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Evaluation of Mixed Intravenous Preparation in Patients at the Hospital "X" Samarinda's Intensive Care Unit (ICU)

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Abstract: Mixing intravenous preparation especially in patients intensive care unit (ICU) at the hospital requiring special attention relating to their higher had medication errors, as nosocomial infection and incompatibility drugs. Things that need to be considered in mixing sterile preparations, namely compounding personnel, facilities and infrastructure and the process of mixing sterile preparations. This study aims to calculate the percentage of suitability for the mixing process for intravenous preparations based on the Basic Guidelines for Dispensing Sterile Preparations, Guidelines for Injectable and Cytostatic Drugs in 2009 and the Handbook of Injectable Drugs Edition 16th for Intensive Care Unit (ICU) patients at the hospital "X" Samarinda. The research is descriptive research using sheets observational data collection. Subject of research is do mixing, facilities, and infrastructure as well as mixing procedure. The results of observations as many 215 processes of mixing intravenous preparations observed in the ICU showed that 100% of compounding personnel were carried out by nurses, and 100% of infrastructure did not have a clean room, LAF, and pass box, 53% carried out the mixing process according to procedures, and physical quality tests. drug preparations are 100% in accordance with the Handbook of Injectable Drugs Edition 16th, namely the preparations produced are clear and free of foreign particles.

Keywords: Mixing, intravenous, Intensive Care Unit (ICU), Sterile Product, Drug physical quality test.

1. Introduction

According to the Regulation of the Minister of Health No. 72 of 2016 concerning pharmaceutical service standards in hospitals includes clinical pharmacy services, namely mixing sterile preparations which can only be done in hospitals that have facilities for mixing sterile preparations. The mixing of sterile preparations is carried out at the pharmacy installation using aseptic technique to ensure the sterility of the drug. The purpose of mixing sterile preparations is to ensure that the drug is received as needed and to ensure the sterility of the drug (1).

Based on the Ministry of Health of the Republic of Indonesia in 2009 regarding the Basic Guidelines for Dispensing Sterile Preparations and Guidelines for Mixing Injectable and Cytostatic Drugs, mixing of sterile preparations must be carried out in pharmacy installation in hospitals to avoid nosocomial infections and the occurrence of medication errors. Mixing of sterile preparations is a series of changes in the form of the drug from its original condition into a new product by dissolving or adding other ingredients carried out aseptically by pharmacists in health care facilities (2). Aseptic mixing of sterile preparations has several requirements that must be met, namely a clean room, LAF, cabinet, and competent

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personnel who meet the requirements as mixing officers. Pharmacy installation in hospitals must also establish a team for product quality assurance and mixing of sterile preparations to ensure quality and minimize errors (3).

Unsterile mixing has a negative impact on patient health, such as nosocomial infections which are a serious problem in hospitals because they can increase morbidity and mortality for contaminated patients (4). The incidence of nosocomial infections that often occur at the Setjonegoro Regional General Hospital, Wonosobo Regency is phlebitis infection, surgical wound infection and pressure sores (5). In addition to nosocomial infections, drug incompatibility can also cause serious problems where chemical degradation of drugs occurs, resulting in reduced drug effectiveness and can cause toxicity (6). This study aims to calculate the percentage suitability of the mixing process for intravenous preparations based on the Basic Guidelines for Dispensing Sterile Preparations, Guidelines for Injectable and Cytostatic Drugs and the 16th edition of the Handbook of Injectable Drugs in ICU patients at "X" Hospital Samarinda.

The results of the study are expected to be an evaluation for Hospital "X" in Samarinda to improve and improve various aspects in mixing sterile preparations that are not appropriate and maintain things that are in accordance with the Book based on the Basic Guidelines for Dispensing Sterile Preparations, Guidelines for Injecting and Cytostatic Drugs in 2009 and Handbook of Injectable Drugs 16th edition.

2. Methodology

This research was conducted with a descriptive observational method with a cross-sectional approach. The data collection technique was carried out by accidental sampling during the observation period, namely every Monday – Friday in June – August 2022. The data was taken on a data collection sheet based on the 2009 Basic Manual for Dispensing Sterile Preparations, the Guidebook for Mixing Injectable and Cytostatic Drugs in 2009 and the 16th edition of the Handbook of Injectable Drugs. Observations were made on the process of mixing intravenous preparations related to various aspects, namely compounding personnel, supporting facilities and infrastructure, drug preparation procedure, mixing procedure, and drug physical quality test results. All samples that met the inclusion criteria were used in the study.

The inclusion criteria in this study were the observed compounding process for intravenous preparations and classified into the 3 most widely used drugs for ICU patients at "X" Samarinda Hospital. The exclusion criteria in this study was the process of compounding intravenous preparations which were classified into the 3 most widely used drugs for ICU patients at Hospital "X" Samarinda, but the entire process was not observed by the researcher.

3. Result and Discussion

This study involved 215 mixing processes carried out in the ICU room of the Hospital "X" Samarinda for 50 patients. Data is taken in the period 08 June 2022 – 08 August 2022 every Monday to Friday. The most frequently mixed drugs were ceftriaxone 102 times (47%), omeprazole 67 times (31%), and tramadol 46 times (22%).

3.1 Compounding Personnel

The process of mixing sterile preparations is carried out by pharmacists who have attended training and continuing education under the responsibility and supervision of pharmacy installation in hospitals pharmacists (2). Based on the results of observations made by researchers, the process of mixing sterile preparations is still fully (100%) carried out by nurses who have attended training and continuing education. Compounding personnel involved in mixing sterile preparations can be seen in Table 1.

This is due to the unavailability of pharmacists or special pharmacy personnel in the ICU. Research conducted by Berdot et al (2016), shows that training may not necessarily reduce the number of errors, but at least it can increase nurses' awareness about the possibility of medication errors (7). There are 34 nursing staff in the ICU, with 1 person preparing sterile preparations in the morning, while in the afternoon the mixing personnel are each nurse who is responsible for each patient or 8 people for 8 beds.

Table 1. Compounding Personnel

No.	Demographic Classification		Amount	Percentage (%)
1	Human Resources	Pharmacists or Pharmacy Technicians	0	0
		Nurse	34	100
Total			34	100
1	Gender	Male Female	10 24	29 71
Total			34	100

3.2 Facilities and infrastructure

The process of mixing intravenous preparations is not carried out in a clean room but in a special room mixing drugs and the mixing process is not carried out under the LAF but is carried out on a workbench which is first wiped with 70% alcohol. This is feared to increase the risk of microbial contamination during the mixing process of sterile preparations (2). Mixing intravenous preparations using a clean room can be the best strategy to reduce the level of contamination of intravenous mixing solutions (4). Aseptic technique is an important procedure used in mixing sterile preparations so that prior to mixing the drug, the compounding personnel must wear complete personal protective equipment (PPE). Available facilities and infrastructure can be seen in Table 2.

Table 2. Facilities and infrastructure.

No.	Compounding Criteria	Number of Conditions According to Standard (2)	Number of Observed Conditions	Percentage (%)
1.	Has a special room and special equipment for compounding.	0	215	0
2.	Compounding is done under LAF.	0	215	0
3.	Taking medical devices and medicines from the pass box.	0	215	0
Total		0	645	0

Based on observations made by researchers, compounding personnel in the ICU room at hospital "X" Samarinda have worn complete PPE, namely protective clothing, masks, and gloves. The primary purpose of the use of PPE is to protect compounding personnel from exposure to drugs and to protect the product against contamination from compounding personnel (8). The distribution of drugs in the ICU of hospital "X" Samarinda is not through the inbox but uses a medicine box because the mixing of drugs is not carried out in a clean room and adequate to ensure the sterility of the drug.

3.3 Drug Preparation Procedure

Checking the completeness of the request documents and the condition of the drugs received

The preparation procedure aims to prevent the occurrence of medication errors to patients that lead to medication errors. Drug preparation procedure can be seen in Tables 3 and 4.

Based on the results of observations made by researchers before mixing, nurses 100% checked the completeness of the request document by checking the correct patient, correct drug, correct dose, correct route and correct time of drug administration and then carried out the drug preparation process, namely by taking the drug in the storage

cupboard. drugs based on the patient bed number and checking the name of the drug, the amount of the drug, the drug solvent used and calculating the dose of the drug. Checking the batch number and expiration date of the drug was not carried out because it was carried out by the pharmacy staff at the pharmacy installation to prevent possible damage to the drugs received by the ICU nurses.

Table 3. Check the completeness of the request document.

No.	Compounding Criteria	Number of Conditions According to Standard (2)	Number of Observed Conditions	Percentage (%)
1	Correct Medicine	215	215	100
2	Correct Patient	215	215	100
3	Correct Dosage	215	215	100
4	Correct Route	215	215	100
5	Right Time to Give	215	215	100
Total		1,075	1,075	100

Table 4. Checking the condition of the drugs received.

No.	Compounding Criteria	Number of Conditions According to Standard (2)	Number of Observed Conditions	Percentage (%)
1	Medicine name	215	215	100
2	Amount of Medicine	215	215	100
3	Medicine Batch Number	0	215	0
4	Expired Date	0	215	0
5	Calculating Appropriate Dosage	215	215	100
6	Calculating the Volume of Solvent Used	215	215	100
Total		860	1,290	67

Making Drug Labels

According to the Guidelines for Mixing Injectable and Cytostatic Drugs, the drug label contains the patient's name, medical record number, treatment room, dose of administration, method of administration, storage conditions, date of manufacture and expiration date of the mixture (2). Making drug labels can be seen in Table 5.

Table 5. Making Drug Labels.

No.	Compounding Criteria	Number of Conditions According to Standard (2)	Number of Observed Conditions	Percentage (%)
1	Patient's name	0	215	0
2	Medical Record Number	0	215	0
3	Ward	0	215	0
4	Dosage	215	215	100
5	Way of giving	0	215	0
6	Storage Condition	0	215	0
7	Manufacture Date	215	215	100
8	Beyond Use Date	215	215	100
Total		645	1,720	38

Drugs in sterile compound dosage forms must be labeled with complete and clear labels with complete and clear information to reduce the risk of errors in therapy (11). According to the Guidelines for Mixing Injectable and Cytostatic Drugs, the drug label contains the patient's name, medical record number, treatment room, dose of administration, method of administration, storage conditions, date of manufacture and expiration date of the mixture (2). Based on observations, 38% of the labeled process did not comply with the Guidelines for Mixing Injectable and Cytostatic Drugs because the drug label only contained the drug name, solvent, reconstitution time, dosage strength, and BUD date.

3.4 Mixing Procedure

Some aseptic techniques that can be used to minimize the occurrence of contamination and nosocomial infections are to wash both hands before compounding. Mixing procedure can be seen in Table 6.

Table 6. Mixing Procedure.

No.	Compounding Criteria	Number of Conditions According to Standard (2)	Number of Observed Conditions	Percentage (%)
1	Using Personal Protective Equipment (Protective clothing, gloves and disposable masks).	215	215	100
2	Perform decontamination and disinfection.	215	215	100
3	Turning on LAF.	0	215	0
4	Prepare the LAF workbench by providing a liquid absorbent mat in the LAF.	0	215	0
5	Prepare garbage disposal bags in LAF for used drugs.	0	215	0
6	Disinfect gloves with 70% alcohol	215	215	100
7	Taking medical devices and medicines from the pass box.	0	215	0
8	Perform aseptic mixing.	0	215	100
9	The technique of transferring drugs from ampoules/vials according to the procedure.	215	215	100
10	Transfer of medication to another vial/infusion bottle according to the procedure.	215	215	100
11	Taking the right volume of medication.	215	215	100
12	Give appropriate labels for each syringe and infusion that already contains the mixed drug.	215	215	100
13	Wrap in black bags or aluminum foil for medicines that must be protected from light.	0	215	0
14	Remove the container that already contains the syringe or infusion through the pass box.	0	215	0
15	Dispose of all traces of drug mixing in a special disposal container.	215	215	100
	Total	1,720	3,225	53

Based on observations made by researchers at the mixing stage, nurses used aseptic procedures, namely by washing hands before mixing and 100% using complete Personal Protective Equipment (PPE), but when mixing, the vial and ampoule caps were not disinfected before opening. The technique of mixing vial preparations carried out by nurses is still not in accordance with the Manual for Dispensing Sterile Preparations because based on observations the nurse shakes the vial with the needle position still in the vial. However, due to limited facilities and infrastructure such as no LAF in the mixing room, during the mixing process the needle can be left in the vial with the aim of preventing contamination of the syringe. Then to dissolve the powder, it is enough to rotate the vial slowly until all the powder in

the vial is dissolved (2). This is to prevent the powder from sticking to the rubber vial which causes the drug to not dissolve completely. Shaking should be done at the 90° position because in this position the contact between the substance and the solvent is greater and the substance can be dissolved well. Shaking should not be done too vigorously, as this may cause powder to remain at the bottom of the vial cap (2). The technique of mixing the ampoule preparations is in accordance with the Manual for Dispensing Sterile Preparations because based on the observations the nurse performs the technique of transferring the drug solution from the neck of the ampoule with a J-motion movement and transferring the drug into the syringe by holding the ampoule at a 45° position. In addition, the use of disposable syringes and needles is recommended to prevent contamination. From the results of observations, all mixing sterile preparations have used single-use syringes and syringes, but when they will be administered to patients, the used syringes are not replaced with new syringe.

Table 7. Drug Physical Quality Test Results.

No.	**Medicine name**	**Parameter**	**Information from literature** (10)	**Observation result**
1.	Ceftriaxone	Foreign particles	Free of foreign particles	Free of foreign particles
		Solution color	Light yellow	Light yellow
		Lucidity	Solution must be clear	Solution must be clear
2.	Omeprazole	Foreign particles	Free of foreign particles	Free of foreign particles
		Solution color	Colorless	Colorless
		Lucidity	Solution must be clear	Solution must be clear
3.	Tramadol	Foreign particles	Free of foreign particles	Free of foreign particles
		Solution color	Colorless	Colorless
		Lucidity	Solution must be clear	Solution must be clear

Waste in the process of mixing sterile preparations is classified as medical waste that must be disposed of in a special place so as not to pollute, harm, and prevent misuse. Disposal of waste, especially drug packaging (vials or broken ampoules) and syringes, must be disposed of in a separate place because it requires a different waste treatment process from other types of waste (9). Based on the results of observations made, 100% of compounding personnel have disposed of the remaining medical waste from the mixing process to the special disposal site provided.

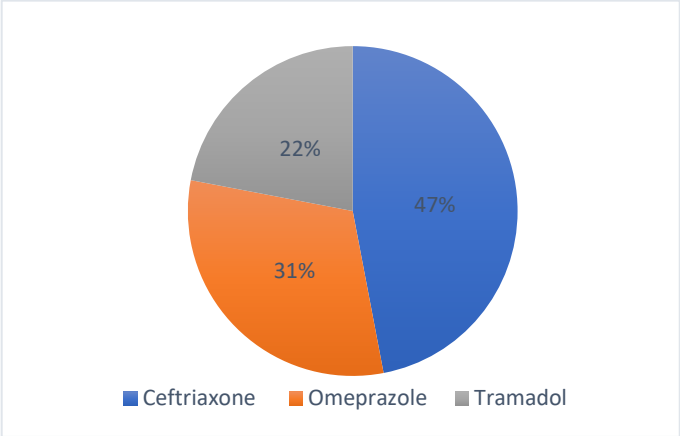

Figure 1. Results from the most frequently mixed drugs.

3.5 Drug Physical Quality Test Results

The results of visual observations made by researchers from 3 samples from the most frequently mixed in the ICU room at Hospital "X" Samarinda showed that 100% of these preparations were physically compatibility and the type of

solvent used was in accordance with the 16th edition of the Handbook of Injectable Drugs, results from the most frequently mixed drugs can be seen in Figure 1. The danger of the presence of visible drug powder particles in solution can cause embolism if they are not completely dissolved when administered. The insoluble drug particles can stick to blood vessels and cause blockages (2). Drug physical quality test result can be seen in Table 7.

In 102 ceftriaxone preparations, the resulting solution was light yellow in color, clear and there were no foreign particles. In 67 preparations of omeprazole and 46 preparations of tramadol, the resulting solution was colorless, clear and there were no foreign particles. There is no BUD information on the mixed preparations because the mixing results are not stored but are given directly to the patient (10).

4. Conclusion

The process of mixing intravenous preparations in the ICU room at Hospital "X" Samarinda still does not meet the criteria set by the Basic Manual for Dispensing Sterile Preparations and the Guidebook for Mixing Injectable and Cytostatic Drugs, but the resulting intravenous preparations are in accordance with the 16th edition of the Handbook of Injectable Drugs. in terms of foreign particles, solution color, and clarity.

Abbreviations

ICU, Intensive Care Unit; LAF, Laminar Air Flow; PPE, Personal Protective Equipment; BUD, Beyond Use Date.

Authors contribution

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Conflict of Interest

The authors declare no conflicts of interest

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