



## Correlation between Personnel Knowledge and Suitability of Intravenous Admixture Preparations at PKU Muhammadiyah Wonosari Hospital

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### ABSTRACT

**Background:** Knowledge and skills related to the preparation and administration of sterile preparations, including the principles of technique aseptic according to procedures, are very important for personnel is compounding intravenous admixture. This knowledge is essential to avoid medication errors and increase patient safety. Improper preparation or administration of intravenous medications can result in patient injury or even death due to medication errors.

**Objectives:** The purpose of this study is to examine the correlation between the appropriateness of antibiotic intravenous admixture preparations and the degree of personal knowledge.

**Methods:** This research was conducted in an observational manner with a cross-sectional design and quantitative analysis. A total of 33 respondents who were in charge of intravenous admixture preparations at PKU Muhammadiyah Wonosari Hospital were measured for their level of knowledge and tested for their relationship with the suitability iv admixture process in the October-November 2022 period and analyzed statistically with the contingency coefficient correlation test.

**Results:** The results of this study showed a p-value of 0.001 indicating a significant correlation between the level of knowledge and suitability for the preparation stage. A p-value of 0.012 indicated a correlation between the level of knowledge and modification of the intravenous injection preparation mixing procedure. Personal profession and training have an effect on the mixing of intravenous injection preparations with a p-value of 0.021; and 0.027.

**Conclusion:** Increased knowledge and continuous training can be implemented to improve the quality of intravenous admixture produced by personnel.

**Keywords:** admixture; intravenous; knowledge; suitability.

### INTRODUCTION

As intravenous injection compounding is a complex process, it should be prepared in a special area before administered to patients. This aims to avoid errors that occur at any stage during the preparation and administration of drugs because they can cause serious adverse drug reactions, such as thrombus formation, severe hypersensitivity reactions, and infections, affecting morbidity and mortality.<sup>1,2</sup> Previous studies have shown that improper intravenous preparation or administration can result in patient harm and even death due to medication errors. Intravenous compounding carried out by nurses, medication errors are influenced by skill and knowledge factors, with the error rate decreasing with increasing clinical experience.<sup>3</sup>

The results of the Institute for Safe Medication Practice (ISMP) investigation report on the Safety of Compounding Sterile Preparations ISMP, released in 2013, documented several medication errors in sterile compounding. These errors relate to contaminated products, wrong drugs, doses, diluents, concentrations, and

product labeling errors. The consequences of these errors include patient injury and death.<sup>4</sup> Intravenous (IV) admixture sterile preparations is crucial in clinical pharmacy services to improve patient safety.<sup>5</sup>

The IV admixture preparations is the pharmacist's task according to the Regulation of the Minister of Health (Permenkes) No. 72 of 2016 concerning Pharmaceutical Service Standards in Hospitals.<sup>6</sup> Due to the prevalence of hospitals lacking both laminar airflow (LAF) facilities and sufficient pharmacists for sterile preparations compounding, the administration of intravenous admixture process is still delegated to other health professionals, primarily nurses or midwives in the room.<sup>7</sup> According to the Indonesian Minister of Health Regulation on Nursing in the section on duties and authorities, nurses, besides being providers of nursing care, these are also task executors based on delegation and/or task executors in certain limited circumstances.<sup>8</sup> Every health worker who prepares or IV admixture must have knowledge and skills related to the preparation and administration of sterile preparations, including the principles of aseptic techniques. Personnel who mix sterile preparations must always improve their knowledge and skills through training and continuing education.<sup>2,9</sup>

Personnel knowledge about preparations and IV admixture process is an important domain for forming a person's actions. Knowledge has an influence as an initial motivation for a person to behave. This can be shown from the results of the study in the influence of parenteral preparation and education on the knowledge and attitudes of nurses.<sup>10</sup> Another study located in one of the Government hospitals in Purwokerto found that most of the intravenous admixture compounding personnel at the hospital had sufficient knowledge, and age and history of intravenous mixture training showed a significant correlation with knowledge.<sup>11</sup>

Previous studies evaluated the suitability of intravenous preparation mixing in terms of the suitability of hand washing, the use of PPE, and mixing of intravenous preparations by 68.84%, 63%, and 42.14%<sup>12</sup> by comparing the level of bacterial contamination that occurs in mixing in the ward of 1.1% and mixing carried out in the clean room of 0%.<sup>13</sup> Another study showed that the preparation of intravenous drugs by pharmacists resulted in less contamination than nurses due to the pharmacist's aseptic skills and environmental aspects in the pharmacy unit.<sup>14</sup> This study was conducted at PKU Muhammadiyah Wonosari Hospital, where the preparations and IV admixture was still delegated by the director to other health workers, such as nurses and midwives. There has been no research that presents the correlation between the level of knowledge and the results of the suitability of intravenous mixing carried out by personnel. Therefore, this study aims to examine the correlation between the appropriateness of antibiotic intravenous admixture preparations and the degree of personal knowledge.

## METHODS

### Research Design

The study was conducted observationally using a cross-sectional design and quantitative analysis.

### Population and Samples

The respondents involved all personnel tasked with intravenous admixture antibiotic injection preparations in the inpatient ward (non-clean room area) of PKU Muhammadiyah Wonosari Hospital and had filled out a willingness sheet to become research respondents from October 2022 to November 2022. A total of 33 participants had participated in all research activities that met the inclusion criteria. Those who mixed intravenous antibiotic injection preparations from the beginning of the preparation stage for the use of personal protective equipment (PPE), mixing intravenous antibiotic preparations until the end of the labeling/labeling stage and the PPE removal stage, and were willing to become respondents, while the exclusion criteria included personnel who mixed intravenous antibiotic injection preparations in emergency conditions or served cito prescriptions, so that it would interfere with the service process to patients.

### Research Instruments

The research instrument employed two instruments, the first was in the form of a data collection blank in the form of an observation checklist sheet at the preparation stage as many as five observation items including steps for washing hands and using proper personal protective equipment (PPE). At the stage of IV admixture preparations in a non-clean room area consisting of 14 observation items starting from how to disinfect the work area, Aseptic techniques, and hygiene at the mixing stage followed the research of Amalia, et al. (2021),<sup>12</sup> Basic Guidelines for Dispensing Sterile Preparations of the Indonesian Ministry of Health 2009, ASHP Compounding Sterile Preparation 2014, and other relevant standard books with modifications. Then the observation checklist sheet was subjected to content validity through expert judgment from two clinical pharmacists working in the

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hospital and obtained an average value of 3.72 out of a total value of 4, so that the instrument was categorized as suitable for use.

The second instrument was a questionnaire to measure personnel knowledge obtained from research that had been conducted on the validity of 13 statement items, describing the level of respondent knowledge regarding basic knowledge, mixing procedures, and aseptic techniques. This knowledge questionnaire was compiled using the Guttman scale, where there were only firm answers "true-false", adopted from research conducted by Genatrika et al. (2021) and Ulfa et al. (2017)<sup>7,15</sup>. Scoring for each answer with the provision that the correct answer was given a score of 1 and the wrong answer with a score of 0. Before the questionnaire blank was used to measure the level of knowledge, modifications were made by conducting content validity to suit the research objectives. Then, statistical testing was carried out through validity and reliability tests on 56 other respondents in the preliminary test. The correlation results with each item were all around 0.76. According to the statistical test, all showed an asterisk indicating a valid statement. A statement is said to be valid if it has a minimum connected correlation coefficient of 0.3 with a type one error (5%).<sup>16</sup> The test using Cronbach's alpha obtained quite high results of 0.775, so that all statements have a corrected total item correlation greater than the minimum correlation coefficient considered valid (0.6). The results of this test indicate that 13 statement items in the questionnaire are valid and reliable.

The independent variables in this study were the level of knowledge, while the dependent variable included the suitability of mixing intravenous drug preparations. The interfering variables were the age, profession, training, and work experience of each personnel.

### Data Collection

The researchers validated the instrument on respondents outside the research location to identify and refine the instrument to be used. Data collection was carried out after obtaining data on the number of personnel working in the inpatient ward, an explanation of the purpose of the study, and personnel who met the inclusion. Then, the exclusion criteria were asked to fill out an informed consent. At the specified time, the researcher conducted direct observations related to the mixing process of intravenous antibiotic preparations carried out by personnel using an observation checklist, recorded the information needed, and after mixing, personnel were asked to fill out a knowledge level questionnaire. Furthermore, the results of each personnel's questionnaire answers were then linked to the suitability of the mixing of vial antibiotic drug preparations carried out by personnel.

### Data Analysis

The Contingency Coefficient Correlation Test was used to analyze the correlation of ordinal categorical data, namely the correlation between knowledge about mixing IV admixture preparations and the suitability of the preparation and mixing stages implementation (appropriate or not appropriate), stated as appropriate if the value is  $\geq 50\%$  based on the Guttman scale and not appropriate if  $< 50\%$ . The level of personnel knowledge was measured using the results of the questionnaire and analyzed quantitatively. The percentage obtained was interpreted using 3-category, where a person's knowledge was categorized into three, namely personnel with poor knowledge ( $\leq 55\%$ ), moderate (56-75%), and good (76-100%).<sup>17</sup> The suitability of the preparation and mixing stages implementation (appropriate, not appropriate) was stated as appropriate if the value was  $\geq 50\%$  based on the Guttman scale and inappropriate if  $< 50\%$ . According to the following data collection, data analysis was carried out using a computerized statistical tool through the Contingency Coefficient Correlation ( $r$ ) test analysis with a value of  $\alpha = 0.05$ . The related provisions state that if the  $p$  value  $\leq \alpha$  (0.05), then the variable and the dependent variable have a significant correlation. Otherwise, the independent and dependent variables are not significantly correlated if the  $p$  value is less than 0.05.

## RESULTS AND DISCUSSION

### Socio-demographic Respondents

Socio-demographics of personnel who mix intravenous injections in the inpatient ward (non-clean room area) of PKU Muhammadiyah Wonosari Hospital can be seen in Table I. Those who mix intravenous injection preparations are in the age group 26-35 years (54.54%), most of them are female (78.79%), with the most professions are Associate degree in Nursing (D3 nurses) (48.49%), the most experience or length of work is in the range of 1-5 years of (78.79%), and most of them have received aseptic dispensing training held by the internal

party of PKU Muhammadiyah Wonosari Hospital with an in-house training concept, namely (60.61%), personnel work in the Unit Marwah/ ward is the special wards for surgery and urology (36.37%).

**Table I. Socio-demographics of Personnel Performing Intravenous Admixture in Non-Clean Room Areas**

Characteristics	N	Percentage (%)
<b>Age</b>		
1. 17-25 years old	13	39.40%
2. 26-35 years old	18	54.54%
3. 36-45 years old	2	6.06
<b>Total</b>	<b>33</b>	<b>100%</b>
<b>Gender</b>		
1. Male	7	21.21%
2. Female	26	78.79
<b>Total</b>	<b>33</b>	<b>100%</b>
<b>Profession</b>		
1. Midwife	7	21.21%
2. Associate Degree in Nursing	16	48.49%
3. Nurse	10	30.30%
<b>Total</b>	<b>33</b>	<b>100%</b>
<b>Length of Work Experience</b>		
1. 1-5 years	26	78.79%
2. 6-10 years	6	18.18
3. 11-15 years	1	3.03
<b>Total</b>	<b>33</b>	<b>100%</b>
<b>Aseptic Dispensing Training</b>		
1. Never Attended	13	39.39%
2. Already Attended	20	60.61%
<b>Total</b>	<b>33</b>	<b>100%</b>
<b>Unit/ Room</b>		
1. Shafa	10	30.30%
2. Marwah	12	36.37%
3. Arofah	11	33.33%
<b>Total</b>	<b>33</b>	<b>100%</b>

#### Level of Personnel Knowledge

The results of the knowledge level study in Table II below show 15 personnel with a good level of knowledge (45.45%). There are 15 personnel with a moderate level of knowledge (45.45%), and three personnel with a poor level of knowledge (9.10%). These results indicate that most of them have good to moderate knowledge about mixing intravenous injection preparations.

**Table II. The Results of the Coefficient Contingency Correlation Analysis in the Correlation between Knowledge Level and Preparation Stage Suitability**

		Preparation Stage Suitability		Correlation Coefficient (r)	P-value
		Yes	No		
<b>Level of Knowledge</b>	Good	15(45.46%)	0(0%)	0.541	0.001
	Moderate	14(42.42%)	1(3.03%)		
	Poor	1(3.03%)	2(6.06%)		
<b>Total</b>		<b>30(90.91%)</b>	<b>3(9.09%)</b>		

Contingency Coefficient Correlation Test

Based on the analysis conducted, the percentage of knowledge level showed 15 personnel with good knowledge level, 15 personnel with moderate knowledge level, and 3 personnel with poor knowledge level.

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These results indicate that most of them have good to moderate knowledge levels. Previous studies stated that most respondents have sufficient to good knowledge about mixing, and most respondents were able to answer more than 11 questions correctly (94.1%)<sup>11</sup>. Another study stated that from the results of the questionnaire on the level of knowledge about aseptic dispensing, 60% of respondents were very good, 33% good, and 7% sufficient.<sup>15</sup>

### The Correlation between Education Level and the Suitability of the Preparation Stage

The results of the contingency coefficient correlation test analysis using SPSS in Table II obtained a p-value = 0.001. This shows that in both variables, namely the level of knowledge (x) correlated with the suitability of the preparation stage (y) significantly. The form of the correlation is positive as the Contingency coefficient value is also positive (0.541). There is a significant correlation between the level of knowledge and the preparation stage with a p-value of 0.001. The correlation obtained is a positive correlation because the Contingency Coefficient value is also positive (0.541). Based on the guidelines for the degree of relationship, x and y variables are included in the moderate correlation category (0.41–0.60) and the form of the correlation is positive.<sup>16</sup> This means that the higher a person's level of knowledge, the higher the level of suitability at the preparation stage of intravenous injection preparations. Personnel with a good level of knowledge tend to be appropriate in the preparation stage consisting of the appropriateness of hand washing and using personal protective equipment (PPE).

The findings of this study are consistent with those of other studies that found a strong correlation between behavior and PPE use compliance (p-value = 0.006) and between knowledge and compliance (p-value = 0.001).<sup>18</sup> When it comes to PPE use, most healthcare professionals are well-informed and compliant.<sup>19</sup> Other than education, factors including the availability of personal protective equipment (PPE), fear, length of work experience, support from coworkers and the environment, and personal responsibility can also affect compliance with logical requirements for PPE use.<sup>20</sup> Gloves, masks, and protective clothes are the bare minimum of personal protective equipment required while intravenous admixture preparations.<sup>8,9</sup> This is important for the Hospital to follow up in an effort to prevent nosocomial infections or Healthcare Associated Infections (HAIs).

### The Correlation between Education Level and Suitability of Intravenous Admixture Stage

The results in Table III show that of the 15 personnel who have a good level of knowledge, they have a higher percentage of suitability of mixing intravenous preparations of antibiotics (36.36%) than those who do not (9.09%). A total those who have moderate knowledge levels have lower suitability in intravenous admixture injection preparations (18.18%) than personnel with moderate and inappropriate ability (27.28%). While three personnel who have low knowledge level and do mixing properly are (0%). Based on the analysis result through the Contingency coefficient correlation test using SPSS, the significant result is p-value = 0.012 with r-value = 0.459.

**Table III. Results of the Contingency Coefficient Correlation Analysis Regarding the Correlation between the Level of Knowledge and the Suitability of Intravenous Admixture Stages**

		Suitability of Intravenous Admixture		Correlation coefficient (r)	P-value
		Yes	No		
Level of Knowledge	Good	12(36.36%)	3(9.09%)	0.459	0.012
	Moderate	6(18.18%)	9(27.28%)		
	Poor	0(0%)	3(9.09%)		
<b>Total</b>		<b>18(54.55%)</b>	<b>15(45.46%)</b>		

Contingency Coefficient Correlation Test

There is a correlation between the level of personnel knowledge and the suitability of intravenous admixture stages carried out with moderate correlation. This can be seen from the results of the analysis using the contingency coefficient correlation test using SPSS in Table III. The results obtained were significant p-value = 0.012, indicating that in both variables, the level of knowledge (variable x) and the suitability of intravenous admixture (variable y) both indicated a relationship or were statistically correlated. This result is also seen from the correlation value of 0.459 indicating a positive correlation with a moderate correlation strength (0.41-0.60).<sup>16</sup>

These results are in accordance with previous studies which explain that factors influencing the suitability of aseptic techniques carried out by personnel are influenced by the level of knowledge.<sup>21</sup> It was found that undergraduate health workers were better at converting units p-value= 0.000 but there was no significant correlation between education level and work during drug preparation with p-value= 1.00.<sup>22</sup>

These results are in line with previous studies, which stated that good knowledge and attitude of pharmacists can support the implementation of their use in practicing good profession.<sup>23</sup> Therefore, it is expected that the knowledge that has been possessed by the compounding officers can be maintained so that there are no obstacles in the process of mixing intravenous injection preparations.

Another study stated that there is a correlation between knowledge and skills with the incident of implementing the principle of six correct drugs using Spearman rank with a p-value= 0.000 and  $r = 0.491$ .<sup>24</sup> The higher the knowledge, the higher the skills and implementation of the principle of correct drugs.<sup>24</sup> Skills mean applications of knowledge so that a person's skill level is related to the level of knowledge. Meanwhile, knowledge is influenced by the level of education, age, and experience. The higher a person's level of education, their knowledge will automatically increase and does with their skills.<sup>25</sup>

#### The Influence of Interfering Variables on the Suitability of Intravenous Admixture

The influence of interfering variables with the suitability of intravenous admixture preparations was analyzed using contingency coefficient correlation. It was found that there was an influence of profession and training with the suitability of mixing intravenous injection preparations with p-values of 0.021; and 0.027, with correlation coefficient values of 0.436 and 0.303. The characteristics of age, gender, length of service, and personnel room did not show any correlation with the suitability of mixing intravenous injections with p-values of 0.403; 0.062; 0.363; and 0.197 as shown in Table IV.

**Table IV. Correlation Analysis of Interfering Factors with the Suitability of Intravenous Admixture**

Characteristics	N	Suitability of IV Admixture		P-value	r
		Appropriate	Not Appropriate		
<b>Age</b>					
1. 17-25 years old	13	7(21.21%)	6(18.18%)	0.403	0.229
2. 26-35 years old	18	9(27.27%)	9(27.27%)		
3. 36-45 years old	2	2(6.06%)	0(0%)		
<b>Gender</b>					
1. Male	7	6(18.18%)	1(3.03%)	0.062	0.309
2. Female	26	12(36.36%)	14(42.42%)		
<b>Profession</b>					
1. Midwife	7	2(6.06%)	5(15.15%)	0.021	0.436
2. Nurse D3	16	7(21.21%)	9(27.27%)		
3. Nurse+ Ners	10	9(27.27%)	1(3.03%)		
<b>Length of Work Experience</b>					
1. 1-5 years	26	15(45.45%)	11(33.33%)	0.363	0.241
2. 6-10 years	6	2(6.06%)	4(12.12%)		
3. 11-15 years	1	1(3.03%)	0(0%)		
<b>Aseptic Dispensing Training</b>					
1. Never Attended	13	4(12.12%)	9(27.27%)	0.027	0.359
2. Already Attended	20	14(42.42%)	6(18.18%)		
<b>Unit/ Room</b>					
1. Shafa	10	6(18.18%)	4(12.12%)	0.197	0.299
2. Marwah	12	3(9.09%)	9(27.27%)		
3. Arofah	11	6(18.18%)	5(15.15%)		
<b>Total</b>	<b>33</b>				

Contingency Coefficient Correlation Test

## Correlation between Personnel Knowledge

The characteristics of the personnel profession and the training attended by the personnel have a statistical correlation with p values of 0.021; and 0.027 respectively, with a correlation coefficient value of 0.436, which is included in the moderate correlation, and training  $r = 0.303$  included in the weak correlation category.<sup>16</sup> While the characteristics of age, gender, length of service, and personnel room do not show any correlation with the suitability of intravenous injection mixing with p values of 0.403; 0.062; 0.363; 0.197 (p-value > 0.05). The results of this study are from previous studies that showed the influence of the suitability of aseptic techniques carried out with factors in the form of knowledge and attending aseptic technique training, work experience related to length of service, personnel profession, and workload.<sup>21</sup>

The previous research indicated a 54% compliance rate with the intravenous drug preparation admixture stage. Notably, the lowest stage observed compliance level was associated with the post-test disinfection of drug containers using 70% alcohol.<sup>26</sup> These results can be used as a guideline for the Hospital Director to conduct internal audits regarding compliance of personnel in mixing intravenous drug preparations with the standards or SOPs applicable in the Hospital. Besides, it can be used to evaluate the suitability of intravenous admixture and preparation in hospitals. Socialization and training steps that are ongoing and continuously evaluated can continue to be provided to improve personnel skills in the process of mixing intravenous preparations. The hospital can provide training to personnel who have not received any training in aseptic techniques for nurses in the ward or nurses in other units, who mix intravenous preparations. Further researchers can analyze other factors that influence personnel skills in the appropriate mixing process. A correlation test needs to be conducted between the above factors and the appropriateness of mixing intravenous preparations. These results sourced from previous studies, which state that other things that influence the appropriateness of intravenous drug mixing are regular training to improve personnel knowledge.<sup>15</sup>

This study acknowledges limitations in its scope, specifically the exclusion of respondent workload and professional position as potential interfering factors influencing the appropriateness of intravenous preparation mixing. However, these limitations do not affect the final results, which was to examine the correlation between the level of personnel knowledge and the appropriateness of mixing intravenous preparations. Future research endeavors should consider investigating the impact of workload and position of personnel on mixing practices, potentially utilizing a larger sample size.

## CONCLUSION

The findings reveal a statistically significant, moderate correlation category between knowledge levels and the suitability of both the preparation ( $p = 0.001$ ) and mixing ( $p = 0.012$ ) stages of the intravenous mixing stage preparation. Specifically, higher levels of personnel competence are associated with increased suitability in these stages. Furthermore, both profession of personnel and training participation affect a significant influence on the suitability of intravenous admixture with p-values ( $p = 0.021$  and  $p = 0.027$  respectively). These results underscore the importance of enhancing personnel knowledge and participate in training to improve the quality of intravenous preparation mixing.

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## STATEMENT OF ETHICS

The Ethics Committee of PKU Muhammadiyah Hospital Yogyakarta has granted ethical eligibility licenses for this project with the number 00241 / KT.7.4 / X / 2022.

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