22,23]. Above all, such reporting would help nurse managers and nurse educators improve the system.

### Reducing environmental distraction

Keeping in view environmental distraction as one of the causes for medication errors in Pediatric settings, the possible solution is facilitating a team approach, as well as ensuring one assignment at a time, and assigning a separate area for medication preparation. Keeping in view the possibilities of medication errors, internationally such things are commonly practiced and have proved to be effective [12,13]. It is felt that by ensuring reduction in environmental distraction, safe medication preparation and administration can be increased among all nurses.

## Recommendations

It is recommended that the content of risk management and safety promotion should be made a part of the nursing curriculum, especially the pediatric curriculum, because this initiative would prepare novice nurses to administer safe medication and to identify risk behaviors. It is also recommended that pediatric drug dosage calculation should be made a part of the pediatric theory course and all pharmacology courses, and the utilized word problems for drug dosage calculation should be logical, critical, and abstract. This recommendation is made because this would enable novice nurses to demonstrate beginning level competency for minute drug dosage calculations. Moreover, it is also recommended that in the orientation programme, a pediatric focused medication module and a competency assessment test should be included for the novice pediatric nurses. The rationale is that it will sort out those nurses who are at risk of errors, and need further support in medication skills. Also, this module would enable novice nurses to get hands on experience for the sophisticated nature of pediatric medication skills. It is also recommended that the pediatric curriculum should be revised every two years and for its revision a partnership should be ensured between nurse educators and nurse clinicians because this would facilitate bridging the theory-practice gap in pediatric education.

## Conclusion

This paper presents the issue of medication errors among novice neonatal and pediatric nurses. An analysis of the issue indicates that medication error holds serious implications for patients, their family members, and the health care system. An analysis of the situation revealed that possible causes for medication errors include: complexity of procedures, lack of adequate knowledge, gaps in training, increased workload, and distraction. To facilitate newly graduated novice nurses perform safe medication skills, seven solutions were proposed at the level of the nursing school, nursing education services, and pediatric unit.

A closer look at the proposed solutions indicated that a collaborative approach between the nurse educators and nurse clinicians is essential to align pediatric education with the current demands of practice setting. It was analyzed that nursing education and training must be offered to students by using effective and innovative teaching learning strategies, like simulation, case based scenarios, abstract word problems for drug calculation, etc. To overcome the issue of medication errors among novice neonatal and pediatric nurses, a need is viewed to bridge the theory-practice gap in pediatric nursing education. It was also realized that the role of the nursing school and the nursing education services is equally important to develop the beginning level clinical competency among novice pediatric nurses.

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