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Original Research

Look-alike sound-alike (LASA) medication errors in Thai hospitals

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Abstract

Look-alike sound-alike (LASA) drugs cause a high proportion of medication errors in hospitals. Drug lists available in hospitals are diverse and complicated. Presently, each hospital has its own LASA drug list and unique management strategies to minimize and prevent LASA errors. **Objective:** This study aimed to explore the prevalence of LASA drug lists, types of LASA drugs, and categories of medication errors in hospitals in Thailand. **Methods:** For this cross-sectional study, questionnaires were developed and distributed along with a letter to 500 government hospitals (selected from a total of 1,309 hospitals) in Thailand via mail from April to June 2021. Data were analyzed using descriptive statistics (frequencies and percentages). **Results:** A total of 128 hospitals participated in this study (response rate: 25.60%), including 12 tertiary hospitals (9.38%), 33 secondary hospitals (25.78%), 24 large primary hospitals (18.75%), 51 small primary hospitals (39.84%), and eight private hospitals (6.25%). A total of 2,510 pairs of LASA drugs were identified, which included 1,674 (66.69%) tablets/capsules (Simvastatin 10-Simvastatin 20 pair had the highest frequency), 427 injections (17.01%) (Ceftriaxone-Ceftazidime pair had the highest frequency), 85 liquid dosage forms (3.39%) (Milk of magnesia-alum milk pair had the highest frequency), 74 special techniques in medicine (2.95%) (Seretide evohaler®-Seretide accuhaler® pair had the highest frequency), 49 external used drugs (1.95%) (Clotrimazole cream-Clobetasol cream pair had the highest frequency), and 28 powder dosage forms (1.12%) (ORS for pediatrics-ORS for adult pair had the highest frequency). **Conclusion:** Despite relevant awareness among healthcare professionals, LASA medication errors occur in hospitals. The most frequent similarities among LASA drugs were detected in their names/pronunciations, and the most common errors belonged to Category B.

Keywords: look-alike sound-alike (LASA); medication error; hospital; Thailand

INTRODUCTION

Medication safety is crucial for positive patient outcomes in healthcare facilities.[1-3] Confusion about drug names is one of the most common causes of medication errors worldwide.[3] The International Nonproprietary Names (INN) Expert Group of the World Health Organization develops internationally accepted nonproprietary names for pharmaceutical substances. However, brand names created by pharmaceutical manufacturers vary frequently between nations. Some medications sold under identical or similar brand names in different countries may contain different active ingredients.[3] In contrast, multiple companies may market the same drug under various brand names.[3,4]

Many pairs of ambiguous drug names, such as Losec® (omeprazole) and Lasix® (furosemide), appear problematic in many countries. Global regulatory authorities and pharmaceutical industries must further emphasize the safety issues associated with drug names.[3,5,6] However, look-alike sound-alike (LASA) drug have identical brand names and international nonproprietary names (INN) and identical packaging and labeling.[4,7] While developing medication safety standards, the Institute for Safe Medication Practices (ISMP) created a list of confused drug names based on reports received through the ISMP Medication Errors Reporting Program (MERP). In May 2009, the ISMP reported the outcomes of a survey in which respondents were asked about the existence and adherence to risk-reduction strategies to prevent errors involving LASA drugs. This indicated that approximately 80% of the survey respondents were aware of the lists of LASA drugs maintained by their institutions. However, only half of the respondents believed that their institutions had fully implemented risk-reduction measures to prevent these errors.[8] In February 2019, the ISMP published a list of confused drug names, which cataloged medications that required special safeguards to reduce the risk of medication errors and minimize adverse effects.[9] The Joint Commission (TJC) on Accreditation of Healthcare Organizations shows a specific approach for

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LASA drugs and error prevention. They developed the National Patient Safety Goals for medication safety, which included a periodic review of LASA drug pairs and proactive measures to prevent medication errors involving pairs of LASA drugs. Essential resources (e.g., the ISMP list of confused drugs, the TJC list of problematic LASA drug names, and Lexi-Comp™) are useful for reviewing LASA drugs. The WHO recommendations aimed at minimizing name-associated confusion include a periodic analysis of new product names, physical separation of medicines with LASA names in all storage areas, the inclusion of the brand name and nonproprietary name on medication orders to prevent redundancy, and the use of "tall man" lettering to emphasize differences in drug names.[10]

However, diverse and complex LASA drug pairs are available in hospitals. Very few systematic quantitative estimates of LASA incidents are reported.[10] LASA errors are often identified through spontaneous reporting, retrospective chart reviews, and computerized documents on medication orders. Previous studies demonstrated LASA drug-related errors in specific therapeutic areas, patient populations, or healthcare settings.[10,11]

The Ministry of Public Health (MoPH) (Thailand) has assigned LASA drug problems as medication safety issues that require preventive measures. Problem solving and research development are restricted to hospital level.[12] Currently, each hospital in Thailand has adopted its methods of preventing and reducing LASA drug-related errors. Limited research on medication safety policies and the magnitude of LASA errors is available in Thai hospitals.[13,14] This study aimed to analyze the prevalence of LASA drug lists, types of similarities among LASA medications, and medication error categories in Thai hospitals.

METHODS

Study population

This study, conducted in public hospitals operated by the MoPH and in private hospitals registered with the MoPH in Thailand, was a cross-sectional one based on a self-administered questionnaire. The sample size was calculated using Yamane's formula: $n = N/(1+[N][e^2])$, where n = sample size, N = population (total number of hospitals in Thailand = 1,309), e = 1-precision, and precision = 95% confidence interval.[15] The calculated sample size was 306. Considering the possible nonresponse rate, an additional allowance of 60% in sample recruitment ($60 \times 306/100 = 183.6$) was included,[16] and hence, the required sample size was increased to 500 subjects.

Representative samples were selected using proportional stratified random sampling from 500 hospitals. A letter of permission was provided to the hospital director. Pharmacists working on LASA-related tasks in each hospital were asked to complete the questionnaire. Those who agreed to participate were asked to return the completed questionnaire, along with their written informed consent. The pharmacists received a regular self-administered questionnaire and a QR code to access an online questionnaire. They could select their preferred mode of response to the questionnaire and were requested to return the completed questionnaires within four weeks. This research was approved by the Research Ethics Committee of Ubon Ratchathani University (No. UBU – REC – 28/2564).

Study design

Questionnaires, developed for this cross-sectional survey, were distributed along with a letter by mail to 500 hospitals between April and June 2021. Descriptive statistics (e.g., frequency, percentage, mean, and standard deviation) were analyzed using the data. The responses to the open-ended questions were coded for quantitative data analysis.

Survey instrument

The questionnaire was divided into three following sections:

1. Demographic data of the respondents and their affiliations.

2. Prevalence of LASA errors in hospitals, type of LASA database available, strategies used to organize medications on shelves.

3. The top 20 LASA drug listed according to the dosage form (e.g., tablets/capsules, injectable drugs, liquid preparations, special techniques in medicine, external use preparations, and powder dosage forms), type of similarities (i.e., similar name, similar tablets/capsules, and similar packaging), and medication error categories (categories A–I).

The National Coordinating Council for Medication Error Reporting and Prevention has classified medication errors[17] as follows: Category A includes situations or occurrences that have the potential to lead to errors. Category B includes medication errors that occurred but did not reach the patient, and Categories C and D comprise medication errors that reached the patient but did not cause harm to the patient. The severity of adverse effects in patients was reflected in categories E, F, G, and H. Category E lists errors that are potentially linked to temporary harm to the patient, which requires intervention. Medication errors categorized as F may have contributed to or caused temporary harm to the patient, which required initial or prolonged hospitalization. Errors categorized as G may have contributed to or caused permanent harm to patients. Category H and I include errors that necessitate life-sustaining interventions and show fatal outcomes, respectively.[18,19] All medication error reports submitted by healthcare professionals (e.g., pharmacists, nurses, and physicians) via voluntary error reporting programs were validated by the respective hospitals.

To ensure the content validity of the questionnaire, five experts with credentials in medication safety and LASA drugs reviewed it.[20] The index of item-objective congruence (IOC) ≥ 0.5 was considered acceptable.[21,22] The experts were asked to rate the clarity and relevance of the items (0 = I am not sure; 1 = yes; -1 = no).[23] They indicated that the types of LASA drugs were reduced from nine to three, and the definitions of clinically significant categories were discussed and clarified. The IOC score of the final version ranged between 0.6 and 1.0. A pilot study was conducted via email with a convenience sample of pharmacists connected to three hospitals to determine the resources required to complete the survey questionnaires and identify difficult or ambiguous questions.

RESULTS

After one month, 128 completed questionnaires were received (response rate of 25.60%) from respondents associated with various hospitals. The majority (58.59%) of the respondents were from primary hospitals. The demographics and characteristics of the study participants are presented in Table 1. The mean age of the respondents was 37.8 years (SD = 43.48), and most were female (85.16%). Majority of the participants (64.06%) hold a Master's degree in Pharmacy. The percentage of respondents from public and private hospitals was 93.75% and 6.25%, respectively.

These analyses detected 2,510 pairs of LASA, among which tablets and capsules were the most frequent (1,674 pairs, 66.69%), followed by injection preparations (427 pairs, 17.01%), liquid preparations (85 pairs, 3.39%), special technique medications (74 pairs, 2.95%), external preparations (49 pairs, 1.95%), and powders (28 pairs, 1.12%). The similarity among LASA medications was categorized into three types, 1. similar name/pronunciation, 2. similar tablets/capsules, and 3. similar packaging and labeling. Among these categories, similarities in name/pronunciation were the most frequent (1,603 pairs, 63.14%) (Table 2). Medication error categories are listed in Table 3. Harmful medication errors (Categories F and I) were also reported (Table 4). Aspirin 300 mg and potassium chloride 500 mg were reported to be available in the form of similar tablets/capsules and were associated with category I medication error (Figure 1).

The highest frequency of LASA in each preparation was as follows:

1. Among the 1,674 pairs of tablets/capsules, simvastatin

Table 1. Characteristics of the respondents (N = 128)

Characteristics	Number of respondents	%	Characteristics	Number of respondents	%
1. Gender			***6.*** **Regional location**		
- Male	19	14.84	- North	33	25.78
- Female	109	85.16	- Central	31	24.22
2. Age (years) (range 25–55, mean±SD = *37.8±43.48)*			- South	15	11.72
- 25–30	28	21.88	- East	8	6.25
- 31–35	25	19.53	- Northeast	38	29.69
- 36–40	19	14.84	- West	3	2.34
- 41–45	40	31.25	***7.*** **Area of practice[a]**		
- 45–50	13	10.16	- Academic in-service/ preceptor	45	26.32
- >50	3	2.34	- Hospital accreditation/ human resource	34	19.88
3. Working experience (years) in LASA-related tasks (range 0–30, mean±SD = 13 ± 7.91)			- Pharmaceutical care	64	37.43
- 1–5	29	22.66	- Others	28	16.37
- 6–10	26	20.31	***8.*** **LASA medication errors found in individual hospitals**		
- 11–15	17	13.28	- Yes	128	100.00
- 16–20	29	22.66	- No	0	0.00
- > 21	27	21.09	***9. Type*** **of LASA drug database in hospital[a]**		
4. Highest degree			- Document	74	57.81
- Bachelor in Pharmacy	38	29.69	- Intranet website	6	4.69
- Master in Pharmacy	82	64.06	- Hospital program	14	10.94
- Ph.D.	8	6.25	- Not available	34	26.56
5. Affiliation of the hospital			***10.*** **Methods of organizing medications on shelves[a]**		
- Public hospital			- Pharmacological category or therapeutic class	82	34.60
• Tertiary hospitals	12	9.38	- Alphabetical order using generic names	36	15.19
• Secondary hospitals	33	25.78	- Alphabetical order using generic and brand names	59	24.89
• Primary hospitals	75	58.59	- Label address or location of the medication noted on the label of the container (e.g., A1, A2)	20	8.44
- Private hospitals	8	6.25	- Mixed as per convenience	40	16.88

[a] Respondents were provided the option to select more than one answer

Table 2. Types of LASA similarity (n = 2,510 pairs)[a]

	Types of LASA errors							
Preparations	**Frequency (pairs)**	**%**	**Similar names/ pronunciation**	**%**	**Similar tablets/ capsules**	**%**	**Similar packaging**	**%**
Tablets/Capsules	1,674	66.69	1,104	68.87	266	100.00	368	54.93
Injections	427	17.01	271	16.91	0	0.00	195	29.10
Liquid dosage forms	85	3.39	43	2.68	0	0.00	46	6.87
Special technique medications	74	2.95	48	2.99	0	0.00	31	4.63
External use preparations	49	1.95	35	2.18	0	0.00	14	2.09
Powders/Sachets	28	1.12	18	1.13	0	0.00	12	1.79
N/A	173	6.89	84	5.24	0	0.00	4	0.60
Total	**2,510**	**100**	**1603**	100.00	**266**	**10.48**	**670**	100.00

[a]One pair of LASA drugs may have more than one type of similarity; N/A= Not available

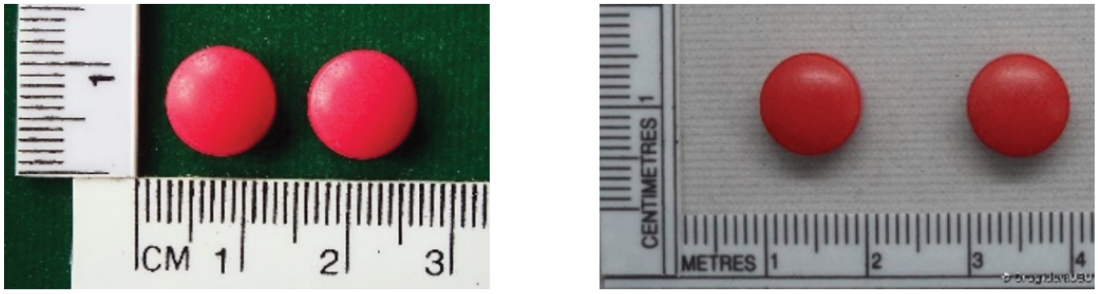
Table 3. Type of medication error category (n = 1,592)

Preparations	**Error category (pairs)[a]**								
	A	B	C	D	E	F	G	H	I
Tablets/Capsules	87	848	97	17	8	2	0	0	1
Injections	31	216	52	2	1	0	0	0	0
Liquid dosage forms	4	56	6	0	0	0	0	0	0
Special technique medications	4	28	3	0	0	0	0	0	0
External use preparations	4	25	1	0	0	0	0	0	0
Powders/Sachets	1	19	3	0	0	0	0	0	0
N/A	1	66	9	0	0	0	0	0	0
Total	132	1,258	171	19	9	2	0	0	1
%	8.29	79.02	10.74	1.19	0.57	0.13	0.00	0.00	0.06

[a]The error category of some LASA drug pairs may not be reported, and one LASA pair may have more than one type of error category; N/A= Not available

Table 4. Harmful medication error (category E, F, I) of LASA pairs

Drug name	**Drug name**	**No. (drug pairs)**	**% from n=2510**	**Preparations**	**Types of LASA pairs***	**Error Category**
Aspirin (ASPENT(R))	Potassium chloride (ENPOTT®)	1	0·04	Tablets/Capsules	Similar tablets/capsules	I
Loratadine	Losartan	1	0·04	Tablets/Capsules	Similar name/pronunciation	F
Paracetamol	Pioglitazone	1	0·04	Tablets/Capsules	Similar packaging	F
Sodium bicarbonate	Sodium Valproate	1	0.04	Tablets/Capsules	Similar name/pronunciation	E
Clozapine	Chlorpromazine	1	0·04	Tablets/Capsules	Similar name/pronunciation	E
Colchicine	Codeine	1	0·04	Tablets/Capsules	Similar name/pronunciation	E
Cyclosporin	Cyclophospharmide	1	0·04	Tablets/Capsules	Similar name/pronunciation	E
Calcitriol	Calciferol	1	0·04	Tablets/Capsules	Similar name/pronunciation	E
Ferrous fumerate	Glipizide	1	0·04	Tablets/Capsules	Similar packaging	E
Glipizide	Colchicine	1	0·04	Tablets/Capsules	Similar packaging	E
Mixtard®	Novomix®	1	0·04	Injections	Similar name/pronunciation, Similar packaging	E
Andrographis Paniculata Capsules	Cissus quadrangularis Capsules	1	0·04	Tablets/Capsules	Similar tablets/capsules, Similar packaging	E



Aspirin (ASPENT®) 300 mg (https://drugiden.ubu.ac.th/?di=7144)

Potassium chloride (ENPOTT®) 500 mg (https://drugiden.ubu.ac.th/?di=7078)

Figure 1. Similar tablets containing Aspirin 300 mg and potassium chloride 500 mg have been reported to cause category I medication error

10 mg and simvastatin 20 mg pairs were the most frequent LASA drug pair (Table 5).

2. Among the 427 injection pairs, ceftriaxone and ceftazidime were the most frequent LASA drug pair (Table 5).

3. Among the 85 pairs of liquid dosage forms, magnesium hydroxide and alum milk were the most frequently used LASA drug pairs (Table 6).

4. Among the 74 pairs of special technique medications, the Seretide evohaler® and Seretide accuhaler® represented the most frequent LASA drug pair (Table 6).

5. Among the 49 pairs of externally used preparations, clotrimazole and clobetasol cream were the most frequent LASA drug pair (Table 6).

6. Among the 28 pairs of powders/sachets, ORS for pediatric patients and ORS for adults represented the most frequent LASA drug pair (Table 6).

DISCUSSION

LASA drugs have been associated with a large percentage of medication errors that pose a persistent threat to patient safety and can occur at any stage of drug use in inpatient, outpatient, or self-care settings. According to the Targeted Medication Safety Best Practices, 2022–2023, the ISMP recommends that medical facilities find and use information on medication safety risks and errors that occurr in other organizations and take measures to prevent similar errors.[24] The identification of past incidents in other organizations, learning from those, and implementing preventative actions are crucial for reducing LASA-related risks and medication errors. The Thai Ministry of Public Health included LASA medications in its national patient safety policy created during 2007–2008.[4,25] However, a lack of research and problem-solving efforts to address this issue has been reported in hospitals. Furthermore, in Thailand, the support mechanisms and systems crucial for implementing systematic solutions are deficient. Therefore, policymakers should adopt systematic solutions to ensure medication safety by approaching this problem from multiple perspectives and raising awareness of its significance.

This study focused on the prevalence of the LASA drug lists, types of LASA drugs, and categories of medication errors in hospitals in Thailand. Despite the recruitment of multiple hospitals, the response rate was low (25.60%), which is possibly attributable to insufficient infrastructure for reporting medication errors in hospitals. Hence, a mandatory centralized reporting system, similar to MEDMARX® and USP-ISMP,[26] is required at the national level to improve the reporting of medication errors. Hospitals play a critical role in preventing LASA medication errors. Hospital Accreditation Organizations should recruit healthcare organizations to develop and maintain programs for risk management. For instance, publishing an annual report on LASA drug names can increase awareness and promote safer medication practices.[2,18]

The study found 2,510 LASA drug pairs, the majority of which were tablets/capsule preparations (1,674 pairs or 66.69%). This can be attributed to the prevalence of these types of drugs in the market, accounting for 14,169 registrations or 62.74% of all available drug preparations.[27]

Confusion related to LASA drugs was categorized as follows: 1) similar names or pronunciations, 2) similar tablets or capsules, and 3) similar packaging or labeling. The first category represented the most frequent type of LASA errors, which is consistent with previous research.[13,28] The most common errors associated with similar names involve identical generic names with different strengths, which can create confusion among healthcare professionals or patients and therefore, lead to medication errors. Similarly, several studies have indicated that pharmacies frequently commit dispensing errors, such as providing incorrect medication and strength.[29,30] These medications are marketed for their various strengths. The incorrect strength of medication can induce serious adverse effects in patients, such as the consequences of frequent category B medication errors involving drugs like “Simvastatin 10 mg” and “Simvastatin 20 mg”. Healthcare professionals and patients must confirm the strength of their medications to prevent such errors. Computerized order entry systems can help reduce the risk of errors involving LASA drugs with similar names. Standardized preprinted order forms can also ensure a clear indication of the prescribed medication, dosage, and instructions. Moreover, independent double checks are crucial throughout the pharmacy workflow, which includes verification with the patient or their agent during prescription drop-off or pick-up.[31,32]

Most of the similar tablets or capsules and packaging or labeling are manufactured by the same company using similar color shades and designs, which is supported by previous studies.[33,34] Category I errors involved confusion between medications marketed in similar forms of tablets or capsules such as aspirin and potassium chloride. Another hospital in Thailand reported this same confusion. To proactively address all potential LASA medication errors, consideration of similar names, evaluation of potential look-alike appearances, and packaging problems are needed.[34] The appearance and packaging of the injections can also contribute to LASA drug-related errors, which may act rapidly and cause various adverse effects.[35] Erroneous use of these drugs, especially high-alert LASA injections, can result in significant damage, such as confusing pairs of medications, including Dopamine-Dobutamine, Vitamin K 1 mg-Vitamin K 10 mg, Norepinephrine-Nicardipine, and Furosemide-Diazepam, which have been reported in this study, and others that were reported previously.[13,36]

Healthcare organizations can reduce the risk of LASA drug-associated errors and improve patient safety by reorganizing shelf storage bins, improving labeling for intravenous medications or other dosage forms available in similar packaging, adopting revised strategies for selection and maintenance of the list of LASA medications to include real-time reviews of new medications added to the formulary, changing contract for altered packaging or drug storage system, and promoting multidisciplinary collaboration within the system.[14,28,37,38] The LASA appearance of drugs also confuses patients. Proper management of LASA medications is essential to improve patient safety.[39]

The results of this study, which relied on a voluntary error-reporting system, may be considered incomplete allowing to the possibility of unreported errors. Some individuals, afraid of repercussions or simply unaware of the error that occurred, may not have reported errors properly. Therefore, the accurate frequency and scope of medication errors were possibly underestimated, which is a common limitation in voluntary error-reporting systems and has been acknowledged in healthcare facilities.[40-42]

This is one of the most recent post-marketing studies that highlights the medication errors related to LASA drugs. Here, we identified types of similarities in LASA medications, including similar names, available forms (tablets or pills), and packaging that could contribute to medication errors.[39] To address this issue, stakeholders must recognize the problems and work to solve them. For example, the Food and Drug Administration plays a significant role in preventing drug confusion, reviewing trademarks before marketing, and rejecting proposals involving drug names deemed very similar to existing ones.[43] Regulatory authorities should collaborate with the pharmaceutical industry to improve medication appearance, labling, and packaging to prevent these errors. Additionally, guidelines indicating the proper review of products and prevention of medication errors in all drug system processes, including prescribing, dispensing, manufacturing, and storage[42], should be created for the industry. Consensus and collaboration among organizations, such as regulators, pharmaceutical industries, and other stakeholders are needed to create guidelines for pharmaceutical product nomenclature, appearance, and packaging. Furthermore, public education and awareness of LASA medication errors are essential for risk management. Safety practices can be redesigned to help healthcare institutions and practitioners minimize medication errors associated with LASA drugs.[43] Healthcare professionals, particularly pharmacists, should implement strict policies to prevent LASA medication errors. Further exploration of other factors that contribute to LASA medication errors is necessary. This LASA drug survey integrated into suitable programs can aid in identifying and preventing medication errors occurring in hospitals.

CONCLUSIONS

This study revealed that LASA medication errors occurred in hospital settings despite the awareness of this issue among healthcare professionals. The similarity in names/pronunciations represented the most frequent similarity among the LASA drugs. We identified medication errors belonging to category B as the most commonly detected. Furthermore, medication errors with adverse effects have been reported.

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CONFLICTS OF INTEREST

None

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References

1. Kovacic L, Chambers C. Look-alike, sound-alike drugs in oncology. J Oncol Pharm Pract. 2011;17(2):104-118. https://doi.org/10.1177/1078155209354135
2. Joint Commission on Accreditation of Healthcare Organizations (JCAHO). JCAHO update for infection control: 2005 patient safety goals warn of sound-alike drugs. https://www.reliasmedia.com/articles/3258-jcaho-update-for-infection-control-2005-patient-safety-goals-warn-of-sound-alike-drugs. 2005. Accessed October 11, 2022.
3. The World Health Organization. WHO launches 'Nine patient safety solutions'. https://www.who.int/news/item/02-05-2007-who-launches-nine-patient-safety-solutions.Accessed August 12, 2022.

4. Napaporn J, Buakaew P, Suksakornthanawat P, et al. Analogous comparison of registered brand name drugs of tablets and capsules commercially available in Thailand: A retrospective study. PLoS One. 2022;17(10). https://doi.org/10.1371/journal.pone.0276321
5. Lizano-Díez I, Figueiredo-Escribá C, Piñero-López M, et al. Prevention strategies to identify LASA errors: building and sustaining a culture of patient safety. BMC Health Serv Res. 2020;20(1):63. https://doi.org/10.1186/s12913-020-4922-3
6. Bryan R, Aronson JK, ten Hacken P, et al. Patient safety in medication nomenclature: orthographic and semantic properties of International Nonproprietary Names. PLoS One. 2015;10(12):e0145431. https://doi.org/10.1371/journal.pone.0145431
7. Beyea SC. Confusing, look-alike, and sound-alike medications. Aorn J. 2007;86(5):861-863. https://doi.org/10.1016/j.aorn.2007.10.008
8. Institute for Safe Medication Practices (ISMP). (2009). Survey on LASA drug name pairs: who knows what's on your list and the best ways to prevent mix-ups? Accessed 15 May, 2023.
9. Institute for Safe Medication Practices (ISMP). (2019). ISMP list of confused drug names. https://www.ismp.org/recommendations/confused-drug-names-list. Accessed October 11, 2022.
10. Seoane-Vazquez E, Rodriguez-Monguio R, Alqahtani S, et al. Exploring the potential for using drug indications to prevent look-alike and sound-alike drug errors. Expert Opin Drug Saf. 2017;16(10):1103-1109. https://doi.org/10.1080/14740338.2017.1358361
11. Galanter WL, Bryson ML, Falck S, et al. Indication alerts intercept drug name confusion errors during computerized entry of medication orders. PLoS One. 2014;9(7):e101977. https://doi.org/10.1371/journal.pone.0101977
12. Wongboonnak P. Look-alike sound-alike drugs situation in Thailand. HCU J. 2018;22:205-216.
13. Chumchit C, Amrumpai Y, Treesak C. Recognition on medication safety and look-alike/sound-alike medication problems in Thai public hospitals. Silpakorn U Science & Tech J. 2015;9(2):40-51.
14. Chanakit T, Napaporn J, Chiempattanakajohn T, et al. The survey of look alike/sound alike (LASA) drugs available in hospitals in Thailand. Afr J Pharm Pharmacol. 2013;7(6):227-239. https://doi.org/10.5897/ajpp11.812
15. Nottidge TE, Nottidge BA, Ekrikpo UE. Prevalence and predictors of low back pain in a Southern Nigerian hospital. Ann Afr Med. 2019;18(3):167-172. https://doi.org/10.4103/aam.aam_59_18
16. Bujang MA. A step-by-step process on sample size determination for medical research. Malays J Med Sci. 2021;28(2):15-27. https://doi.org/10.21315/mjms2021.28.2.2
17. National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP). (2022). Types of medication errors. https://www.nccmerp.org/types-medication-errors. Accessed 11 October, 2022.
18. Tariq RA, Vashisht R, Sinha A, et al. Medication Dispensing Errors And Prevention. StatPearls. Treasure Island (FL): StatPearls Publishing; 2021. https://pubmed.ncbi.nlm.nih.gov/30085607/
19. Dos Santos L, Winkler N, Dos Santos MA, et al. Description of medication errors detected at a drug information centre in Southern Brazil. Pharm Pract (Granada). 2015;13(1):524. https://doi.org/10.18549/pharmpract.2015.01.524
20. Azraii AB, Ramli AS, Ismail Z, et al. Validity and reliability of an adapted questionnaire measuring knowledge, awareness and practice regarding familial hypercholesterolaemia among primary care physicians in Malaysia. BMC Cardiovascular Disorders. 2021;21(1):39. https://doi.org/10.1186/s12872-020-01845-y
21. Jarernsiripornkul N, Nakboon S, Anarj K, et al. Survey of healthcare professionals' practices, expectations, and attitudes towards provision of patient information leaflets in Thailand. Int J Clin Pharm. 2020;42(2):539-548. https://doi.org/10.1007/s11096-020-00965-x
22. Aziz MM, Ji W, Masood I, et al. Patient Satisfaction with Community Pharmacies Services: A Cross-Sectional Survey from Punjab; Pakistan. Int J Environ Res Public Health. 2018;15(12):2914. https://pubmed.ncbi.nlm.nih.gov/30572667/
23. Pérez-Rojo G, Noriega C, Velasco C, et al. Development and assessment of the content validity of the professional good practices scale in nursing homes. Int Psychogeriatr. 2019;31(10):1517-1521. https://doi.org/10.1017/s1041610218002077
24. Institute for Safe Medication Practices (ISMP). (2023). Worksheet for the 2022-2023: ISMP Targeted Medication Safety Best Practices for Hospitals. https://www.ismp.org/system/files/resources/2022-02/2022-2023_ISMP_TMSBP_Worksheet_0.pdf Accessed 13 April, 2023.
25. The Association of Hospital Pharmacist (Thailand). (2020). Framework of hospital drug system. https://www.thaihp.org/?fbclid=IwAR1itl_pQ0hVUnrJEyNBzfI_OBKIvUbos2QeTzhVQBtG1KDFGnaZxFtJN0U Accessed 6 Aug, 2022.
26. Santell JP, Hicks RW, McMeekin J, et al. Medication errors: experience of the United States Pharmacopeia (USP) MEDMARX reporting system. J Clin Pharmacol. 2003;43(7):760-767. https://doi.org/10.1177/0091270003043007011
27. Medicines regulation division Food and Drug Administration. (2017). Statistics. https://www.fda.moph.go.th/sites/drug/SitePages/Statistic.aspx Accessed May 4, 2023.
28. Cohen MR, Smetzer JL. ISMP Medication Error Report Analysis. Hosp Pharm. 2018;53(4):217-219. https://doi.org/10.1177/0018578717747449
29. James KL, Barlow D, McArtney R, et al. Incidence, type and causes of dispensing errors: a review of the literature. Int J Pharm Pract. 2009;17(1):9-30. https://doi.org/10.1177/0018578717747449
30. Han JH, Heo KN, Han J, et al. Analysis of medication errors reported by community pharmacists in the Republic of Korea: a cross-sectional study. Medicina (Kaunas). 2023;59(1):151. https://doi.org/10.3390/medicina59010151

31. Kawano A, Li Q, Ho C. Preventable medication errors–look-alike/sound-alike drug names. Pharmacy Connection. 2014;21(2):28-33.
32. Gangakhedkar G, Waghalkar P, Shetty A, et al. Look-alike drugs: avoiding potential medical errors. Int J Prev Med. 2019;10(1):9. https://doi.org/10.4103/ijpvm.ijpvm_331_18
33. Dave NM. "Look alike" packaging: Do we need a wake-up call? J Anaesthesiol Clin Pharmacol. 2018;34(1):133-134. https://doi.org/10.4103/0970-9185.173353
34. McCoy LK. Look-alike, sound-alike drugs review: include look-alike packaging as an additional safety check. Jt Comm J Qual Patient Saf. 2005;31(1):47-53. https://doi.org/10.1016/s1553-7250(05)31007-5
35. Dsouza S, Kulkarni A. The hazards of look alike packaging in anaesthesia practice. Asian J Anesthesiol. 2017;55(4):91-92. https://doi.org/10.1016/j.aja.2017.10.003
36. WHO Collaborating Centre for Patient Safety. Look-alike, sound-alike medication names. Patient Safety Solutions. 2007;1(1):1-4.
37. Cohen MR, Smetzer JL. No Unlabeled Containers Anywhere, Ever! Where Did this Come From? Hosp Pharm. 2015;50(3):185-188. https://doi.org/10.1310/hpj5003-185
38. Cohen MR. Maalox brand name extension causes confusion near sight/sound dead hit! Omacor–Amicar look-alike Tylenol packets. Hosp Pharm. 2006;41(1):13-16. https://doi.org/10.1310/hpj4101-13
39. Tranchard F, Gauthier J, Hein C, et al. Drug identification by the patient: Perception of patients, physicians and pharmacists. Therapie. 2019;74(6):591-598. https://doi.org/10.1016/j.therap.2019.03.003
40. Jeong H, Lee W. A strategy to overcome under-reporting issues of voluntary medication error reporting system, part II: changes in number of reports by a counter-error measure—computerized prescriber order entry. Biom Biostat Int J. 2017;5(5):199-203. https://doi.org/10.15406/bbij.2017.05.00146
41. Zacher JM, Cunningham FE, Zhao X, et al. Detection of potential look-alike/sound-alike medication errors using Veterans Affairs administrative databases. Am J Health Syst Pharm. 2018;75(19):1460-1466. https://doi.org/10.2146/ajhp170703
42. Ságiné EP, Romvári Z, Dormán K, et al. Your clinical pharmacist can save your life, the impact of pharmacist's intervention. Pharm Pract (Granada). 2022;20(4):2729. https://doi.org/10.18549/pharmpract.2022.4.2729
43. Rahman Z, Parvin R. Medication errors associated with look-alike/sound-alike drugs: a brief review. J Enam Med Coll. 2015;5(2):110-117. https://doi.org/10.3329/jemc.v5i2.23385