Pakistan Journal of Medical & Cardiological Review
https://pakjmcr.com/index.php/1/about
Online ISSN 3007-2387
Print ISSN 3007-2379

Assessment of Nurses' Knowledge and Self-Reported Practices in Using Infusion Pumps for Pediatric units at Tertiary Care Hospitals, Lahore

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Keywords: Infusion Pumps, Pediatric Nursing, Medication Errors, Knowledge and Practice, Tertiary Care

Received on 20 May 2026
Accepted on 14 Jun 2026
Published on 24 Jun 2026

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Abstract

Background: Infusion pumps are essential medical devices in pediatric care, designed to deliver fluids and medications with high precision. However, their safe use is heavily dependent on the knowledge and competence of nursing staff, as errors in these units can lead to life-threatening complications due to the physiological vulnerability of neonates and children.

Objective: This study aimed to assess the level of knowledge and self-reported practices among nurses regarding the use of infusion pumps in pediatric units at tertiary care hospitals in Lahore.

Methodology: A descriptive cross-sectional research design was employed. Data were collected from 150 registered nurses working in pediatric units at Jinnah Hospital and other tertiary care facilities in Lahore using a simple random sampling technique. A structured, 5-point Likert scale questionnaire and checklist, adopted from previously validated research, were used to measure knowledge and practice levels. Data were analyzed using SPSS version 27.

Results: The majority of participants were aged 26–35 years (86.7%) and held a Post RN or Diploma in Nursing. While 97.3% of nurses managed more than three patients per shift, only 2% had attended formal training on infusion pump usage. Despite this, nurses demonstrated high knowledge levels, with mean scores ranging from 4.55 to 4.98. Significant majorities strongly agreed they could program rates (60.7%) and understand safety alarms (64%). Self-reported practices were also satisfactory (mean scores 4.38–5.14), with high compliance in checking settings (80%) and priming lines (81.3%). However, lower compliance was noted in hand hygiene (59.3%) and equipment cleaning (64.7%).

Conclusion: Nurses in Lahore's tertiary pediatric units possess satisfactory theoretical knowledge and self-reported clinical skills regarding infusion pumps. Nevertheless, the critical lack of formal training and standardized procedure manuals highlights an institutional gap that must be addressed to ensure long-term patient safety and minimize the risk of medication errors.

Introduction

Infusion pumps, common medical devices, are used to administer fluids such as nutrients or medications to patients. In comparison to manual administration of fluids, infusion pumps provide the advantage of controlled administration the ability to deliver fluids in small volumes or at precisely programmed rates or intervals(Hoffman and Bacon 2020).

Infusion Pumps (IP) are medical devices that were developed in the 1960s and generate fluid flow at pressures higher than that of normal blood pressure. Various hospital sectors make use of them, and they have become indispensable in therapies requiring continuity and precision in the administration of medication and/or food(Silva, Araújo et al. 2023).

Smart infusion pumps are devices widely used in clinical settings to infuse fluids and drugs in controlled amounts. Different infusion pumps are used for intravenous infusions, in clinical settings. These devices are considered smart when incorporate safety systems that provide high control, accuracy, and precision in drug delivery, with the potential to reduce medication errors and improve patient care (Herrero, Cano et al. 2025).

A syringe pump is a device that intravenously infuses fluids, drugs, or nutrients in the patient. The use of infusion pump is helpful as it helps in reducing nurses' workload and in improving accuracy and efficiency in terms of delivery of drugs or fluids. The purpose of using a syringe pump in clinical settings is to administer an accurate amount of drug or fluid over a relatively long duration *(Gao, Wen et al. 2019)*.

Acutely ill patients with life threatening conditions require constant care, monitoring and a number of life-sustaining medications The administration of medication and fluids into a patient's veins is referred administration, to as intravenous (IV) and about 90% of an infusion pump electronically regulates the flow of intravenous solutions and drugs. They are used when a precise flow rate is required for instance (S El-sayed, I Abdel-sattar et al. 2019).

Syringe infusion pumps are used in critical care medicine and anesthesia for the continuous intravenous administration of short-acting cardiovascular drugs. In the pediatric setting, highly concentrated drug solutions are administered at low infusion rates ($\leq$1 ml h$-$1) to prevent fluid overload, particularly in neonates and infants. Accordingly, precise and regular fluid delivery is essential to avoid hemodynamic disturbances(Baeckert, Batliner et al. 2020).

The neonatal care unit is an intensive and demanding environment where newborn infants are constantly bordering on life and death. It is an area that provides challenges to those working within it or being a parent or relative visiting an ill neonate(Yildirim, Parlar et al. 2010).

The most prevalent cause of medical injuries is medication errors especially when patients take multiple medications at the same period of time with different doses. One of the technologies that have been developed to improve patient outcomes is the smart infusion pump, which has the ability to identify several programming problems when applied correctly(Algushairy, Bayahya et al. 2023).

Medication administration is considered as one of the main nurses' roles. The medication administration process is complex. The intravenous route is a critical part in the treatment of patients admitted to hospital. An intravenous route for a neonate is a challengeable mission due to difficult insertion of peripheral line and decreased blood volume that affect medication concentration and ability to carry IV fluids.

Neonates' patients or fluid restricted patients may require a higher degree of infusion devices accuracy than other patients (Yildirim, Parlar et al. 2010).
Programmable syringe pumps deliver solutions such as fluids, medications, or blood products to patients. Continuous infusions subject to frequent adjustment or titration, as needed. They are commonly used in settings where patients may need highly concentrated medication doses because of fluid restriction or fluid intolerance(S El-sayed, I Abdel-sattar et al. 2019).
Infusion pumps have shown a positive impact on medications' safety for critical patients, the reduction of IV medication errors, the creation of safer work environments for nurses and the optimization of capital returns, quality control, and the continuous improvement of the processes. Furthermore, the use of pump technology has shown to be profitable in the intensive care unit (ICU) because it avoids costs from prevented medications errors and allows for savings on disposables and medications by establishing standardized concentrations and dosing units(Herrero, Cano et al. 2025).
Pediatric and neonatal patients are one of the most affected groups by medical errors, especially when admitted to an intensive care unit. This is due to the need of many different medications, immature body system and their inability to communicate symptoms. Around 57% of adverse events are considered as preventable errors and one of the most frequent are the dosing errors. Administration via infusion pumps should ensure an accurate dose deliver(Felipe, Latour et al. 2020).
Medication errors (MEs) are common in pediatric inpatient populations and the risk of potential adverse drug events is significant in neonates particularly in neonatal intensive care units (NICUs). Also, the medication-use process in NICU is particularly complex because of the wide use of intravenous (IV) administration routes, weight-based small dosages, multiple calculations and dilutions, common of-label use, and the use of unlicensed drugs(Kuitunen, Kärkkäinen et al. 2022).
In Pediatric Intensive Care Units (PICUs), among so many equipment, infusion pump (IP) is a widely used medical care equipment (MCE). MCE is defined as an equipment or system, including its accessories, used directly or indirectly for diagnosis, therapies and monitoring in the population's health care. IP is an essential ally to the nursing staff in the process of administration of fluids, diets, and medications safely(Oliveira, Silva et al. 2021).

Significance of the Study:
Safe and precise medication administration is crucial in pediatric care, where small errors can have serious consequences. Infusion pumps are essential tools, but their safe use depends on the knowledge and competence of nurses. This study will provide valuable insights into nurses' understanding and practices regarding infusion pumps in pediatric units, highlight gaps in training, and guide the development of targeted educational programs and clinical policies. Ultimately, the findings aim to enhance patient safety, reduce medication errors, and improve the overall quality of pediatric healthcare in tertiary hospitals.

Research Question:
What is the level of knowledge among nurses regarding the use of infusion pumps in the pediatric units of tertiary care hospitals in Lahore?
What are the self-reported practices of nurses in administering medications and fluids using infusion pumps in pediatric care?

Aim of study:
This study aims to assess the knowledge and practice of nurses regarding the use of infusion pumps in pediatric settings, recognizing their critical role in ensuring safe and accurate medication administration.

Objectives of Study:
To assess the level of knowledge among nurses regarding the use of infusion pumps in the pediatric units at tertiary care Hospitals, Lahore.
To evaluate the self-reported practices of nurses in administering medications and fluids using infusion pumps in pediatric care.

Conceptual Definitions
Knowledge:
Conceptually, knowledge refers to the understanding, awareness, or familiarity that nurses have about the functions, uses, safety measures, and handling of infusion pumps in paediatric care.

Practice:
Practice refers to the actual application of skills, techniques, and procedures by nurses when using infusion pumps during patient care in the paediatric ward.

Operational Definitions
Knowledge:
In this study, knowledge refers to the understanding nurses have about the use of infusion pumps, including their purpose, advantages, safety checks, and technical aspect. It will be measured through 10 Likert-scale items in the questionnaire. Each item will be scored on a 5-point scale (1 = Strongly Disagree to 5 = Strongly Agree). The total score will range from 10 to 50. A score of 40 or above (≥80%) will be classified as satisfactory knowledge, while a score of less than 40 (<80%) will be considered unsatisfactory knowledge.

Practice:
Practice refers to the actual performance and behaviors of nurses in using infusion pumps during patient care. It will be assessed through 10 Likert-scale items in the checklist. Each item will be rated on a 5-point scale (1 = Never to 5 = Always). The total score will range from 10 to 50. A score of 40 or above (≥80%) will be classified as satisfactory practice, while a score of *less than 40 (<80%) will be considered unsatisfactory practice.

LITERATURE REVIEW
Several studies have highlighted the critical role of nurses in ensuring neonatal safety, particularly in the context of medication administration using intravenous devices. A descriptive study conducted at Mansoura University Children Hospital assessed the practical knowledge of 82 nurses working in the neonatal intensive care unit (NICU) regarding neonatal safety and the prevention of medication errors through the use of intravenous devices. The findings revealed that the majority of nurses demonstrated an average level of knowledge about neonatal safety practices and strategies to prevent medication errors. Additionally, nearly half of the participants exhibited average to poor knowledge concerning the medication administration process, although most were aware of key strategies to reduce medication errors in neonates(Elsayed, Abusaad et al. 2020).
Notably, the study found a statistically significant association between nurses' practical knowledge and their gender, while no significant relationship was identified between knowledge levels and other demographic variables. The researchers recommended the implementation of regular in-service training programs focused on neonatal safety protocols, medication administration, and error prevention techniques to enhance nurses' competencies in the NICU setting(Elsayed, Abusaad et al. 2020).
The safe administration of intravenous medications through infusion pumps is a critical responsibility of nurses, particularly in intensive care settings. A descriptive

exploratory study conducted at the Cardiac Intensive Care Units of the Center of Cardiac and Digestive System in Sohag examined the performance of 30 nurses regarding medication administration using infusion pumps for critically ill patients. Data were collected using two tools: a structured questionnaire assessing nurses' demographic characteristics and knowledge, and an observational checklist evaluating their practical performance(S El-sayed, I Abdel-sattar et al. 2019).

The findings revealed that approximately three-quarters of the nurses had an unsatisfactory level of knowledge related to infusion pump use, and over half demonstrated inadequate practical performance. Importantly, a statistically significant correlation was found between nurses' knowledge and their practice levels, indicating that deficits in theoretical understanding were reflected in clinical performance. The study concluded that both knowledge and practice were insufficient among the participants, and emphasized the need for continuous in-service education and training based on evidence-based protocols to enhance nurses' competencies in infusion pump medication administration(S El-sayed, I Abdel-sattar et al. 2019).

Kuitunen et al. (2022) developed a simulation-based method to evaluate dosing limits in smart infusion pump drug libraries within a neonatal intensive care unit (NICU). Analyzing 601 medication error reports, they found that 3.5% involved incorrect infusion rates, commonly due to 2-, 5-, and 10-fold dosing errors or drug mix-ups. Simulation test cases using hypothetical neonates showed that while most extreme dosing errors triggered alerts (73%), mix-ups were often missed (only 24% triggered alerts). The study highlights the value of combining real error data with simulation testing to optimize drug library settings and recommends ongoing monitoring after implementation(Kuitunen, Kärkkäinen et al. 2022).

A study conducted at the Pediatric Intensive Care Units of Alexandria University Children's Hospital and Alanfoshy Children's Hospital assessed nurses' performance in operating life-saving medical devices, including mechanical ventilators, cardiac monitors, and infusion and syringe pumps. Using an observational checklist, data were collected from 50 nurses. The results showed that while 60% of the nurses demonstrated satisfactory performance in operating the devices, 98% performed unsatisfactorily in the interoperating maintenance aspect. The study concluded that although nurses are generally competent in using these devices, there is a critical need for continuous training programs focused on device maintenance to ensure patient safety and optimal device functioning(Essawy, Mohamed et al. 2025).

In Pediatric Intensive Care Units (PICUs), among so many equipment, infusion pump (IP) is a widely used medical care equipment (MCE). A study was done to see how easy and effective two types of infusion pumps were for nurses to use in a Pediatric Intensive Care Unit. The study included 72 nurses and followed a set of guidelines for testing medical equipment. It found that most tasks (91.7%) were completed successfully. However, one of the pump models caused more problems—it took longer to use, led to more mistakes, and often required nurses to use a manual calculator. The researchers concluded that looking at how well and how quickly nurses can use these devices is important to find and fix any issues, helping to improve patient care and nurse performance(Oliveira, Silva et al. 2021).

Medication errors pose a serious risk to patient safety, especially in children who are three times more likely to be affected than adults. A review of studies from 2000 to 2020 identified key nursing interventions aimed at reducing medication administration errors in pediatric care. These interventions included education programs, involvement of clinical pharmacists, double-checking procedures, minimizing interruptions, smart pump implementation, and other improvement strategies. Education was the most common intervention and was linked to a 64% reduction in medication errors after implementation. The review concluded that medication safety requires a combination of strategies tailored to local needs, and

understanding the causes of errors is essential before applying interventions(Marufu, Bower et al. 2022).

Even though smart infusion pumps are made to help prevent medication mistakes, they can still cause new types of problems. One study looked at how nurses use smart pumps when giving secondary medications and found 43 different usability issues. These problems can make nurses' work more mentally tiring and increase the chance of errors. This shows how important it is for nurses not only to have knowledge and skills, but also for the devices they use to be well-designed and easy to operate. These findings relate to my study because safe use of infusion pumps in pediatric care depends on both good training and user-friendly equipment(Klarich, Noonan et al. 2022).

Ivenix Inc. developed a new large-volume infusion pump with a strong focus on safety and ease of use. Since infusion pumps are used often, mistakes can easily happen. To reduce these errors, the company did over 400 hours of testing with real users. As a result, they created a pump with better safety features and a more user-friendly design than many pumps used today. Their efforts were recognized with the 2019 Stanley Caplan User-Centered Design Award. This example shows how important both safe equipment and proper nurse training are for preventing errors—especially in settings like pediatric care(Smith and Gray 2022).

Despite the widespread use of infusion pumps in pediatric care, there is insufficient published research on nurses' knowledge and practices regarding their use within the context of Pakistan. This study seeks to fill that gap by assessing the current knowledge and practices of nurses working in pediatric settings in Pakistan.

PROBLEM STATEMENT

Infusion pumps are vital for accurate medication and fluid administration in pediatric care. Improper use due to inadequate knowledge or poor nursing practice can lead to serious patient complications. Despite their critical role, the knowledge and practices of nurses regarding infusion pump use in pediatric wards remain under-assessed, particularly at Tertiary care Hospitals, Lahore. This study aims to address this gap and identify areas for improvement to enhance patient safety.

MATERIAL AND METHODS

Collection and data analysis This chapter outlines the research methodology employed in the study, including the study design, study setting, study population, sample size, sampling technique, data collection tools, and ethical considerations. It also details the procedures for data.

Study Design:

This study employs **descriptive cross sectional research design**, focusing on capturing and summarizing the current knowledge and practices of nurses regarding the use of infusion pumps in the pediatric ward without manipulating any variables. This design will provide a comprehensive overview of how infusion pumps are being understood and used by nurses at tertiary care Hospitals, Lahore.

Settings:

The study was conducted among the nursing staff working in the pediatric units at jinnah hospital and children tertiary care Hospitals, Lahore.

Duration of Study:

The study was conducted over a period of three months following the approval of the synopsis by the Institutional Review Board (IRB).

Sample Size:

The sample size was calculated using **Slovin's formula**:

$$\mathbf{n = N/1+N \times e2}$$

Where:
n is the sample size.
N is the population size.
e is the margin of error.
n = 250/**1**+250 (0.05)
n=250/1+250(0.0025)
n=250/1+0.625
n=250/1.625
n=153.8

Sampling Technique:
A **Non probability convenient sampling** technique was employed to select nurses who will be readily accessible and available in the pediatric units at tertiary care Hospitals, Lahore.

Sample Selection:
The target population for this study include all staff nurses working in the pediatric units at tertiary care Hospitals, Lahore.

Inclusion Criteria:
Registered nurses working in the pediatric units of tertiary care Hospitals.
Minimum 6 months' experience in pediatric nursing.
Willing to participate and provide informed consent.

Exclusion Criteria:
Nursing interns, or trainees.
Nurses from other departments.
Nurses on leave or with less than 6 months' pediatric experience.

Data Collection Tool:
A structured questionnaire **was used** to assess the knowledge and practice of nurses regarding the use of infusion pumps in the paediatric ward of Jinnah Hospital, Lahore. The questionnaire **has been adopted** from a previously published study(S El-sayed, I Abdel-sattar et al. 2019).
The tool **is consisting** of three parts:

Part I – Demographic Data:
This section **collected** information on nurses' age, gender, educational qualification, total years of nursing experience, experience in pediatric nursing, patient-to-nurse ratio, and whether the nurse has attended training on infusion pump use.

Part II – Knowledge Questionnaire:
This section included 10 items focusing on the definition, purpose, programming, calculation, safety features, disadvantages, labeling, and patient monitoring related to infusion pump use in pediatrics. Each item was scored on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). The total score ranged from 10 to 50. A score of ≥40 (≥80%) was considered satisfactory knowledge, while a score of less than 40 was considered unsatisfactory knowledge.

Part III – Practice Checklist:
This section consisted of 10 items related to the actual performance of nurses when using infusion pumps, such as preparation, labeling, programming, responding to alarms, documentation, and patient monitoring. Each item was rated on a 5-point Likert scale (1 = Never to 5 = Always). The total score ranged from 10 to 50. A score of ≥40 (≥80%) was considered satisfactory practice, while a score of less than 40 was considered unsatisfactory practice.
The data collection tool for this study was adopted from a previously published study by El-Sayed et al. (2019), which will assess nurses' knowledge and practice regarding infusion pump use. Content validity of the questionnaire was established through expert review by senior pediatric nurses and faculty, ensuring clarity, relevance, and comprehensiveness of items. A pilot study was then conducted on 25 expert pediatric nurses to assess reliability. Using Cronbach's Alpha, the Knowledge Questionnaire showed an excellent reliability score of 0.996, while the Practice Checklist demonstrated a high reliability score of 0.898. These results confirm that the modified tool is valid and reliable for assessing nurses' knowledge and practice regarding infusion pump use in pediatric care.

ETHICAL CONSIDERATIONS

Approval: Follow the ethical guidelines set by the Ethical Committee of the College of Nursing, Allama Iqbal Medical College, and Jinnah Hospital Lahore.
Consent: Obtain written informed consent from participants.
Anonymity and Confidentiality: Ensure participants' data remains confidential and anonymous.
Voluntary Participation: Inform participants they can withdraw at any time without penalty.
No Harm: Assure participants there are no risks or disadvantages associated with participation.

DATA COLLECTION PROCEDURE

Preparation:
Obtain approval from the Institutional Review Board (IRB) & relevant Hospital authority.
Develop and validate the data collection tools.

Recruitment of Participants:
Select nurses meeting the eligibility criteria.
Obtain written informed consent.

Data Collection:
Distribute self-administered questionnaires to the participants.
Provide guidance and clarification if required.

Confidentiality:
Maintain confidentiality and anonymity throughout the data collection process.
Store data securely under lock and key or a password-protected laptop.

DATA ANALYSIS PROCEDURE

Data was analyzed using SPSS (Statistical Package for the Social Sciences) version 27.

Descriptive Statistics:
Frequencies and percentages were calculated for nurses' knowledge and practices regarding the use of infusion pumps.

Knowledge and practice levels were categorized based on percentage scores

RESULTS

Table 1: Demographic Characteristics of Participants (N = 150)

Variable	Category	Frequency (n)	Percentage (%)
Age	21–25 years	18	12.0%
	26–30 years	64	42.7%
	31–35 years	66	44.0%
	36–40 years	2	1.3%
Gender	Female	150	100%
Educational Qualification	Diploma in Nursing	57	38%
	BSc Nursing	33	22%
	Post RN	60	40%
Total Nursing Experience	6 months–5 years	65	43.3%
	6–10 years	74	49.3%
	11–15 years	11	7.3%
Pediatric Nursing Experience	6 months–5 years	70	46.7%
	6–10 years	75	50%
	11–15 years	5	3.3%
Patient-to-Nurse Ratio	1:3	4	2.7%
	More than 3	146	97.3%
Attended Training on Infusion Pump	Yes	3	2%
	No	147	98%
Availability of Nursing Procedure Manual	Yes	8	5.3%
	No	142	94.7%

Table 4.1 illustrates the demographic characteristics of the study participants. The majority of nurses were aged between 31–35 years (44%), followed by 26–30 years (42.7%). All participants (100%) were female. Regarding educational qualification, 40% held Post RN degrees, 38% had Diploma in Nursing, and 22% had BSc Nursing degrees.

Nearly half of the nurses (49.3%) had 6–10 years of total nursing experience, while 50% had 6–10 years of pediatric nursing experience. Most participants (97.3%) reported managing more than three patients per shift, indicating a high patient-to-nurse ratio.

Only 2% of nurses had attended any formal training related to infusion pump usage, and 94.7% reported absence of a nursing procedure manual in their respective units.

Table 4.2: Nurses' Knowledge Regarding Use of Infusion Pump (N = 150)

Knowledge Variables	Strongly Disagree n (%)	Disagree n (%)	Neutral n (%)	Agree n (%)	Strongly Agree n (%)

Knowledge Variables	Strongly Disagree n (%)	Disagree n (%)	Neutral n (%)	Agree n (%)	Strongly Agree n (%)
Definition & purpose of infusion pump	0 (0%)	0 (0%)	2 (1.3%)	54 (36%)	94 (62.7%)
Programming infusion pump for infusion rates	0 (0%)	0 (0%)	2 (1.3%)	57 (38%)	91 (60.7%)
Calculation of infusion rate (ml/hr)	0 (0%)	0 (0%)	1 (0.7%)	58 (38.7%)	91 (60.7%)
Priming IV lines & removing air bubbles	0 (0%)	0 (0%)	1 (0.7%)	53 (35.3%)	96 (64%)
Dead volume concept awareness	0 (0%)	1 (0.7%)	5 (3.3%)	55 (36.7%)	89 (59.3%)
Knowledge of safety features (alarms etc.)	0 (0%)	0 (0%)	3 (2%)	51 (34%)	96 (64%)
Awareness of common errors & risks	0 (0%)	0 (0%)	5 (3.3%)	56 (37.3%)	89 (59.3%)
Proper IV-line labelling practices	0 (0%)	0 (0%)	0 (0%)	38 (25.3%)	112 (74.7%)
Patient monitoring during infusion therapy	0 (0%)	0 (0%)	7 (4.7%)	47 (31.3%)	96 (64%)
Regular training is essential	0 (0%)	0 (0%)	1 (0.7%)	28 (18.7%)	121 (80.7%)

Table2 presents nurses' knowledge regarding the use of infusion pumps in pediatric units. The findings indicate that the majority of nurses either agreed or strongly agreed with all knowledge-related statements. A large proportion of participants strongly agreed that they could correctly define the purpose of infusion pumps (62.7%), program infusion pumps for different infusion rates (60.7%), and accurately calculate infusion rates (60.7%). Furthermore, 64% strongly agreed that they understood proper IV line priming techniques and were knowledgeable about infusion pump safety features such as alarms and occlusion detection. Regarding medication safety, 59.3% strongly agreed that they were aware of common errors and risks associated with infusion pumps, while 74.7% strongly agreed about proper IV line labeling practices. Additionally, 64% strongly agreed that they understood patient monitoring requirements during infusion therapy. Importantly, 80.7% of nurses strongly agreed that regular training is essential for safe and effective infusion pump use. The mean scores ranged from 4.55 to 4.98, indicating an overall satisfactory level of knowledge among pediatric nurses regarding infusion pump operation and safety measures.

Figure 4.2: Knowledge Level Regarding Infusion Pump

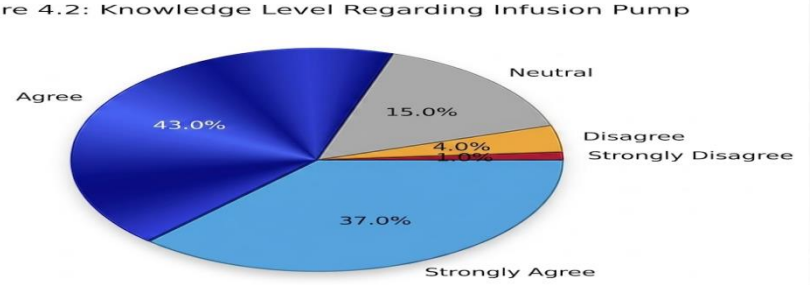

Table 4.3: Nurses' Self-Reported Practices Regarding Use of Infusion Pump (N = 150)

Practice Variables	Never n (%)	Rarely n (%)	Sometimes n (%)	Often n (%)	Always n (%)
Wash hands before handling infusion pump	0 (0%)	2 (1.3%)	28 (18.7%)	31 (20.7%)	89 (59.3%)
Check pump settings (rate, volume, time) before starting	0 (0%)	0 (0%)	1 (0.7%)	29 (19.3%)	120 (80%)
Ensure IV lines are properly primed	0 (0%)	0 (0%)	0 (0%)	28 (18.7%)	122 (81.3%)
Confirm correct drug and concentration	0 (0%)	0 (0%)	1 (0.7%)	30 (20%)	119 (79.3%)
Perform independent double-check for high-alert drugs	0 (0%)	0 (0%)	3 (2%)	32 (21.3%)	115 (76.7%)
Respond immediately to pump alarms	0 (0%)	1 (0.7%)	0 (0%)	29 (19.3%)	120 (80%)
Monitor patient for side effects during infusion	0 (0%)	2 (1.3%)	2 (1.3%)	34 (22.7%)	112 (74.7%)
Label IV tubing and syringe clearly	0 (0%)	0 (0%)	0 (0%)	29 (19.3%)	121 (80.7%)
Document pump settings and patient condition	0 (0%)	6 (4%)	18 (12%)	33 (22%)	93 (62%)
Safely turn off and clean pump after use	0 (0%)	8 (5.3%)	21 (14%)	24 (16%)	97 (64.7%)

Table 3 illustrates nurses' self-reported practices regarding infusion pump use in pediatric units.

The findings show that the majority of nurses reported performing safe infusion pump practices consistently. A high percentage of participants always checked pump settings before starting infusion (80%) and confirmed correct drug concentration (79.3%). Similarly, 81.3% always ensured IV lines were properly primed, while 80.7% always labeled IV tubing clearly.

Regarding patient safety, 76.7% reported always performing independent double-checks for high-alert medications, and 80% responded immediately to pump alarms. Furthermore, 74.7% always monitored patients for side effects during infusion therapy.

However, lower compliance was observed in hand hygiene practices, where only 59.3% reported always washing hands before handling infusion pumps. Additionally, documentation practices were suboptimal, with only 62% always documenting pump settings and patient condition. Cleaning of infusion pumps after use was consistently performed by 64.7% of participants.

Mean practice scores ranged from 4.38 to 5.14, indicating overall satisfactory practice levels, although certain infection control and documentation practices require improvement.

Figure 4.3: Practice Level Regarding Infusion Pump

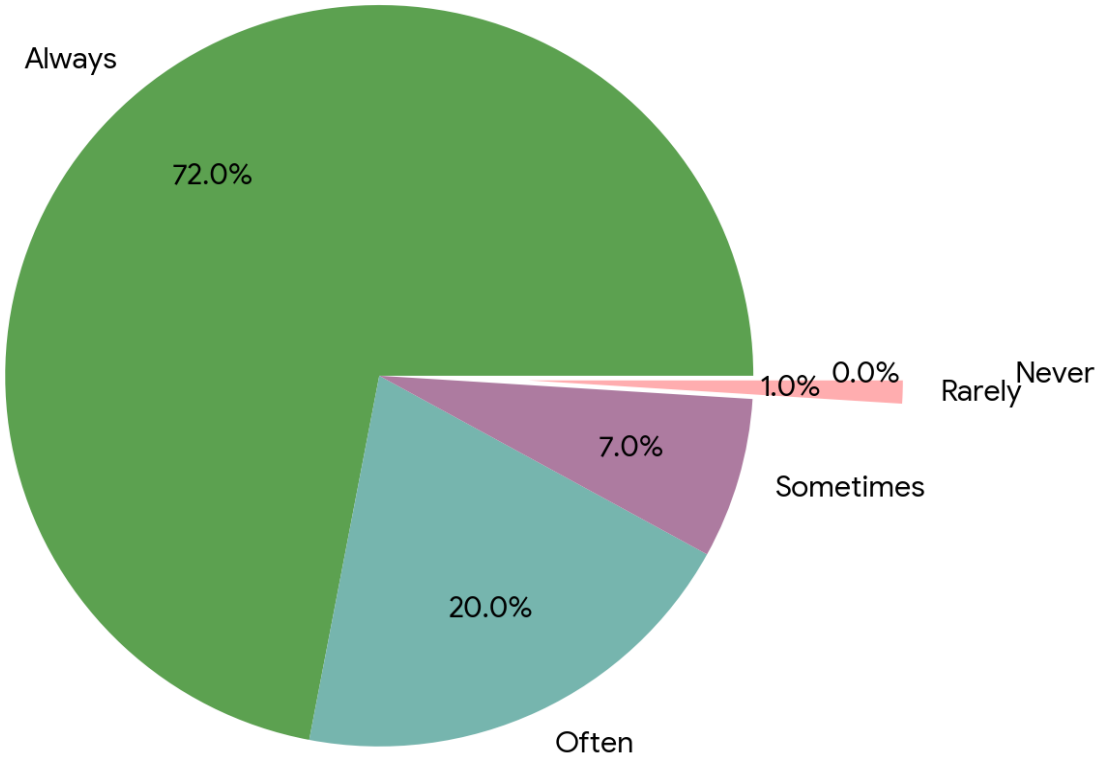

Table 4.4: Overall Level of Knowledge and Practice Among Nurses (N = 150)

Variable	Category	Score Range	Frequency (n)	Percentage (%)
Knowledge Level	**Satisfactory**	**40 – 50**	**148**	**98.7%**
	Unsatisfactory	< 40	2	1.3%
Practice Level	**Satisfactory**	**40 – 50**	**141**	**94.0%**
	Unsatisfactory	< 40	9	6.0%

The study found that 98.7% (n=148) of the nurses achieved a satisfactory level of knowledge (score >40), while only 1.3% (n=2) were categorized as having unsatisfactory knowledge. This indicates a high theoretical understanding of infusion pump operation and safety.

Regarding self-reported clinical practices, 94% (n=141) of participants reached a satisfactory level (score >40). However, 6% (n=9) fell into the unsatisfactory category, suggesting that while knowledge is high, there are slight gaps in the consistent application of all safety protocols in daily practice.

DISCUSSION

This study was conducted to assess nurses' knowledge and self-reported practices regarding the use of infusion pumps in pediatric units at Jinnah Hospital Lahore and Children's Hospital Lahore. Infusion pumps are considered essential medical devices in pediatric care because they ensure accurate administration of medications and fluids, especially among critically ill neonates and children who are highly vulnerable to medication errors and fluid imbalance. The findings of this study demonstrated that the majority of nurses possessed satisfactory levels of knowledge and self-reported practices regarding infusion pump use. However, significant deficiencies were identified in formal training opportunities, institutional support systems, and adherence to certain infection control practices.

The demographic findings revealed that the majority of participants were between 26–35 years of age, and all participants were female. Most nurses had between 6–10 years of total nursing and pediatric experience. This indicates that the study participants had sufficient clinical exposure and practical experience in pediatric care settings. Furthermore, 40% of participants held Post RN qualifications while 22% possessed BSc Nursing degrees. The relatively high educational background of participants may have positively influenced their theoretical understanding and confidence in operating infusion pumps safely.

The findings of the present study showed that 98.7% of nurses demonstrated satisfactory knowledge regarding infusion pump use. Most participants strongly agreed that they understood the purpose and function of infusion pumps, could calculate infusion rates accurately, and were familiar with infusion pump programming and alarm systems. These findings are consistent with the study conducted by Oliveira et al., which reported that nurses working in pediatric intensive care settings demonstrated satisfactory performance while operating infusion pumps and other medical devices. Similarly, the findings support the review conducted by Marufu et al., who emphasized that adequate nursing knowledge and continuous education significantly reduce medication administration errors in pediatric patients.

The current study also revealed satisfactory self-reported practices among nurses, with 94% achieving satisfactory practice scores. Most nurses reported that they always checked pump settings before initiating infusion therapy, ensured proper priming of IV lines, confirmed medication concentration, and responded immediately to infusion pump alarms. These findings indicate that nurses recognize the importance of maintaining accuracy and safety during infusion therapy. Similar findings were reported by Essawy et al., who found that nurses demonstrated satisfactory practical competency while operating life-saving medical devices in pediatric intensive care units.

However, the findings of the present study contradict the results of El-Sayed et al., who reported that approximately three-quarters of nurses had unsatisfactory knowledge regarding infusion pump use, and more than half demonstrated inadequate practical performance. Several factors may explain the contradiction between these findings and the present study. First, the participants in the current study had higher educational qualifications and relatively greater pediatric clinical exposure. Nurses working in tertiary care hospitals such as Jinnah Hospital Lahore and Children's Hospital Lahore are frequently exposed to critically ill pediatric patients requiring continuous infusion therapy, which may improve their familiarity and practical experience with infusion pumps.

Second, the current study used a self-reported questionnaire to assess practices, whereas some previous studies used direct observational methods. Self-reported practices may overestimate actual clinical performance because participants may provide socially desirable responses rather than reporting their exact behaviors. Therefore, although nurses in this study reported satisfactory practices, actual bedside performance may differ in real clinical situations.

One of the most important findings of the current study was the severe lack of formal training regarding infusion pump use. Only 2% of nurses had attended formal training sessions related to infusion pumps, while 98% reported no formal training exposure. Additionally, 94.7% of participants stated that nursing procedure manuals were unavailable in their units. These findings indicate a major institutional gap in professional development and patient safety support systems. Despite possessing satisfactory theoretical knowledge, nurses may primarily depend on peer learning, senior guidance, and clinical experience rather than evidence-based standardized protocols.

These findings are supported by Klarich et al., who emphasized that inadequate training and poor infusion pump usability increase nurses' cognitive workload and may contribute to medication errors. Similarly, Kuitunen et al. highlighted that infusion pump programming errors remain a major safety concern in neonatal and pediatric intensive care settings. Pediatric patients are particularly vulnerable because even minor dosage errors can result in serious complications due to low body weight, immature body systems, and fluid restrictions. Therefore, although nurses in the present study demonstrated confidence in infusion pump operation, the absence of structured competency-based training programs remains a significant patient safety concern.

The study further identified deficiencies in infection control and documentation practices. Only 59.3% of nurses reported always washing their hands before handling infusion pumps, while only 64.7% consistently cleaned infusion pumps after use. Similarly, only 62% always documented pump settings and patient conditions appropriately. These findings are concerning because infection prevention, documentation accuracy, and equipment disinfection are critical components of safe pediatric nursing practice.

The lower compliance observed in these areas may be associated with heavy workload and staffing shortages. In the current study, 97.3% of nurses reported managing more than three pediatric patients during each shift. High patient-to-nurse ratios increase physical and mental workload, potentially causing nurses to prioritize urgent technical tasks while overlooking hand hygiene, cleaning, and documentation procedures. Similar findings were reported by Marufu et al., who identified workload burden, interruptions, and staffing shortages as major contributors to medication administration errors in pediatric settings.

Another significant finding in the current study was that 80.7% of nurses strongly agreed that regular training programs are essential for safe infusion pump use. This reflects nurses' awareness regarding the complexity of infusion therapy and their recognition of the need for continuous professional education. The finding is consistent with the recommendations of Elsayed et al., who emphasized the importance of regular in-service educational programs focusing on neonatal safety, medication administration, and prevention of medication errors.

The present study also emphasizes the importance of smart infusion pump technology in improving medication safety and reducing adverse drug events in pediatric care. Existing literature suggests that smart pumps equipped with safety alarms, dose-error reduction systems, and drug libraries can significantly minimize medication errors when nurses are properly trained. However, technology alone cannot ensure patient safety. The effectiveness of infusion pumps depends greatly on nurses' competency, institutional support, availability of standardized guidelines, and regular monitoring systems.

Overall, the findings of this study indicate that nurses working in pediatric units at Jinnah Hospital Lahore and Children's Hospital Lahore possess satisfactory theoretical knowledge and self-reported clinical practices regarding infusion pump use. Nevertheless, important institutional deficiencies remain, including inadequate formal training, absence of nursing procedure manuals, heavy patient workload, and

inconsistent compliance with infection control and documentation practices. Addressing these gaps through structured educational programs, competency-based training, improved staffing, and evidence-based clinical guidelines is essential to improve pediatric patient safety and reduce infusion-related medication errors.

Limitations Of The Study

This study has several limitations that should be considered while interpreting the findings. First, the study used a self-reported questionnaire to assess nurses' practices regarding infusion pump use, which may have resulted in socially desirable responses and possible overestimation of actual clinical performance. Direct observational assessment was not conducted; therefore, the actual competency and adherence of nurses to infusion pump protocols could not be objectively verified. In addition, the descriptive cross-sectional design collected data at a single point in time, limiting the ability to establish causal relationships between nurses' knowledge, practices, and institutional factors.

Furthermore, the study was conducted only in the pediatric units of Jinnah Hospital Lahore and Children's Hospital Lahore using a convenience sampling technique. Therefore, the findings may not be generalizable to nurses working in private hospitals, rural healthcare settings, or other regions of Pakistan. The study also focused exclusively on pediatric units and did not include other departments such as NICUs, ICUs, or emergency units where infusion pump use may differ. Despite these limitations, the study provides important baseline information regarding nurses' knowledge and practices related to infusion pump use in pediatric care settings.

CONCLUSION

This study concludes that nurses in pediatric units at tertiary care hospitals in Lahore possess a satisfactory level of theoretical knowledge and self-reported practice regarding infusion pumps. However, there is a stark deficiency in institutional support, characterized by a near-total lack of formal training and standardized procedure manuals. The high patient-to-nurse ratio and gaps in infection control (handwashing) and documentation remain significant threats to pediatric patient safety**.**

RECOMMENDATIONS

Based on the findings, the following actions are recommended:

Mandatory Training: Implement regular, certified in-service training programs for all pediatric nurses focusing on "smart pump" features and error prevention.

Standardized Manuals: Develop and distribute bilingual (English/Urdu) nursing procedure manuals in every pediatric unit to ensure standardized care.

Improve Staffing: Address the high patient-to-nurse ratio to reduce the workload that may lead to rushed documentation and bypassed hygiene protocols.

Infection Control Monitoring: Strengthen supervision regarding hand hygiene and equipment disinfection post-use to prevent healthcare-associated infections.

Observational Studies: Future research should use direct observation rather than self-reporting to validate if actual clinical practice matches the nurses' high self-assessment.

ACKNOWLEDGMENT

We begin by expressing our deepest gratitude to Allah the Almighty for granting us the strength and guidance to achieve this significant academic milestone. We extend heartfelt appreciation to the **College of nursing Allama Iqbal medical college Lahore** for providing the intellectual forum and resources that have shaped our academic and professional growth. We are profoundly grateful to our supervisor **Mrs. Rehana Nawaz.** We acknowledge the invaluable support of our beloved family members our parents, sibling, and spouse whose faith and understanding have been

the foundation of our journey. To our friends and well-wishers, your encouragement and belief in our abilities have made this challenging path more manageable. We also extend our gratitude to the college's management, staff, and faculty for fostering an environment conducive to learning and research. This research project is a collective achievement, reflecting the contributions of these remarkable individuals and the divine guidance of Allah.
We dedicate this work to all with immense gratitude.

CONSENT FORM
You are invited to participate in a research study conducted by **Rabia Niaz, Samina Naz and Abida Yousaf.** The purpose of this research is to evaluate the **"Knowledge and Practice of Nurses Regarding Uses of Infusion Pump in Paedriatic Ward Jinnah Hospital Lahore".**

Risks and Discomforts:
There was no any risk associated with this research.

Protection of Confidentiality
We will do everything we can to protect your privacy. Your identity will not be revealed in any publication resulting from this study.

Voluntary Participation
Your participation in this research study is voluntary. You may choose not to participate and you may withdraw your consent to participate any time. You will not be penalized in any way should you decide not you participate or to withdraw from this study.

CONSENT
I have read this consent form and have been given the opportunity to ask questions. I give my consent to participate in this study.
Participant's Signature _____ Date: _____
A copy of this consent form should be given to the participant.

تحقیق میں شرکت کا دعوت نامہ

عنوان:

نقصانات اور تکلیف: اس تحقیق سے کسی قسم کے نقصان یا تکلیف کا اندیشہ نہیں ہے ۔

ممکنہ فوائد: آپکو ایک اہم تحقیق میں حصہ لینے کا موقعہ دیا جائے گا۔

رازداری کا تحفظ: ہم آپ کی معلومات کے تحفظ کے لیے وہ سب کچھ کریں گے جو ہم کر سکتے ہیں۔ تحقیق کے متعلق اکٹھی کیی گیی تمام معلومات کو انتہا ئی خفیہ رکھا جاے گا۔ ڈیٹا انٹری اور تجزیے کے دوران آپ کے متعلق وہ تمام معلومات جن سے آپ کی شناخت ہو سکتی ہو کو ختم کر دیا جاے گا۔ اس تحقیق کے نتیجے میں شائع ہونے والی کسی بھی اشاعت میں آپ کی شناخت کو ظاہر نہیں کیا جاے گا۔

رضاکارانہ شمولیت: اس تحقیقی مطالعہ میں آپ کی شرکت رضاکارانہ ہے۔ آپ کو شرکت نہ کرنے اور کسی بھی وقت پغیر وجہ بتانے اس تحقیق میں شمولیت کو چھوڑنے کا اختیار ہے۔ شرکت نہ کرنے یا اس میں شمولیت کو چھوڑنے کی صورت میں آپ کے خلاف کوئی کاروایی نہیں کی جاے گی

درجذیل معلومات تحقیق میں شامل ہونے والوں کے لیے پڑھیں اور ان کا جواب دیے گیے خانوں میں درج کریں

☐ میں نے معلوماتی شیٹ جو کہ تحقیق کی وضاحت کر رہی ہے کو سمجھ لیا ہےاورمجھے تحققیق کے سوالات کرنے کا موقع دیا گیا تھا۔

☐ میں سمجھ گیا/گیی ہوں کہ میری شرکت رضاکارانہ ہے اور یہ کہ میں کسی بھی وقت اپنا ارادہ بدل سکتا/سکتی ہوں اور تحقیق سے دستبردار ہو سکتا/سکتی

☐ میں سمجھ گیا/گیی ہوں کہ میرے جوابات خفیہ رکھے جاءیں گے۔ میں محقیقیین کو اس بات کی اجازت دیتا/دیتی ہوں کے وہ جوابات کو جانچ سکیں۔

☐ میں سممجھ گیا/گی ہوں کے معلومات میرے نام کے بجاے نمبر کی صورت میں محفوط کی جائیں گی۔ تا کہ میں نتائج کی اشاعت کے دوران کسی بھی طرح سے شناخت نہ کیا جا سکوں۔ میں اس بات سے رضامند ہوں کے جو معلومات مجھ سے لی جائیں گی وہ تحقیق میں استعمال ہوں گی۔

☐ میں اوپر بتایی گی تحقیق میں شامل ہونے کے لیے رضامند ہوں اور محقیقین کو اپنا پتہ تبدیل ہونے کی صورت میں مطلع کروں گا/گی۔

رضا مندی:میں نے یہ اجازت نامہ پڑھا ہے اور مجھے سوال پوچھنے کا موقع دیا گیا ہے۔ میں اس سٹڈی میں شرکت کے راضی ہوں۔

شرکت کنندہ کا نام _____ دستخط_____ تاریخ _____

اجازت لینے والے کا نام _____ دستخط _____تاریخ _____

اس اجازت نامہ کی ایک نقل آپکو دی جانی چاہیے۔

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Infusion Pump Questionnaire Tool

PART I: Demographic Data

No.	Demographic Item	Response Options
1	Age	☐ 21–25 years ☐ 26–30 years ☐ 31–35 years ☐ 36–40 years ☐ Above 40 years
2	Gender	☐ Male ☐ Female
3	Educational Qualification	☐ Diploma in Nursing ☐ BSc Nursing ☐ Post RN ☐ Other: _____
4	Total years of nursing experience	☐ 6 months – 5 years ☐ 6–10 years ☐ 11–15 years ☐ 16–20 years ☐ More than 20 years
5	Years of experience in paediatric nursing	☐ 6 months – 5 years ☐ 6–10 years ☐ 11–15 years ☐ 16–20 years ☐ More than 20 years
6	Patient-to-nurse ratio in unit	☐ 1:1 ☐ 1:2 ☐ 1:3 ☐ More than 3
7	Attended training/workshop on infusion pumps?	☐ Yes ☐ No
8	Availability of nursing procedure/manual in unit?	☐ Yes ☐ No

Part II: Knowledge Questionnaire

1 = Strongly Disagree | 2 = Disagree | 3 = Neutral | 4 = Agree | 5 = Strongly Agree

No.	Question	Strogly disagree	disagree	Neutral	Agree	Strongly Agree
1	I can correctly define what an infusion pump is and its purpose.					
2	I know how to program an infusion pump for different infusion rates.					
3	I can accurately calculate infusion rate (ml/hr) and set it on the pump.					
4	I understand how to prime IV lines and remove air bubbles before using a pump.					
5	I am aware of the concept of dead volume and its effect on medication delivery.					
6	I know the safety features of infusion pumps (e.g., alarms, occlusion detection)					
7	I am aware of common errors and risks associated with infusion pumps					
8	I know proper labeling practices for IV lines when using infusion pump					
9	I can explain patient monitoring requirements during infusion pump therapy.					
10	I believe regular training is essential for safe and effective use of infusion pumps.					

Part III: Practice Checklist

1 = Never | 2 = Rarely | 3 = Sometimes | 4 = Often | 5 = Always

No.	Practice Item	Never	Rarely	Sometime	Often	Always
1	I wash my hands before preparing and handling infusion pumps					
2	I check the pump settings (rate, volume, time) before starting infusion.					
3	I ensure IV lines are primed properly before connecting to the pump					

4	I confirm the correct drug and concentration before programming the pump.
5	I perform independent double-checks when administering high-alert drugs with a pump
6	I respond immediately to pump alarms (e.g., occlusion, air-in-line).
7	I monitor the patient closely for side effects during infusion pump therapy.
8	I label the IV tubing and syringe used with the infusion pump.
9	I document pump settings and patient's condition after each infusion.
10	I safely turn off and clean the infusion pump after use.

ETHICAL REVIEW BOARD

ALLAMA IQBAL MEDICAL COLLEGE
& JINNAH HOSPITAL LAHORE-PAKISTAN

Ref No: ERB198 obs/ 02/16-12-2025/AIMC/JHL Dated: 16-12-2025

To

Miss. Rabia Niaz,
Charge Nurse,
Jinnah Hospital Lahore.

Subject: **Ethical Approval for Research Proposal Titled "Assesment of Nurses Knowledge And Self Reported Practices in Unsing Infusion Pumps for Peadiatric Units in Tertiary Care Hospial Lahore."**

Respected Madam,

With reference to your request for ethical approval of research article entitled "**Assessment of Nurses Knowledge and Self Reported Practices in Unsing Infusion Pumps or Peadiatric Units and Tertiary Care Hospial Lahore."** I would like to inform you that the ERB reviewed the documents submitted by you, including the protocol, informed consent forms and other documents. The ERB found the documents satisfactory and approved the conduct of this study for period of 06 months, after satisfying the following conditions:

1. You will acknowledge the source of the data in any publication related to the project.
2. You will submit a report on the project to the ERB at the conclusion of the project and also submit a copy of the paper for the ERB records.
3. You will abide by the code of conduct of the institution.

Yours sincerely,

Dr. Mehwish Akhtar
Secretary ERB,
AIMC/Jinnah Hospital,
Lahore

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