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Evaluation of High-Alert Medication Storage in the Inpatient Pharmacy Unit of Pasar Rebo Regional General Hospital

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ABSTRACT: High-Alert Medications are medicines that pose a high risk of causing severe errors or adverse events, including sentinel events and unintended drug reactions. These medications including high-risk medicines, concentrated electolytes, and LASA (Look-Alike-Sound-Alike) medicines. This study evaluates the storage practices for high-alert medications at the inpatient pharmacy unit of Pasar Rebo Regional Public Hospital period May-June 2023, assessing compliance with the hospital's Standard Operating Procedures (SOP) for such medicines. Data collection was conducted prospectively using an observation checklist aligned with the SOP for high-alert medication storage. The findings showed 100% compliance for concentrated electrolytes, 80% for high-risk medicines, and 83.75% for LASA medicines. High-alert medicines were stored separately from other medicines, marked with red warning tape, and labelled with "High Alert" stickers. However, LASA medicines were not placed in a dedicated cabinet; instead, they were stored at least two shelves apart from other medicines and labelled as "LASA." In conclusion, the storage of high-alert medicines at the inpatient pharmacy unit generally adheres to the SOP but requires improvement, particularly in providing a dedicated storage system for LASA medicines.

KEYWORDS: High-alert medication storage; high-risk medicines; inpatient pharmacy unit of hospital.

1. INTRODUCTION

A hospital is a healthcare institution that provides comprehensive individual health services, including inpatient care, outpatient care, and emergency services. The Hospital Pharmacy Installation is a hospital unit responsible for managing pharmaceutical services, including preparation, quality control, supply management, prescription services, drug information, counselling, and clinical pharmacy services [1]. Pharmaceutical Service Standards are benchmarks used as guidelines for pharmaceutical personnel in delivering pharmaceutical services. Pharmaceutical Services are direct and responsible services provided to patients related to pharmaceutical preparations, aimed at achieving definite outcomes to improve the quality of patients' lives [2].

One crucial aspect of pharmaceutical activities is storage. Storage must ensure the quality and safety of pharmaceutical preparations and health supplies in accordance with pharmaceutical requirements. These requirements include stability and safety, sanitation, light, humidity, ventilation, and categorization of pharmaceutical preparations and health supplies. Proper storage practices are essential to enhance safety, particularly for medications that require special attention (High Alert Medications). High Alert Medications are drugs that must be closely monitored as they frequently lead to errors or serious mistakes (sentinel events) and pose a high risk of Adverse Drug Reactions (ADR) [1]. According to a study by Andriyani (2021) at Hospital X in Tangerang, medication errors involving High Alert Medications frequently occur, particularly during the drug retrieval process. The highest number of errors involved LASA (Look Alike Sound Alike) drugs at 72%, High Alert Medications at 25%, and concentrated electrolytes at 3%. The LASA drug group experienced the highest error rate at Hospital X in Tangerang due to the large quantity of these drugs and their fast-moving nature, which impacted the frequency of errors and reduced accuracy during drug retrieval. Therefore, monitoring and evaluation are necessary to prevent medication errors in the future [3]. High Alert Medications, including high-risk drugs, concentrated electrolytes, and LASA drugs, require careful storage

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per established guidelines to prevent errors. This study observes the storage practices for High Alert Medications at the Inpatient Pharmacy unit of Pasar Rebo Regional General Hospital.

2. MATERIALS AND METHODS

2.1. Material

The materials used in this study include an observation checklist for High Alert Medication storage and the Standard Operating Procedure (SOP) for High Alert Medication storage at the Inpatient Pharmacy Depot of Pasar Rebo Regional General Hospital.

2.2. Type of Research

This study employs a descriptive research method, which aims to provide an objective description of a specific phenomenon. Descriptive studies collect, analyze, and interpret data to offer insights and a clear representation of the observed phenomenon [4].

2.3 Data Collection Method

The data collection method used is observation, where data is directly obtained from the subject, environment, during the observation period at May-June 2023 at inpatient pharmacy unit Pasar Rebo Regional General Hospital.

2.4 Data Analysis

The collected data is analysed descriptively through the following steps:

1. Creating a checklist for High Alert Medication storage.
2. Evaluating the compliance of High Alert Medication storage at the inpatient pharmacy unit against the SOP for High Alert Medication storage at Pasar Rebo Regional General Hospital.
3. Calculating the percentage of compliant High Alert Medication storage using the following scoring system:
    - Compliant storage = Score 1
    - Non-compliant storage = Score 0

    Percentage formula (P%)

    $P = \frac{f}{n} \; x \; 100\%$

    - f = Total compliant scores
    - n = Total scores
4. Discussing and concluding the percentage results to determine compliance with the SOP for High Alert Medication storage at Pasar Rebo Regional General Hospital.

3. RESULTS

Based on the observation results of high-alert medication storage in the inpatient pharmacy unit of Pasar Rebo Regional General Hospital, the findings are presented in Table 1.

Table 1. Percentage of Compliance with Concentrated Electrolyte Medicine Storage

No	Therapeutic Class	Name of Medicine	Stored Separately & marked with Red Tape	Labeled with a "High-Alert" Sticker	Stored Alphabetically Based on Dosage Form	Stored by Appropriate Temperature	*f*
1	Concentrated electrolyte	KCl 7,46%	1	1	1	1	4
		MgSO4 50%	1	1	1	1	4
		Meylon 8,4%	1	1	1	1	4
		NaCl 3%	1	1	1	1	4
Total score (*f*)			**4**	**4**	**4**	**4**	**16**
Maximal score (n)			**4**	**4**	**4**	**4**	**16**
% Compliance Level (P)							**100%**

Table 2 explain about the compliance with high risk medication storage in the inpatient pharmacy unit of Pasar Rebo Regional General Hospital.

Table 2. Percentage of Compliance with High-Risk Medication Storage

No	Therapeutic Class	Name of Medicine	Stored Separately & marked with Red Tape	Labeled with a "High-Alert" Sticker	Stored Alphabetically Based on Dosage Form	Stored by Appropriate Temperature	*f*
1	Narcotics	Fentanyl inj	1	1	1	1	4
		Morphin inj	1	1	1	1	4
		Pethidine inj	1	1	1	1	4
2	Anesthetics	Marcain Inj	1	0	1	1	3
		Ketamin inj	1	1	1	1	4
		Propofol Lipuro inj	1	1	1	1	4
		Lidocain inj	1	1	1	1	4
3	Blood-influencing medicines	Arixtra inj	1	1	1	1	4
		Lovenox 0,4 mg inj	1	1	1	1	4
		Lovenox 0,6 mg inj	1	1	1	1	4
		Heparin inj	1	1	1	1	4
4	Parenteral antidiabetics	Novorapid inj	1	1	1	1	4
		Lantus inj	1	1	1	1	4
		Levemir inj	1	1	1	1	4
5	Neuromuscular inhibitor	Roculax inj	1	1	1	1	4
6	Adrenergic agonist	Dopamin inj	1	1	1	1	4
		Dobutamin inj	1	1	1	1	4
		Epinefrin inj	1	1	1	1	4
		Norepinefrin inj	1	1	1	1	4
		Ephedrin inj	0	0	0	1	1
7	Inotropic medication	Digoxin (Fargoxin) inj	1	1	1	1	4
Total score (*f*)			**20**	**19**	**20**	**21**	**80**
Maximal score (n)			**21**	**21**	**21**	**21**	**100**
% Compliance Level (P)							**80%**

Based on the observation results of LASA medication storage in the inpatient pharmacy unit of Pasar Rebo Regional General Hospital, the findings are presented in Table 3 and Table 4.

Table 3. Percentage of Compliance with Storage of LASA (Look-Alike) Medicines

No	Name of Medicine	Storage is spaced at least 2 shelves apart from other medicines	Labeled with "LASA" Sticker	Stored Alphabetically Based on Dosage Form	Stored by Appropriate Temperature	*f*
1	Acarbose 50 mg Acarbose 100 mg	1	1	1	1	4
2	Acyclovir 200 mg Acyclovir 400 mg	1	1	1	1	4
3	Amlodipine 5 mg Amlodipine 10 mg	1	1	1	1	4
4	Candesartan 8 mg Candesartan 16 mg	0	1	1	1	3
5	Captopril 12,5 mg Captopril 25 mg	1	1	1	1	4
6	Cefixime 100 mg Cefixime 200 mg	1	1	1	1	4
7	Cendo Catarlent Cendo Lyteers	0	0	1	1	2
8	Cendo Timol 0,25% Cendo Timol 0,5%	0	0	1	1	2
9	Cendo Tropine 0,5% Cendo Tropine 1%	0	0	1	1	2
10	Clindamycin 100 mg Clindamycin 300 mg	1	1	1	1	4
11	Flunarizine 5 mg Flunarizine 10 mg	1	1	1	1	4
12	Furosemide 40 mg ISDN 5 mg	1	1	1	1	4
13	Glimepiride 1 mg Glimepiride 3 mg Glimepiride 4 mg	1	1	0	1	3
14	Ibuprofen 200 mg Ibuprofen 400 mg	1	1	1	1	4
15	Methyl Prednisolone 4mg Methyl Prednisolone 8mg	1	1	1	1	4
16	Micardis 40 mg Micardis 80 mg	1	1	1	1	4
17	Sodium Diclofenac 25mg Sodium Diclofenac 50 mg	1	1	1	1	4
18	Nitrokaf 2,5 mg Nitrokaf 5 mg	1	1	1	1	4
19	Ondansetron 4 mg Ondansetron 8 mg	1	1	1	1	4
20	Rifampicin 450 mg Rifampicin 600 mg	1	1	1	1	4
21	Salbutamol 2 mg Salbutamol 4 mg	1	1	0	1	3
22	Spironolactone 25 mg Spironolactone 100 mg	1	1	1	1	4
23	Valsartan 80 mg Valsartan 160 mg	1	1	1	1	4
24	Kalnex 250 mg Kalnex 500 mg	1	1	1	1	4
25	Lisinopril 5 mg Lisinopril 10 mg	1	0	1	1	3
26	Gabapentin 100 mg Gabapentin 300 mg	1	1	0	1	3
27	Ondansetron 4 mg inj Ondansetron 8 mg inj	1	0	1	1	3

Table. 3 Continue

28	Lovenox 0,4 mg inj Lovenox 0,6 mg inj	1	1	1	1	4
29	Tranexamic acid 250 mg inj Tranexamic acid 500 mg inj	1	0	0	1	2
30	Citicoline 250 mg inj Citicoline 500 mg inj	1	0	1	1	3
	Total score (*f*)	**26**	**23**	**26**	**30**	**105**
	Maximal score (n)	**30**	**30**	**30**	**30**	**120**
	% Compliance level (P)					**87,5%**

Table 4. Percentage of Compliance with Storage of LASA (Sound-Alike) Medicines

No	Name of medicine	Storage is spaced at least 2 shelves apart from other medicines	Labeled with "LASA" Sticker	Tallman lettering usage	Stored Alphabetically Based on Dosage Form	Stored by Appropriate Temperature	*f*
1	amiTRIPTILIN amiNOFILIN	1	0	1	1	1	4
2	cefoTAXIME cefTAZIDIME	0	0	1	1	1	3
3	NORepinephrin epinephrine	1	0	1	1	1	4
4	metFORMIN metRONIDAZOLE	1	1	1	1	1	5
5	doBUTamine doPAmine	1	0	0	1	1	3
6	CIPROfloxacin LEVOfloxacin	1	1	1	1	1	5
7	OMEprazole PANTOprazole	1	1	1	1	1	5
8	novoRAPID novoMIX	1	0	0	1	1	3
	Total score (*f*)	**7**	**3**	**6**	**8**	**8**	**32**
	Maximal score (n)	**8**	**8**	**8**	**8**	**8**	**40**
	% Compliance Level (P)						**80%**

The total percentage of compliance with LASA medication storage can be seen in Table 5.

Table 5. Total Percentage of Compliance with LASA Medication Storage

LASA Category	Percentage	
	Compliant	Not-compliant
Look Alike	87,5%	12,5%
Sound Alike	80%	20%
Average	83,75%	16,25%

4. DISCUSSION

In accordance with Regulation of the Minister of Health (PERMENKES) No. 72 of 2016, High Alert Medications are defined as medicines that require special caution due to their frequent association with serious errors (sentinel events) and a high risk of causing Adverse Drug Reactions (ADR). These medications include concentrated electrolytes, high-risk drugs, and LASA (Look-Alike, Sound-Alike) medicines [2].

At the inpatient pharmacy unit of Pasar Rebo Regional General Hospital, high alert medications are stored alphabetically, based on their dosage forms and storage temperatures, employing the FIFO (First In, First Out) and FEFO (First Expired, First Out) methods. Dedicated storage racks for high alert medications are segregated from other drugs by red warning tape outlining the storage cabinets and marked with special "High Alert" stickers. This organizational system is designed to facilitate easy retrieval of medications.

Based on previous research highlights the importance of adhering to standardized medication storage practices. These include organizing medications by dosage forms, such as tablets, capsules, syrups, injections, liquids, ointments, and creams, as well as alphabetically. Such systematic storage methods not only enhance operational efficiency but also ensure medication safety [5]. The storage of high alert medications based on temperature is crucial to maintaining their stability. Medications requiring storage at 2–8°C must be kept in refrigerators or coolers. For instance, insulin preparations such as Novorapid, Lantus, and Levemir should never be frozen. Freezing insulin can cause its particles to crystallize or clump, rendering the medication ineffective and unusable [6].

According to Table 1, concentrated electrolyte solutions classified as high alert medications, including KCl 7.46%, MgSO4 40%, Meylon 8.4%, and NaCl 3%, achieved a 100% compliance rate in storage practices. Concentrated electrolytes are particularly prone to medication errors when inadvertently administered undiluted during patient care or emergencies. To mitigate this risk, it is critical to store concentrated electrolytes in accordance with the established Standard Operating Procedures (SOPs). These SOPs mandate the use of packaging labels marked with red stickers stating, "Warning! Must Be Diluted." Observations at the inpatient pharmacy unit of Pasar Rebo Regional General Hospital confirm that all concentrated electrolytes are stored in full compliance with the applicable SOPs, ensuring the safety and proper handling of these medications.

Table 2 presents storage compliance data for high-risk medications, based on SOPs at Pasar Rebo Regional General Hospital. The compliance rate was 80%, with discrepancies observed in the storage of Ephedrine Injection. This medication was not stored separately from other drugs, nor was it placed in a designated high alert cabinet marked with red adhesive tape and labeled "High Alert." Ephedrine Injection, an adrenergic agonist used to treat hypotension during anesthesia, requires careful storage to prevent human errors. Non-compliance occurred due to insufficient diligence among pharmacy staff and the absence of a visible list of high alert and LASA medications in the inpatient pharmacy unit.

Table 2 also includes narcotic high alert medications such as Pethidine Injection, Fentanyl Injection, and Morphine Injection. These medicines are stored in narcotics-specific cabinets, meeting the storage requirements outlined in the Ministry of Health Regulation No. 5 of 2023. The regulations stipulate that narcotics cabinets must be constructed of durable materials, immovable, secured with two different locks held by an authorized pharmacist and designated staff member, and placed in a secure, non-visible location [7]. Research by Dwi Haryadi (2022) emphasizes the importance of proper storage for narcotic medications to prevent patient harm and misuse. Observations at the Inpatient Pharmacy Depot of Pasar Rebo Regional General Hospital confirmed full compliance with these regulatory requirements for narcotic storage. This adherence ensures the safe management of these high-risk medications [8].

The research on the compliance of Look-Alike, Sound-Alike (LASA) medications in the Look-Alike category (Table 3) at Pasar Rebo Regional General Hospital's inpatient pharmacy unit showed an 87.5% compliance rate with the Standard Operating Procedures (SOPs). The main areas of non-compliance were related to labelling and organization. Specifically, only 23 out of 30 medications were labelled with the designated "LASA" sticker, and just 26 medications were stored with adequate spacing from other drugs and arranged alphabetically.

For LASA medications in the Sound-Alike category (Table 4), the compliance rate was 80%. The primary issues included insufficient labelling, as only 3 out of 8 medications were marked with "LASA" stickers, and partial adherence to the use of tallman lettering, with compliance in only 6 medications. Furthermore, 7 medications were stored with adequate spacing from other drugs, indicating some room for improvement.

Although the overall compliance with LASA medication storage protocols is relatively high, there are notable gaps, particularly in consistent labelling and spacing practices, especially for Sound-Alike drugs. Enhancing staff training, conducting routine audits, and reinforcing adherence to SOPs can help address these shortcomings and ensure a safer medication storage system.

The storage method for LASA medications at the inpatient pharmacy unit of Pasar Rebo Regional General Hospital is organized alphabetically based on the form of the medication and storage temperature, using the FIFO (First In First Out) and FEFO (First Expired First Out) systems. The FIFO system ensures that medications that arrive first are used first, while the FEFO system prioritizes the use of medications that are closer to their expiration dates. One common non-compliance observed with Look-Alike LASA medications is the storage of eye drop preparations. All eye drop formulations are placed on the same shelf in the pharmacy without separation, increasing the risk of medication errors [9].

According to research by Nurul Hasna (2021), storing LASA medications together on the same shelf increases the likelihood of medication errors. To minimize these errors, it is essential to implement a strategy for organizing LASA medications. One effective approach is to label or mark LASA medications clearly, signalling that these drugs are potentially confusing and require additional caution in storage and administration [10].

Another common non-compliance observed in the storage of LASA medications (as shown in Table 3) is the failure to place "LASA" identification stickers on each medication storage shelf. This issue arises due to a lack of attention to the management of LASA medication storage and the high volume of patients being served by the staff, which leads to suboptimal labeling of LASA medications. According to research by Lailia Kharisma (2021), the application of "LASA" identification stickers is essential to ensure that LASA medications are clearly identified on the shelves. This strategy of labeling LASA medications is crucial to prevent errors during the retrieval of these medicines [11].

A common issue observed with Sound Alike LASA medications is the lack of "LASA" identification stickers on some medication storage shelves and the incomplete application of the tallman lettering system. According to research by Muhlis (2019), tallman lettering is used in the writing of medication names to emphasize the main differences between LASA drugs that have similar names and pronunciations. Several studies have shown that the use of tallman lettering can help differentiate similar medication names more easily and reduce errors by using capital letters for distinguishing parts and lowercase for similar parts [12]. This issue occurs because pharmacy staff at the inpatient pharmacy unit have specific tasks and responsibilities in each care unit, leading to insufficient attention to the storage of LASA medications.

According to research by Rika (2021), the labelling of high-alert and LASA medications significantly influences the risk of human error. This indicates that the better the labelling of high-alert and LASA medications, the lower the risk of human error, and vice versa. Proper labelling can enhance the caution and awareness of staff when retrieving medications [13].

In the storage of high-alert and LASA medications, monitoring processes are necessary to assess the availability and quality of these medications [14]. According to PERMENKES No. 72 of 2016, monitoring ensures the effective and efficient stock of medications, avoiding both overstocking and shortages, as well as the prevention of damage and expiration. This is achieved through periodic and regular stock-opname activities. At the inpatient pharmacy unit of Pasar Rebo Regional General Hospital, stock-opname is performed every six months.

Based on observations, the inpatient pharmacy unit Pasar Rebo Regional General Hospital does not have a list of high-alert or LASA medications displayed in the room. This lack of a clear listing contributes to non-compliance in the storage of high-alert and LASA medications. According to research by Lailia Kharisma (2021), having a list of high-alert and LASA medications in the pharmacy room helps pharmacists, pharmaceutical technical staff, and nurses quickly identify which medications are categorized as high-alert or LASA. Displaying the list of high-alert and LASA medications in each service unit is part of the SOP at Pasar Rebo Regional General Hospital. Implementing medication storage in accordance with the SOP serves as a guideline for the proper handling of high-alert medications at Pasar Rebo Regional General Hospital. Storing high-alert and LASA medications improperly can lead to medication errors, endangering patient safety if not managed correctly.

This study is compared to previous research on the storage of high-alert medications at the Citra Husada Hospital Pharmacy Installation, which reported a compliance rate of 97.72% for high-alert medications and

75.20% for LASA medications [11]. The SOP for storing high-alert medications at both Citra Husada Hospital and Pasar Rebo Regional General Hospital are similar. In both hospitals, high-alert medications are stored separately from other medications, with warning boundaries marked by red solatif on the storage area and a "High Alert" sticker on the storage shelves. However, unlike Citra Husada Hospital, Pasar Rebo Regional General Hospital does not have a dedicated storage cabinet for LASA medications. At both hospitals, LASA medications are labelled with "LASA" stickers on the shelves and stored with at least a two-shelf gap between other medications.

5. CONCLUSION

The compliance of high-alert medication storage based on the Standard Operationg Procedure (SOP) showed 100% compliance for concetrated electrolyte, 80% for high-risk medications, and 83,75% for LASA medications. Facilities and infrastructure should be improved to prevent drug administration errors to patients. Therefore, it can be concluded that the storage of high-alert medications in the inpatient pharmacy unit of Pasar Rebo Regional General Hospital is in accordance with the applicable SOP, but not fully compliant.

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