Journal of Health Economic and Policy Research
JHEPR Vol. 3 No. 1 Year 2025
ISSN 3025-5198

Risk Assessment Analysis of Medication Error Incidents from Public Health Center in Tangerang City, Indonesia: A Cross-Sectional Study

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Article Information:

Submitted : *December 1st 2024*
Revised : *February 12th 2025*
Accepted : *February 15th 2025*

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DOI: https://doi.org/10.30595/jhepr.v3i1.222

Abstract

Background: Unsafe health care has been recognized as a global challenge, which ensures that safe medication practices lead to solving these challenges. The implementation of these practices is becoming an essential factor to be applied in primary health care in Indonesia. This study aimed to analyze and explore the root cause of medication error incidents reported internally at one of the public health centers in Tangerang City, Indonesia.

Methods: This descriptive study was conducted utilizing 41 internal reports of medication error incidents in 2023 extracted from the patient safety committee system. The data collected includes the medical personnel involved, the stage of error, and a brief description of the incident. The reports are analyzed based on Failure Mode and Effect Analysis (FMEA) to demonstrate all possible failures, and the Risk Priority Number (RPN) is calculated to set a priority scale. Furthermore, Bow Tie Analysis (BTA) is conducted to explore preventive and corrective actions of the leading root cause of the highest-priority ones.

Results: This study showed that most medication errors occurred at the prescribing stage (39.1%). This outcome emphasized the top priority root cause with the highest RPN value (810). Across all stages, it is known that contraindicated-drug-disease interaction was the most frequently reported error category (24.4%). The data on medication error obtained display that errors are dominated by the no harm level (36.6%), while the cases of severe level were 5 out of 41 incidents (12.2%).

Conclusion: The main reasons for medication errors in the prescribing stage were prescription writing errors and patient identification failures. Good patient safety practices are needed to prevent and reduce occurrences, especially the organization that plays an active role in improving safety culture and awareness.

Keywords: *Medication Error, Patient Safety, Risk Assessment, Tangerang City.*

Introduction

The United States National Coordinating Council for Medication Error Reporting and Prevention defines a Medication Errors (ME) as any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer[1]. Approximately 0.1 million people die each year due to medical errors in hospitals, and the death rate is higher than accidents in the workplace. World Health Organization (WHO) defines unsafe medication practices and medication errors as the leading cause of avoidable injury and harm in healthcare systems worldwide. Medication errors occur when weak medication systems and/or human factors such as fatigue, poor environmental conditions, or understaffing affect prescribing, transcription, dispensing, administering, and monitoring practices, which can then result in serious harm, disability, and even death[2,3].

Unsafe health care has been recognized as a global challenge as the WHO has identified Medication Without Harm, which proposes solutions to address many of the obstacles the world faces today to ensure the safety of medication practices. Accessible and safe primary care is essential to achieving Universal Health Coverage (UHC) and supporting the United Nations Sustainable Development Goals (SDGs). The existence of quality primary care supports the success of UHC. Primary care services are increasingly at the heart of integrated people-centered health care in many countries, including Indonesia. The provision of safe primary care, including health centers, is a priority. Good primary care may lead to fewer hospitalizations, but unsafe primary care can have catastrophic implications[2,4].

Based on data from the Indonesia Ministry of Health, Medication Error (ME) in drug administration in Indonesia ranked first (24.8%) of the top 10 reported incidents. The types of errors that caused death in patients included 40.9% wrong dose, 16% wrong drug, and 9.5% wrong route of administration[5]. Several incidents of ME at the primary care level that have recently occurred and have become a national concern in Indonesia are the

ISSN 3025-5198

administration of expired drugs. In 2019, the Kamal Muara Health Center in Jakarta was found to have given expired vitamins to a pregnant patient, causing the patient to experience symptoms of drug poisoning[6]. Followed by a similar incident in 2022, the administration of expired paracetamol syrup to a toddler occurred at the Karang Tengah Health Center in Tangerang. Both incidents related to the negligence of officers in implementing patient safety, causing adverse events in patients[7].

Medication error reporting is a powerful tool for developing and maintaining awareness of ME risk in healthcare practice if properly utilized. Error reporting helps to unfold the healthcare system's underlying risks and causes of near-miss or error events. Developing a well-structured internal reporting is essential. Applying this concept in analyzing reported ME incidents draws attention to the system rather than blaming individuals and overlooking crucial system pitfalls. Primary health care in Indonesia consists mainly of independent private practices and regional public health care that are not linked or well-coordinated. Based on literature studies, finding information about patient safety is difficult, especially medication error incidents at the primary healthcare level. Even though the Ministry of Health has created a safety reporting application, the reporting rate is still very low[8]. This is most likely due to ME incidents managed internally by the pharmacy department and not reported to the committee[9]. The aim of this study was to analyze and categorize ME incidents reported internally in one of the public health centers in Tangerang City, Indonesia. In addition, the root causes of ME incidents will be identified using the combination of Failure Mode and Effect Analysis (FMEA) and Bow Tie Analysis (BTA) methods, as well as exploring preventive and corrective actions to reduce the risk of occurrence.

Methods

Study design and setting

This article used a cross-sectional study based on ME incidents report at Panunggangan Barat Public Health Center, one of the health centers with emergency and maternity facilities. This primary care facility was chosen because it had previously functioned as an inpatient health care and was used as Integrated Isolation House or Rumah Isolasi Terintegrasi (RIT) during the Covid pandemic in Tangerang city[10].

Inclusion and exclusion criteria

ME was included in the type of incidents reported internally to the patient safety committee. The data were taken from the pharmacy department's reporting records covering prescribing, transcribing, dispensing, administration, and monitoring practices errors. Patient safety incident reports other than medication error incidents are excluded from this study.

Data collection procedure

Data collection was conducted from January to December 2023, and the data was extracted from the patient safety system. The patient samples taken were divided into health services based on the life cycle, including age ranges under 18, 18-59, and over 60. Each ME report is accompanied by a brief description of the incident, the health worker involved, and the category of error that occurred.

The data obtained is then classified using an approach to the stages in the sequence of drug use processes: prescribing, transcription, distribution, administration, monitoring, and others. Furthermore, observations were made on case reports to calculate the severity scale based on severity guidelines for the design of FMEA.

Table 1. Severity Scale Classification

Effect	Rank	Criteria
No	1	No effect
Very Slight	2	Patient not complained
Slight	3	Patient slight complained
Minor	4	Patient experiences minor nuisance
Moderate	5	Patient experiences some dissatisfaction
Significant	6	Patient experiences discomfort
Major	7	Patient dissatisfied
Extreme	8	Patient very dissatisfied
Serious	9	Potential hazardous effect
Hazardous	10	Hazardous effect

Statistical analysis

The collected data was analyzed using Bow Tie Analysis (BTA) based on Bow Tie XP version 9.0.10.0 representation of IEC/ISO 31010[11]. In contrast, the root cause analysis was carried out using the FMEA method. FMEA reviews as many components, assemblies, and subsystems as possible to identify potential failure modes in a system[12].

The Bow Tie Analysis (BTA) started by identifying the top event in the center, which represents the critical moment when control over a hazard is lost. Then, on the left side, potential threats or causes that could lead to the top event are examined, and on the right side, possible consequences that could occur if the top event happens. Barriers or controls to prevent or mitigate

the risk are listed on both sides of the top event, illustrating how to manage the hazard at each stage. Key elements of a bow tie diagram as follows:

- Top Event (Center)
  The focal point of the diagram represents the moment when control over a hazard is lost, but before any major consequences occur.
- Threats (Left Side)
  Potential causes or events that could trigger the top event are listed as "initiating factors."
- Consequences (Right Side)
  Potential negative outcomes or impacts that could arise from the top event.
- Barriers (Both Side)
  Controls or safeguards put in place to prevent the threats from occurring or to mitigate the consequences of the top event.

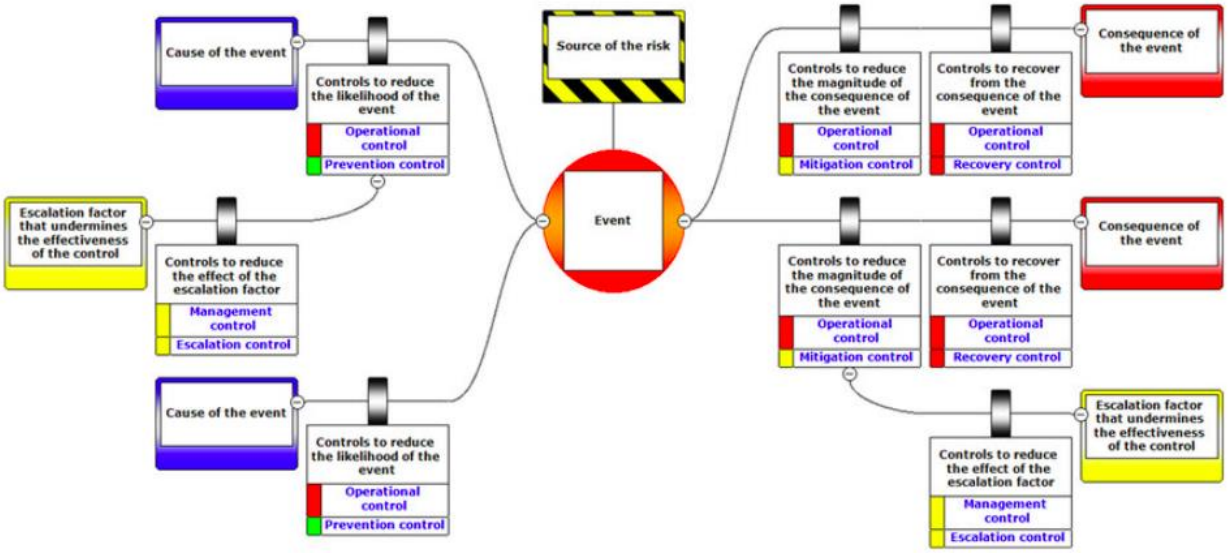

Figure 1. Bow-tie analysis adapted from Cormier et al., 2018

Result

Overview

During this study period, only 41 cases were included from a total of 52 patient safety incidents, while 11 were excluded because they did not belong to the medication error incidents category. Furthermore, summary statistics illustrated that most errors occurred at the prescribing stage (39.1%, n=16), followed by the monitoring stage (17.1%, n=7). Across all stages of error, it is known that contraindicated-drug-disease interactions was the most frequently reported error category (24.4%, n=10).

Based on a brief description of the report, the incidents were classified by adapting the Primary Care Harm Severity Classification System[13]. The data showed how medication errors were dominated by the no harm level (36.6%, n=15), while the cases of severe level were 5 out of 41 incidents (12.2%). One of the serious incidents reported was a case of a contraindicated-drug-disease interaction, where the incident report indicated a pediatric patient was prescribed loperamide, which is contraindicated for children under 12 years of age[14,15]. On the same day, the patient returned and received treatment at the emergency unit of the public health center because he showed symptoms of anaphylactic shock. Then, the child was immediately referred to the nearest hospital for intensive care.

Failure Mode and Effect Analysis (FMEA)

The American Society for Quality defines FMEA as a step-by-step approach for identifying all possible failures in a design, a manufacturing or assembly process, a product, or a service. Failures are prioritized according to how severe their consequences are, how frequently they occur, and how easily they can be detected. The purpose of the FMEA Is to take actions to eliminate or reduce failures, starting with the highest-priority ones[16,17].

The analysis of an FMEA should include multiple-level considerations, including: Severity of 9/10 or Safety and Regulatory alone (Failure Mode Actions); Criticality combinations for Severity and Occurrence (Cause Actions); Detection Controls (Test and Control Plan Actions); and Risk Priority Number (RPN) Pareto.

Table 2. Summary statistics of categorical variables n= 41 incident reports

	Category	Number	%
Patient Age Range	<18 years	13	31.70
	18-59 years	20	48.79
	> 60 years	8	19.51
Level of Harm	No harm	15	36.59
	Low harm	8	19.51
	Moderate harm	13	31.70
	Severe harm	5	12.20
	Death	NA	NA
Stage of Error	Prescribing	16	39.03
	Transcribing	6	14.63
	Dispensing	3	7.32
	Administering	3	7.32
	Monitoring	7	17.07
	Other	6	14.63
Error Category	Contraindicated-drug-disease interactions	10	24.39
	Dose extra/duplication	2	4.87
	Mismatching between patient and medicine	4	9.76
	Patient allergic to the treatment	2	4.87
	Wrong drug/medicine	3	7.32
	Wrong frequency	5	12.20
	Wrong method of preparation/supply	3	7.32
	Wrong quantity	1	2.44
	Wrong route	1	2.44
	Wrong/unclear dose or strength	7	17.07
	Wrong/transposed/omitted medicine label	3	7.32

The analysis of an FMEA should include multiple-level considerations, including: Severity of 9/10 or Safety and Regulatory alone (Failure Mode Actions); Criticality combinations for Severity and Occurrence (Cause Actions); Detection Controls (Test and Control Plan Actions); and Risk Priority Number (RPN) Pareto.

Table 3. FMEA Result from Stage of Medication Errors

Stage of Error	Severity (S)	Occurrence (O)	Detection (D)	Risk Score (S x O)	RPN (S x O x D)	Priority
Prescribing	9	10	9	90	810	1
Transcribing	4	4	6	16	96	3
Dispensing	4	2	7	8	56	6
Administering	8	2	5	16	80	5
Monitoring	6	5	4	30	120	2
Other	7	4	3	28	84	4

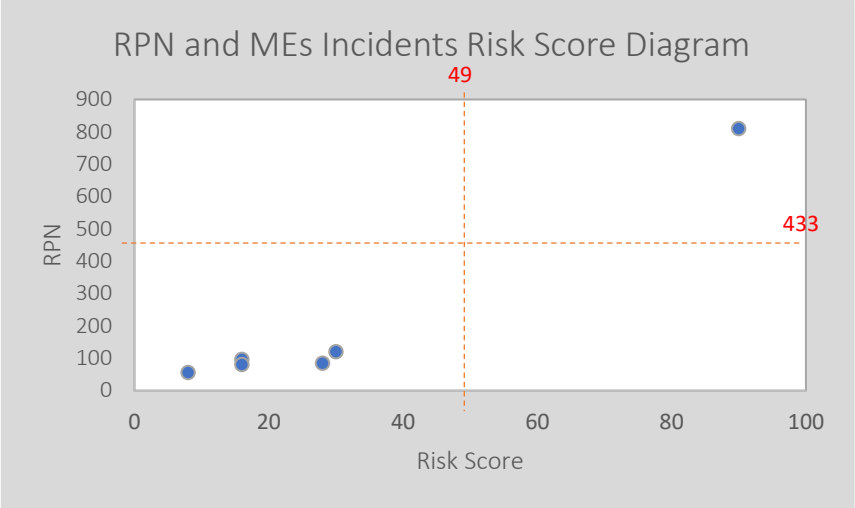

Figure 2. RPN and ME Incidents Risk Score Diagram

Root cause analysis is performed at the error stage from ME incident reports; then, all data is calculated using the FMEA method approach (Table 2). In addition, the results are compared between RPN and Risk Score and illustrated with a scatter diagram (Figure 2)[18]. The outcome emphasized the number one priority root cause, with the highest RPN value, at the prescribing stage (RPN = 810). In contrast, other variables displayed a significant gap with prescribing stage results and shared almost similar RPN values, no more than 120.

According to information from the incident follow-up report, it is known that factors that contribute to medication errors include: lack of awareness of patient safety; high patient visit rates and short service times increase the risk of errors; the absence of an effective communication system between departments; and filling in the completeness of patient medication history data is often missed; and the operational system for reporting incidents has not been implemented properly, so many errors are not recorded and reported.

Bow Tie Analysis (BTA)

BTA is a technique that refers to a bow-tie diagram that depicts or visualizes risk exposure and is used to identify, analyze, and manage high-risk scenarios. In the bow-tie diagram visualization, the left side depicts proactive risk management, while the right side depicts protective risk management. The BTA technique aims to provide a helicopter view of the logic of multiple risk event scenarios and to help provide risk events and their causes and consequences[19,20].

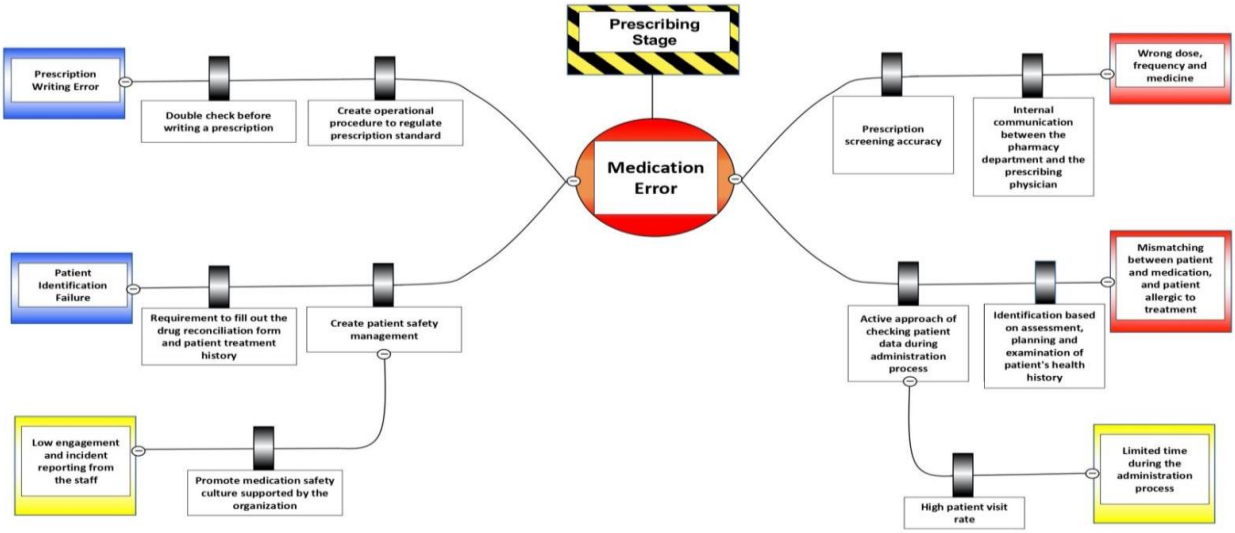

Figure 3. Bow-Tie Analysis of Prescribing Stage Medication Error

The left side of the BTA illustrates the causes of medication errors at the prescribing stage: prescription writing errors and patient identification failures. Proactive risk management of prescription errors by rechecking prescriptions through standard operating procedures, while patient identification

ISSN 3025-5198

failure, can be reduced by the obligation to complete the patient's medical history, supported by patient safety management. The challenge in implementing patient safety management is the low involvement and reporting of incidents from staff, so it would be great if the organization could promote this safety culture to raise awareness.

Meanwhile, the right of the BTA shows the mitigation action from the output of the event that occurred. The outcome of a medication error at this stage can be the wrong dose, frequency, and medication; protective actions can be done by screening the prescription thoroughly and then conducting internal communication with the doctor on duty to confirm the possibility of a prescription error. Moreover, the result of mismatching between patient and medication and patient allergic to treatment might be used as an active approach to checking patient data during the administration process, which is identified based on assessment, planning, and examination of the patient's health history. However, this protective action is hampered when patient visits are high, leading to a limited duration of service.

Discussion

Medication errors are common occurrences in every healthcare institution and organization. This is the result of system failure, not individual failure. Proper utilization and analysis of medication error reports provide valuable insights into system-based downfalls regardless of the care setting[21,22]. However, several systems exist in North America and Europe to collect information on medication error events; such a practical system is still needed in Indonesia. It is known that research on medication error at the primary care level, especially in public health centers in Indonesia, is still rare[23,24].

From this study, it is known that out of the seven stages of ME incidents, the most common occurred at the prescribing stage. This finding might be explained because no good management system prevents such incidents as double-checking drug writing and patient identification checklists. This is in accordance with the discussion in the chapter on the causes of medication errors mentioned in the WHO Technical Guidelines on Medication Errors. In addition, the lack of awareness of health workers in prioritizing patient safety is shown based on the number of medication error reports in one year, which is very low. This is most likely due to the strong belief that work errors manifest a lack of professionalism and concerns about social pressure in the work environment, so many incidents are not reported.

Several studies examined other social-cultural determinants of reporting. This included resistance to change and sociocultural variations across primary care organizations. Community pharmacists reported that reporting prescribing errors may create tension with general practitioners and potentially affect their business. Interestingly, general practitioners also highlighted that the commercial nature of general practice may have an influence over reporting error rates if it damages their reputation in a competitive environment. However, differences in error reporting across primary care can arise due to varying management styles and reporting systems, which was addressed in one study by individualizing interventions[25–27].

Furthermore, public health centers as primary health care providers currently have a very high number of visits considering the implementation of the national health insurance system in Indonesia, where patients must get referrals to hospitals from public health centers[25]. The increase in patient visits creates demands for service times to be as short and efficient as possible, which ultimately increases the risk of errors. Half of the other studies suggested that clinical workload and the associated time constraints had a negative impact on the frequency of prescribing errors and reporting of errors. In general, under-reporting of medication errors is reported to be common in many primary care settings due to the volume of patients seen in primary care. This setting is where most prescriptions are generated within the health system. The Pharmacist-Led Information Technology Intervention for Medication Errors project, in particular, highlighted that pharmacists working with general practice who had only a short time frame for delivering intervention struggle to develop meaningful clinical relationships and integrate into practice team[25,27].

This study showed that common error categories are contraindicated-drug-disease interactions and wrong/unclear dose or strength. However, the service process at the Tangerang Public Health Center has been facilitated with an electronic prescription system. The latter result was found to be statistically significant. The main root cause of ME is the prescribing process. The absence of an effective communication system between departments, the completeness of patient medication history data is often missed, and the operational system for reporting incidents has not been implemented properly, which were contributing factors that led to harmful incidents in this study. Although serious

errors are relatively rare, the absolute number is significant, with the potential for considerable adverse health consequences. The root causes that have been demonstrated can also potentially be found in other primary care settings. Furthermore, the results of the analysis presented in this study can be a trigger for building or shifting patient safety management report advancement across the community healthcare organization. However, reducing medication errors and improving medication safety requires a system approach. The challenge is compounded by variations in health care system organization and the use of incident reporting systems. Meanwhile, learning from errors and improving the safety of the healthcare system is only possible when patient safety incidents are effectively reported and promptly analyzed and disseminated throughout the organization. Therefore, further research is needed to assess a good and ideal reporting system that can effectively increase reporting rates in primary care settings.

Conclusions

This study confirms that the main reasons for Medication Error (ME) at the prescribing stage are prescription writing errors and patient identification failure. In order to prevent and reduce occurrences, good patient safety practices are needed, especially in organizations that play an active role in improving safety culture and awareness. Therefore, healthcare providers can implement the ME reporting program as a tool to identify system-based problems in the patient safety management system. Overall, it appears that the proportion of serious MEs in primary care may be quite low. However, given the large number of cases that are likely to be unreported in this study, there is still the potential to cause significant harm in absolute terms. In addition, the scope of this study is limited by only focusing on the prevalence and nature of ME without emphasizing the reporting culture in primary care. Future research is needed to find how the ME reporting process can be optimized to support learning and improve patient safety.

Acknowledgment

The authors received no financial support for this article's research, authorship, and publication.

Author Contribution

Study design	:	PSH, WA
Data acquisition	:	PSH
Data analysis	:	PSH
Manuscript writing	:	PSH, WA

Abbreviation

BTA	:	Bow Tie Analysis
FMEA	:	Failure Mode and Effect Analysis
ME	:	Medication Errors
RPN	:	Risk Priority Number
SDGs	:	Sustainable Development Goals
WHO	:	World Health Organization

References

1. Payne, Rupert., Slight, Sarah., Franklin, B. Dean. & Avery, A. J. . Medication Errors. (World Health Organization, 2016).
2. Medication Without Harm WHO Global Patient Safety Challenge. http://apps.who.int/bookorders. (2017).
3. Amalia, A. E. & Basabih, M. OVERVIEW OF MEDICATION ERROR INCIDENCE IN HOSPITALS IN VARIOUS COUNTRIES: LITERATURE REVIEW. Indonesian Journal of Health Administration vol. 11 145–153 Preprint at https://doi.org/10.20473/jaki.v11i1.2023.145-153 (2023).
4. Rodziewicz, T. L. H. B. V. S. H. J. E. Medical Error Reduction and Prevention. StatPearls (2024).
5. Kementerian Kesehatan. Pentingnya Terapkan Prinsip 7 Benar Pemberian Obat. https://kms.kemkes.go.id/pengetahuan/detail/66977b1a13258959e48fa676 (2024).
6. Pemerintah Kota Tangerang. Terkait Pemberian Obat Kadaluarsa, Ini Penjelasan Dinas Kesehatan. https://www.tangerangkota.go.id/berita/detail/31243/terkait-pemberian-obat-kadaluarsa-ini-penjelasan-dinas-kesehatan (2022).
7. Redaksi Sehat Negeriku. Soal Pemberian Obat Kadaluarsa, Dirjen Engko Tak Ingin Kasus Terulang Lagi. https://sehatnegeriku.kemkes.go.id/baca/umum/20190830/1631572/ (2019).
8. Kementerian Kesehatan Republik Indonesia. PETUNJUK TEKNIS PENGGUNAAN APLIKASI LAPORAN INSIDEN KESELAMATAN PASIEN DI PUSKESMAS. (2021).
9. RS Siloam Akui Dua Pasien Meninggal Diduga Salah Injeksi Obat. https://www.cnnindonesia.com/nasional/20150217141204-20-32774/rs-siloam-akui-dua-pasien-meninggal-diduga-salah-injeksi-obat.
10. Pemerintah Kota Tangerang. Sederet antisipasi Pemkot Tangerang menghadapi Covid-19 Varian omicron Website Resmi Pemerintah Kota Tangerang. https://tangerangkota.go.id/berita/detail/29517/sederet-antisipasi-pemkot-tangerang-menghadapi-covid-19-varian-omicron (2022).
11. Cormier, R., Elliott, M. & Rice, J. Putting on a bow-tie to sort out who does what and why in the complex arena of marine policy and

management. Science of The Total Environment 648, 293–305 (2019).
12. What is FMEA? Failure Mode & Effects Analysis | ASQ. https://asq.org/quality-resources/fmea.
13. Cooper, S. A. et al. Management and prevalence of long-term conditions in primary health care for adults with intellectual disabilities compared with the general population: A population-based cohort study. Journal of Applied Research in Intellectual Disabilities 31, 68–81 (2018).
14. Information for Prescribers/Consumers Search. https://www.medsafe.govt.nz/medicines/infosearch.asp.
15. Li, S. T. T., Grossman, D. C. & Cummings, P. Loperamide therapy for acute diarrhea in children: Systematic review and meta-analysis. PLoS Med 4, 495–505 (2007).
16. Guide to Failure Mode and Effect Analysis - FMEA | Juran Institute, An Attain Partners Company. https://www.juran.com/blog/guide-to-failure-mode-and-effect-analysis-fmea/.
17. Anandavel, S. V. MASTER OF SCIENCE IN AUTOMOTIVE ENGINEERING Analysis of manufacturing processes according to FMEA techniques and Implementation of IoT systems to prevent process failures DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING (DIMEAS).
18. Nugroho, M. J., Bahartyan, E., Raymond, R., Hidayat, B. & Irawan, M. I. Root Cause Analysis of Fires in Coal Power Plants Using RFMEA Methods. IOP Conf Ser Mater Sci Eng 1096, 012100 (2021).
19. Alijoyo, A., Wijaya, Q. B. & Jacob, I. Layers of Protection Analysis Analisis Lapisan Proteksi. www.lspmks.-.
20. McLeod, R. W. & Bowie, P. Bowtie Analysis as a prospective risk assessment technique in primary healthcare. Policy and Practice in Health and Safety 16, 177–193 (2018).
21. Svitlica, B. B. & Konstantinidis, G. Factors contributing to non-reporting of medication errors. Global Pediatrics 8, 100144 (2024).
22. Tabatabaee, S. S., Ghavami, V., Javan-Noughabi, J. & Kakemam, E. Occurrence and types of medication error and its associated factors in a reference teaching hospital in northeastern Iran: a retrospective study of medical records. BMC Health Serv Res 22, (2022).
23. Angkow, L. G., Citraningtyas, G. & Wiyono, W. I. FAKTOR PENYEBAB MEDICATION ERROR DI INSTALASI GAWAT DARURAT (IGD) RUMAH SAKIT BHAYANGKARA TK.III MANADO. PHARMACON 8, 426–433 (2019).
24. Handayani, F. Gambaran Insiden Keselamatan Pasien Berdasarkan Karakteristik Perawat, Organisasi, dan Sifat Dasar Pekerjaan di Unit Rawat Inap Rumah Sakit Al-Islam Bandung pada Periode 2012-2016. (2017).
25. Yusuf, E. (Eva) & Awwaliyah, I. (Irma). The Implementation of Indonesian National Health Insurance Programme: How Satisfiedwerethe Insured Participants and the Healthcare Providers? Journal of Consumer Sciences 3, 27–42 (2018).
26. Hall, N. et al. Exploration of prescribing error reporting across primary care: A qualitative study. BMJ Open 12, (2022).
27. Bullen, K., Hall, N., Sherwood, J., Wake, N. & Donovan, G. Prescribing error reporting in primary care: a narrative synthesis systematic. Integrated Healthcare Journal 22, (2020).