

Causes and Issues of High-risk Intravenous Medication Safety among Nurses

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Abstract

This survey study systematically investigated issues associated with medication-related procedures and elucidated the issues regarding high-risk intravenous medication safety among nurses. The results indicated that for nurses, high-risk intravenous medication safety issues included a lack of knowledge about administered medicines, patient confirmation negligence, inappropriate medicine management, inappropriate storage, lack of awareness about high-risk medicines, frequent verbal prescriptions, and confusion regarding packages and containers. This study therefore will contribute to improvements in nurses' work satisfaction, patient safety, and medication-related knowledge and performance in terms of the safety of high-risk medicines requiring caution.

Keywords: Nurses, Medication Safety, high-risk intravenous injection

1. Introduction

Medication safety refers to “an action to correct and prevent medication errors that can occur during medicine use, which are defined as accidents or errors that can occur during medicine utilization;” the establishment of medication safety through improvements to and prevention of the causes of medication errors using various literature and study results has been confirmed as a practical concept [1].

Medication errors were found to derive from a lack of knowledge, substandard work performance, and system defects. The following were suggested as issues related to work procedures: 1) cases without guidelines, regulations, and procedures; 2) cases with guidelines, regulations, and procedures but lacking education; 3) cases with guidelines, regulations, and procedures but no implementation assessment after education; 4) cases with education about guidelines, regulations, and procedures but no guideline implementation. All guidelines, regulations, and procedures were combined to analyze the factors that influenced medication safety practices [2]. Medication errors are reportedly among the most frequent accidents that threaten patient safety, with particular emphasis placed on patient confirmation for the purpose of patient safety in a hospital setting, indications for medication safety, and generation of a medication list for each patient [3]. In addition, the use of medication-related abbreviations and verbal prescriptions, particularly for warnings and guidelines regarding high-risk and high-cautious medicines, have been described.

High-concentration electrolytes, which represent a class of high-risk medicines, refer to electrolytes that exceed isotonic concentrations and carry a high risk of adverse events because of the strong risks of medication errors and narrow treatment areas; these include

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NaCl and KCl. Heparin, an anticoagulant that prevents blood clotting during thrombotic and embolic treatments, cardiac surgery, transfusion, and hemodialysis, requires periodic blood testing and careful patient observation because of the strong bleeding tendency [4]. In addition, patients receiving chemotherapy are at risk of adverse events such as nausea, vomiting, and a loss of appetite, in contrast to the therapeutic effects of these agents, and for nurses, chemotherapy presents a risk of secondary anticancer medicine exposure through the respiratory and gastrointestinal system and skin during medicine preparation, administration, nursing care, examination procedures, and waste treatment [5].

Moreover, a study, in which an intravenous medication safety system was developed for high-risk, intravenously injected medicines, generated a profile based on patient types, such as adults receiving critical patient care, cancer patients, internal medicine and surgery patients, and pediatric patients, to define the characteristics of device operation (*e.g.*, maximum injection speed and pressure settings) and thus secure patient safety; the authors subsequently applied this program, which included a range of variable medicine injection factors [6, 7]. In that study, the patients' morbidity and mortality rates decreased and both patient and nurse satisfaction improved [8]. Accordingly, high-risk medicines should be administered by nurses with appropriate medication experience and preparation, and nurses in charge of medication should be well aware of the potential adverse events associated with medicines and be responsible for the correct assessments and management of patients and medicines in order to provide safe and effective nursing care.

Therefore, the objective of this study was to investigate the issues associated with medication procedures and identify the causes of high-risk intravenous medication safety issues in order to increase the implementation of high-risk intravenous medication safety measures among nurses and provide basic data with which to improve the quality of medication care.

2. Method

2.1. Study Design

This was a survey study intended to elucidate the awareness of high-risk intravenous medication safety issues among nurses.

2.2. Sampling and Data Collection

The study subjects included 50 nurses with high-risk intravenous medication related-experiences and knowledge who worked at a university hospital located in D city. Regarding the selection criteria, because this study assessed responses to semi-structured questions, samples were selected in consideration of the depth and abundance of knowledge-rich data and information regarding the study topics.

2.3. Data Analysis

A survey was performed using the following semi-structured question: "what are the issues and causes of high-risk intravenous medication procedures in nurses?"; the survey included 50 nurses who had experience with high-risk intravenous medication nursing care in corresponding wards, and affinity analyses were conducted to determine the main issues. A Pareto chart of the main issues associated with high-risk intravenous medication performance was created, and the final integrated results were determined and analyzed.

3. Results

3.1. General Characteristics of the Subjects

Twenty-seven subjects (54%) were aged 26–35 years, 30 (60%) had graduated from university, 38 subjects (76%) currently worked in wards, 24 (48%) had 25–74 months of clinical experience, 42 (84%) were general nurses, 34 (68%) scored 7–10 points on a high-risk medicine explanation confirmation, 46 (92%) responded positively regarding the presence of relevant education, 42 subjects (84%) continued their education while working at a hospital, and 40 (80%) received a lecture-type education Table 1.

In terms of relevant opinions, the nurses requested developing video-assisted education for adverse events in case of high-risk drug overdose and education on practical contents such as anticancer drug mixing and proactive plans for drug adverse events.

Table 1. General Characteristics of the Subjects (N = 50)

Item	Category	N(%)
Age	Under 25 years old	21(42%)
	26–35 years old	27(54%)
	Over 35 years old	2(4%)
Education	College graduation	18(36%)
	University graduation	30(60%)
	Graduate school graduation	2(4%)
Current work place	Ward	38(76%)
	Intensive Care Unit	12(24%)
Clinical experience	Less than 24 months	14(28%)
	25–74 months	24(48%)
	More than 74 months	12(24%)
Position	General nurse	42(84%)
	Charge nurse	5(10%)
	Chief nurse	3(6%)
Confirmation of high-risk drug guidelines	0–3	8(16%)
	4–6	8(16%)
	7–10	34(68%)
Presence of high-risk intravenous injection education	Yes	46(92%)
	No	4(8%)
Amount of education	1–4 times	35(70%)

	More than 5 times	9(18%)
Education method	Lecture	40(80%)
	Practice	1(2%)
	Lecture and practice	4(8%)
	Others	1(2%)
	University education	3(6%)
Education organizer	Refresher education while working at hospitals	42(84%)
	Outside lecture and seminar	1(2%)

3.2. Analysis of Nurse-Perceived Medication Safety Issues

The analysis of nurse-perceived high-risk intravenous medication safety issues assessed a total of 12 categorical issue items, including a lack of knowledge about the administered medicines, negligent patient confirmation, inappropriate medicine management, inappropriate storage, frequent verbal prescription use, confusion regarding packages and containers, poor medication device operation, lack of awareness about high-risk medicines, discontinuation during medication protocols, absence of manuals for medication procedures, and ineffective communication Table 2.

Table 2. Analysis of Nurse-Perceived Medication Safety Issues (N = 50)

Category of issue content	Issue content	N(%)
Lack of knowledge about medicines	1. Except for nurses in main wards, most nurses lack knowledge on medication procedures and precautions for anticancer injection	4
	2. Overall, nurses do not know protocols, procedures, and adverse events of high-risk medicines well.	3
	3. For anticancer drugs, nurses do not know the major adverse events, making them difficult to monitor.	2
	4. Nurses overlook basic characteristics of drugs due to lack of knowledge, which raises issues.	1
Subtotal		10(20%)
Negligent patient confirmation	1. When preparing drugs at the same time, drugs are stored in a tray without separating them; therefore, nurses get confused about which drug should be administered to whom when administering in shared rooms.	3

	2. Nurses get distracted because they work while talking with other patients, and therefore they often confuse patients.	2
	3. Nurses make mistakes by not confirming the name of fluid bottles that are similar to each other.	1
	4. Nurses mishandle fluid samples of patients in the same room with similar names.	1
	Subtotal	7(14%)
Inappropriate medicine management	1. Due to frequent angiodynia and phlebitis occurrence during high-risk medication, line changes should be undertaken occasionally.	3
	2. Even though drugs are made of plastic substances, they can easily contaminate one's hands, and there are frequent chances of exposure to high-risk drugs.	2
	3. Nurses can touch high-risk drugs, thereby possibly getting into the body.	1
	Subtotal	6(12%)
Inappropriate storage	1. Storage is open, not separate.	2
	2. For NaCl and KCl, undiluted solutions are stored in wards.	2
	3. NaCl and KCl are found in patient carts, which may be confused with saline solutions and injection fluids.	1
	4. There is no "caution" mark and adverse events-related statements in drug storage and packaging.	1
	Subtotal	6(12%)
Frequent verbal prescription	1. Telephonic verbal prescription is performed solely without confirmation from others. This leads to a high possibility of mistakes compared to using electronic prescription.	1
	2. The prescription is forgotten or incorrect as nurses do not take memos of prescriptions.	1
	3. Due to the absence of confirming drug names and units, drugs of various sizes are not administered appropriately.	1
	4. Verbal prescriptions may not be properly performed due to noisy environments and haste on the part of the nurses.	1

Subtotal		4(8%)
Confusion on packages and containers	<ol style="list-style-type: none"> 1. NaCl and KCl can be incorrectly mixed if not thoroughly examined because their appearance is similar in size and shape although they have a slightly different color. 2. It is confused because dose does not match with the volume (cc). 	<p>2</p> <p>2</p>
Subtotal		4(8%)
Lack of medication device preparation and operation errors	<ol style="list-style-type: none"> 1. Medication is not properly performed due to the problems of dead batteries in a fluid speed controller of the fluid injection device during examination. 2. Preparation of medication devices is often lacking. 	<p>2</p> <p>1</p>
Subtotal		3(6%)
Poor medication device operation	<ol style="list-style-type: none"> 3. In the presence of operational problems while transferring to other areas such as examination rooms, non-medical staff are not aware of proper operational methods. 	<p>1</p>
Subtotal		1(2%)
Lack of awareness about high-risk medicines	<ol style="list-style-type: none"> 1. Nurses are not aware that drugs easily accessible in surroundings (excluding anticancer drugs) are high-risk drugs. If (video clips) education is given with practical cases of adverse events from overdose of high-risk drugs, nurses would use high-risk drugs more carefully than currently. 2. All anticancer drugs are considered high-risk drugs and therefore administered using protective gears with caution but the risk of NaCl, KCl, and heparin is not well known. 3. High-risk drugs are considered overused in internal medicine. 	<p>2</p> <p>1</p> <p>1</p>
Subtotal		4(8%)
Discontinuation during medication protocols	<ol style="list-style-type: none"> 1. When someone talks when the nurse is in the middle of medication management, administration is discontinued and nurses forget what they were doing before being distracted. 2. Cut-off injection ampule fails and the fluid leaks thereby making the dose inaccurate. 3. Beeping of nurse's pagers or calling from patients make 	<p>1</p> <p>1</p> <p>1</p>

nurses lack concentration on medication.

Subtotal		3(6%)
Absence of manuals for medication procedures	1. Data on medication procedures is absent due to insufficient data on the list of adverse events of each anticancer drug.	1
Subtotal		1(2%)
Ineffective communication	1. In the absence of an IV line, it is difficult to mediate opinions between doctors who desire peripheral venous medication and patient situations where central lines should be taken.	1
Subtotal		1(2%)
Total		50(100%)

3.3. Analysis of the Pareto Chart of Nurse-Perceived Issues

The Pareto analysis of nurse-perceived issues associated with high-risk intravenous medication procedures found that a total of 7 items, with a cumulative percentage of up to 82%, comprised the major nurse-perceived high-risk intravenous medication safety issues; these included a lack of knowledge about administered medicines, negligent patient confirmation, inappropriate medicine management, inappropriate storage, lack of awareness about high-risk medicines, frequent verbal prescription use, and confusion regarding packages and containers Figure 1.

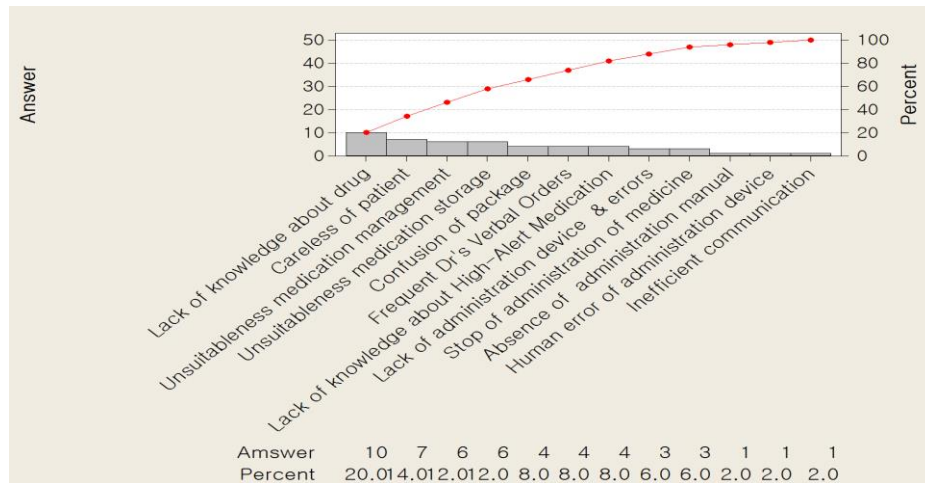


Figure 1. Nurse-perceived Medication Safety Issues

4. Discussion and Conclusion

The analysis of major medication safety issues affecting nurses identified a lack of knowledge about administered medicines, negligent patient confirmation, inappropriate medicine management, inappropriate storage, lack of awareness about high-risk medicines,

frequent verbal prescription use, and confusion regarding packages and containers. Medication errors can be prevented when nurses comply with confirmation, caution, and explanation duties before and after medication, and when they have sufficient knowledge on administering medicines. Evidence that nurses can prevent practical medication errors before medication administration suggests that nurses can play a role in medication safety in the hospitals [9, 10].

As such, high-risk intravenous medication errors primarily require improving the awareness of medication for nurses involved in medication procedures [11] and fulfilling standard guidelines related to medication. Along with this, however, organizational measures to prevent and minimize medication issues also need to be prepared. In addition, procedure related factors and environmental factors, which correspond to such system factors, can be prevented by confirming and improving the risk factors that predict errors in organizations. Understanding and periodic improvement activities for both causative factors would be an appropriate approach for fundamental problem solving and improvements.

In other words, this investigation and analysis of nurse-perceived high-risk intravenous medication safety issues will contribute to improvements in nurses' work satisfaction and patient safety and can be applied to the establishment and preparation of programs with the expectation that it will yield improvements in medication knowledge and performance associated with the safety of careful high-risk medication.

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