

Nurse's Characteristics and Their Understanding Regarding the Compatibility of Mixing Intravenous Drug Preparations in Hospital Settings

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ABSTRACT

Background: Drug incompatibility can occur in patients in hospitals who receive one or more drugs at the same time due to inappropriate drug mixing, and mixtures that are said to be incompatible in the presence of deposits, crystals, visual discoloration. This study aims to determine the relationship between knowledge and nurses to the incompatibility of mixing intravenous drug preparations, so that collaboration between nurses and pharmacists can occur in administering intravenous drugs and can reduce the occurrence of errors in treatment, especially in intravenous drug administration.

Subjects and Method: Cross sectional research was conducted at dr. Soeselo Hospital, Tegal, Central Java, in November 2023. The research subjects were 152 nurses selected by purposive sampling technique. The dependent variable is knowledge. The independent variables were age, gender, length of work, duration of work, and training. The data were compiled with a questionnaire and analyzed by multiple linear regression.

Results: The survey respondents in this study amounted to 152 people with the majority being female as much as 73.7% and male as much as 26.3%. The average age of nurses was $31.82 \pm SD 5.09$ and $6.14 \pm SD 3.26$ on the length of work of nurses participating in this study, as well as the average working duration of 10.08 ± 2.00 . In the multivariate analysis test of gender, last education, duration of work, length of work, age on knowledge had a value of $p > 0.005$ so there was no significant influence.

Conclusion: The majority of nurses still have a poor level of knowledge $< 75\%$ on some of the questionnaire question items, in addition, this study shows that there are still many nurses who do not understand the stability of intravenous and the stage of intravenous administration, which is shown in the question value. Therefore, the role of clinical pharmacy in monitoring and providing education related to nurse training on drug incompatibility is needed.

Keywords: Knowledge, nurse, incompatibility, intravenous mixing

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BACKGROUND

Drug incompatibility can occur in patients in hospitals who receive one or more drugs

at the same time as inappropriate drug mixing (Ramesan, 2021). Physicochemical incompatibility is an incompatibility that

can occur in hospitals, where physical changes such as precipitation, foam, and discoloration occur and in chemistry more than 10% of degradation of one or more components of the preparation occurs within 24 hours.

Incompatibility can occur between drugs and drugs or drugs with solvents, auxiliary substances (preservatives, buffers, *stabilizers*) can also occur in containers and tools when administering drugs (Fahimi et al., 2015). Incompatibility is caused by drugs settling at the time of dilution, drug sedimentation due to pH changes during mixing, ion reactions that form insoluble substances, and denaturation of biological molecules (Sriram, 2020).

Intravenous Admixture is a sterile solution made by mixing one or more drugs sterilely given to patients through an intravenous or vein (Farhan, 2018). Improper administration of drugs can cause problems that are detrimental to patients such as wrong dosage (high/low), direct and harmful side effects (Hedlund et al., 2017). Knowledge of the right medication is part of safe medication. Nurses are the largest group of care professionals in the process of administering drugs intravenously, so it is important for nurses to know in administering drugs (Abd Elmageed, 2020).

Incompatibilities can occur in drugs that are mixed in the same parenteral place or solution. Many incompatibilities can be seen as changes occur, but there are some incompatibilities that cannot be proven by visible changes (the presence of deposits or changes in color). So if you want to mix drug preparations parenterally, it is necessary to first check the incompatibility of the drug in the literature (such as handbook on injectable drugs trissel, drug information handbook, medscape) (Ramesan, 2021).

Knowledge of the right medicine, pharmacology is part of safe medication.

Nurses are the largest group of health care professionals in the process of administering drugs intravenously, so pharmacological knowledge is important for nurses. Other knowledge that nurses must have includes nurses' knowledge of drug administration (Abd Elmageed, 2020). The Pangestika study, 2022 showed that there was no relationship between working age, education, and length of work with health workers' knowledge about the incompatibility of intravenous preparations (Pangestika, 2022). This study aimed to determine the relationship between gender, age, length of work, duration of work, and training on nurses' knowledge of incompatibility with intravenous drug preparation mixing.

SUBJECTS AND METHOD

1. Study Design

Cross-sectional study was conducted in the wards of Intensive Care Units (ICU), Neonatal Intensive Care Units (NICU), Obgyn, Pulmonary, Pediatrics, Internal Medicine, Cardiology, Surgery, Emergency Department (IGD), and Psychiatry, dr. Soeselo Hospital, Tegal, Central Java, Indonesia, November 2023.

2. Population and Sample

The minimum number of samples was selected using the slovin formula, with a confidence level of 95% and a margin of error of 5% for 133 respondents. In this study, a questionnaire was given to the respondents directly, with the number of nurses willing to fill out the questionnaire as many as 152 respondents.

3. Study Variables

The research variables used in this study are independent variables and bound variables. Independent variables include demographic factors such as age, gender, education level, length of work, working time, and having participated in training.

Bound variables include nurses' knowledge, attitudes and behaviors.

4. Operational Definition of Variables

Knowledge is the respondent's knowledge of the incompatibility of intravenous preparations

Gender is a physical sign that is identified in respondents who are carried from birth

Age is the life span of the respondent, calculated from birth to the last birthday

The length of work is the respondent's working period, calculated from the beginning of the respondent's work in the hospital until filling out the questionnaire.

Work duration is the time used by respondents to complete their work in one day.

The training is the experience of respondents related to intravenous drug preparation mixing training.

5. Instrument

Knowledge data was collected with a questionnaire containing 22 question items with a score range of 0-1 about the incompatibility of intravenous preparation mixing. Other data were collected with questionnaires.

6. Data Analysis

Continuous data is described as Mean, SD, minimum, and maximum. Categorical data are reported in frequency and percentage values. The relationship between gender, age, and length of work on nurses' knowledge was examined by multiple linear regression.

7. Research Ethics

This research was approved by the Health Research Ethics Commission (KEPK) of the Faculty of Medicine, University of Muhammadiyah Surakarta with number No. 5066/B.1/KEPK-FKUMS/X/2023 in October 2023. All respondents received written and verbal information about the study, prior to data collection. Respondents had the opportunity to ask questions about the research before giving answers and respondents agreed to informed consent.

RESULTS

1. Sample Characteristics

Table 1 shows that the average age of the participants was 31 years old (Mean= 31.82; SD= 5.09), average working 6 years (Mean= 6.14; SD= 3.26), and the average work per day is 10 hours (Mean= 10.08 SD= 2.00).

Table 1. Characteristics of continuous data research subjects

Variable	n	Mean	SD	Min.	Max.
Age (years)	152	31.82	5.09	25	44
Length of service (years)	152	6.14	3.26	1	14
Working duration (hours)	152	10.08	2.00	8	12

Table 2 shows that more than two-thirds of the research subjects were female (73.7%). The number of nurses with a Diploma III education is slightly more

(55.9%) than those with a Bachelor's or Professional education (44.1%). Half of the participants had received training (55.9%).

Table 2. Characteristics of categorical data research subjects

Variable	Category	Frequency	Percentage (%)
Gender	Male	40	26.3
	Female	112	73.7
Education Level	Diploma III	85	55.9

Variable	Category	Frequency	Percentage (%)
Attend Training	College/ profession	67	44.1
	Yes	67	44.1
	No	85	55.9

2. Multivariate analysis

Table 3 shows that there is no effect on sex (OR= 0.86; 95% CI= 0.41 to 1.81; p= 0.692), age (OR= 1.56; CI 95%= 0.46 to 3.09; p= 0.471), education level (OR= 0.57; 95% CI= 0.29 to 1.09; p= 0.088), duration of work (OR= 1.01; 95% CI= 0.53 to 1.94; p= 0.972), and length of work (OR= 1.20;

95% CI= 0.53 to 2.74; p= 0.666) of nurses' knowledge of drug mixing. Nurses who attended the training had a higher likelihood of knowledge than those who did not obtain training, but statistically marginally significant (OR= 1.77; CI 95%= 0.92 to 3.40; p= 0.088).

Table 3. Results of multiple linear regression tests on gender relationships, age, length of work, duration of work, and training on nurses' knowledge

Independent variables	aOR	CI 95%		P
		Lower limit	Upper limit	
Gender	0.86	0.41	1.81	0.692
Education	0.57	0.29	1.09	0.088
Working duration (hours)	1.01	0.53	1.94	0.972
Length of service (years)	1.20	0.53	2.74	0.666
Age (years)	1.56	0.46	3.09	0.471
Training (yes)	1.77	0.92	3.40	0.088

DISCUSSION

A recent study has shown that gender does not influence the level of understanding or skills related to drug mixing among nurses, which has significant implications for the healthcare profession (Teresa-Morales et al., 2022). This finding suggests that training programs should be equally accessible and effective for all nurses, focusing on competency-based assessments rather than gender. It also challenges gender stereotypes in nursing, promoting a culture of equality where skills and competencies are recognized regardless of gender (Nair and Adetayo, 2019). This can encourage greater diversity in the nursing workforce, particularly in roles that involve critical skills like drug mixing. Additionally, mentorship and role models can be fostered in a gender-neutral manner to enhance skills

development (Hill et al., 2022). Future research should explore other factors that might influence nurses' competencies, building on these findings to ensure an inclusive, skilled, and effective nursing workforce.

The findings indicating that tenure and education do not influence the level of understanding or skills related to drug mixing among nurses suggest that factors other than experience and formal education play a crucial role in acquiring these competencies (Farzi et al., 2020). This could point to the effectiveness of on-the-job training and continuous professional development programs that standardize knowledge and skills across nurses with varying backgrounds. It underscores the importance of practical, hands-on training and possibly the role of teamwork and peer

learning in ensuring that all nurses, regardless of their tenure or educational background, can perform drug mixing tasks competently (Babiker et al., 2014; Baek et al., 2023). These insights may lead to a reevaluation of current educational and professional development strategies, focusing more on practice-oriented training modules and collaborative learning environments to maintain high standards in patient care.

The study's findings revealed that neither age nor training significantly influence the level of understanding or skills related to drug mixing among nurses (Vujančić et al., 2022). This suggests that nurses, regardless of their age or the amount of training they have received, possess comparable knowledge and abilities in this critical area of patient care (Al-Busaidi et al., 2019). These results are particularly noteworthy as they challenge the common assumption that more experienced or extensively trained nurses would exhibit superior proficiency in drug mixing. Consequently, these findings underscore the importance of continuous education and regular competency assessments for all nursing staff, ensuring that high standards of practice are maintained across the board. By acknowledging that age and training duration do not inherently equate to better drug mixing skills, healthcare institutions can focus on providing targeted support and resources to enhance the competencies of all nurses equally.

AUTHOR CONTRIBUTIONS

All authors contributed equally.

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CONFLICT OF INTEREST

There is no conflict of interest in this study.

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