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Review Article

A Comparative Scoping Review of Medication Error Reporting in Malaysia and International Healthcare Systems Using the Swiss Cheese Model

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Abstract

Background: Medication errors (MEs) are a persistent global threat to patient safety and underreporting remains widespread. The Swiss Cheese Model (SCM) offers a framework to analyse system-level barriers and defences. **Objectives:** This scoping review aimed to compare Malaysian and international medication error reporting (MER) practices, map them to the SCM's six defence layers and identify strategies to strengthen Malaysia's reporting culture. **Methods:** Articles included were comprehensively checked for reliability in line with JBI (critical appraisal checklist) and PRISMA-ScR guidelines, hence a systematic search of Scopus, PubMed, Web of Science, ScienceDirect and Google Scholar from (2015–2025) yielded 489 records; 33 studies met inclusion criteria. **Results:** International studies demonstrated stronger SCM alignment through interdisciplinary reporting, anonymous electronic platforms (e.g., MEDMARX, CIRS), "structured feedback and non-punitive cultures". By contrast, Malaysian systems showed pharmacist-driven reporting, limited training, punitive cultures and weak feedback mechanisms. **Conclusion:** Strengthening Malaysia's MER requires anonymous platforms, just culture policies, structured training and feedback integration, embedding SCM principles to advance safer and more accountable healthcare systems.

Keywords: *Global Healthcare; Malaysia; Medication Error Reporting; Nurses; Swiss Cheese Model*

Introduction

Medication errors remain a major global patient safety concern, with underreporting limiting improvements in care (Elden & Ismail, 2015). The Swiss Cheese Model (Reason, 2000) conceptualizes errors as system failures arising when multiple defense layers align. World Health Organization (2017) estimates over 3 million annual deaths worldwide due to medication errors, with nearly half considered preventable (Kumar *et al*., 2022). Underreporting, often exceeding 50%, persists due to "fear of blame, punitive responses and weak feedback" (Alrasheadi, 2019; Alqubaisi *et al*., 2016). In Malaysia, MOH hospitals issued 68.6 million prescriptions over four years, yielding 17,357 error reports an incidence of 0.025% (Ministry of Health of Malaysia, 2011; 2014).However, actual rates are likely higher, as private sector reporting remains minimal (Samsiah *et al*., 2016) and underreporting is particularly evident in critical and neonatal care (Chew *et al*., 2022). Studies also show 403 geriatric prescriptions with MEs, averaging 20 cases daily (Abdullah *et al*., 2004).

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Medication errors remain a major global patient safety concern, with underreporting frequently reported across healthcare settings. In Malaysia, medication error reporting is facilitated through the Medication Error Reporting System; however, previous Malaysian studies suggest that reporting remains low and is affected by fear of blame, unclear procedures and lack of feedback (George *et al*., 2018; Samsiah *et al*., 2016). International evidence also shows that fear of punishment, workload and weak feedback systems are common barriers to reporting (Afaya *et al*., 2021; Alotaibi, 2024).

Globally, the SCM is widely applied in safety science and healthcare to guide reporting and root cause analysis (Collins *et al*., 2014; Diller *et al*., 2014; Durstenfeld *et al*., 2019; Li & Harris, 2006; Neuhaus *et al*., 2018; Patterson & Shappell, 2010; Reinach & Viale, 2006; Spiess *et al*., 2015; Thonon *et al*., 2020). Tools such as the Human Factors Analysis and Classification System extend its utility in identifying latent system flaws (Diller *et al*., 2014; Li & Harris, 2006; Patterson & Shappell, 2010; Reinach & Viale, 2006; Wiegmann & Shappell, 2017; Spiess *et al*., 2015). Structured, system-based frameworks, including the Swiss Cheese–inspired SWISS model, have been proposed for Malaysia to mitigate underreporting through technology adoption (CDSS, e-prescribing), patient involvement, feedback loops and training (Sabila *et al*., 2018; Chew *et al*., 2022). However, uptake remains fragmented. By recognizing how multiple defences fail simultaneously, the SCM shifts focus from individual blame to systemic reform (Wiegmann *et al*., 2022) supporting the call for a standardized national ME reporting system with common nomenclature (Elden & Ismail, 2015). This review aims to investigate the Swiss Cheese Model (SCM) which has demonstrated efficacy in both clinical and academic context of medication error in the healthcare settings.

The Swiss Cheese Model was selected because medication error reporting is not only an individual behavior but also a system-dependent process. The model helps explain how weaknesses in organizational culture, supervision, training, feedback and reporting systems create gaps that allow errors and underreporting to occur. Its strength lies in shifting attention away from blaming individual nurses towards identifying system-level failures (Reason, 2000; Wiegmann *et al*., 2022).

Ultimately, the SCM strengthens safety culture and provides a framework to compare how healthcare systems address medication error reporting among nurses in Malaysia and globally.

Objectives

- To compare medication error reporting practices between Malaysia and international healthcare systems, identifying similarities, differences and contextual variations.
- To apply the Swiss Cheese Model to examine system-level weaknesses, barriers and facilitators influencing medication error reporting among nurses across settings.
- To propose evidence-based policy and practice reforms aimed at strengthening patient safety, improving reporting infrastructure and enhancing nurse participation in Malaysia's medication error reporting system.

Methodology

Literature Search and Study Design

This scoping review followed the Joanna Briggs Institute framework (JBI, 2021) and was reported using PRISMA-ScR guidelines. A comprehensive search of Scopus, PubMed, Web of Science, ScienceDirect and Google Scholar identified studies published between January 2015 and April 2025. Only peer-reviewed English-language articles were included. Search strategies used Boolean operators like AND/ OR were utilized to link keywords and Medical Subject Headings (MeSH) in the search strategy the MeSH terms. Studies applying the Swiss Cheese Model or similar systems-based approaches to medication error reporting among nurses or healthcare personnel were included, while non-nursing populations, non-English articles and studies unrelated to system-level reporting were excluded.

Study Selection

Criteria for Inclusion and Exclusion

This review included studies on medication error reporting among nurses and healthcare professionals in hospital and community settings, focusing on adult nursing staff in public or private facilities. Eligible studies applied the Swiss Cheese Model or similar system-level safety frameworks and addressed barriers, interventions, or factors influencing reporting behavior. Hence, accepted study designs included qualitative, cross-sectional, mixed-methods, observational and review studies published between 2015 and 2025.

Countries were not selected in advance. Instead, countries were included based on the availability of published studies that met the inclusion criteria. Therefore, the term “international” in this review refers to evidence from countries represented in the included studies rather than all countries globally. This approach is consistent with scoping review methodology, which aims to map available evidence rather than provide complete global representation. However, countries with limited published research may be underrepresented, especially in regions where “Medication Error Reporting” research is less developed or less frequently published (Mutair *et al*., 2021) (Table 1).

Table 1: The Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
-Studies from 2015-2025 were included.	-Studies which do not include healthcare professionals
-Especially those using the Swiss Cheese Model of the elements of this (SCM) to understand and improve medication error reporting.	-Studies that lack focus on system-level factors or not applying SCM-related frameworks.
-Involving nurses and other healthcare workers.	- Studies focusing solely on ADRs, pharmacovigilance, or medication use without examining reporting systems.
-Articles that involve medication error reporting in hospital settings.	- Non–peer-reviewed publications theses, dissertations, abstracts, editorials, commentaries, conference papers, or grey literature
-Articles published in English.	- Studies which is not in English and published outside 2015–2025.
-Articles that are peer-reviewed and full text available.	Excluded Substance Types: Studies that examined the use of illicit drugs, herbal medicines, or unregulated pharmaceuticals
	Study Design: Randomized controlled trials (RCTs), as they are less appropriate for real-world reporting practice investigation
	Language: Studies not published in English

Data Extraction

After completing the database search, duplicates were manually removed by the principal reviewer. Titles and abstracts were then screened against inclusion and exclusion criteria using Rayyan (http://rayyan.qcri.org/; Qatar Foundation, Qatar), which supported semi-automated sorting and conflict resolution.

Studies unrelated to reporting systems, nursing, or the Swiss Cheese Model were excluded, with reasons documented. Full-text screening was conducted independently by two reviewers, with disagreements resolved through discussion. The search strategies combined Boolean operators such as "AND" and "OR., keywords and MeSH terms, while included studies were organized using Mendeley for citation tracking. The overall selection process, including records retrieved, excluded and finalized, is illustrated in the PRISMA flow diagram (Table 2).

Table 2: Database Search Strings and Records Retrieved

Database	Boolean Search String (AND/OR)	Articles Retrieved (n)
PubMed	("Medication Errors"[MeSH] OR "medication error*" OR "prescription error*") AND ("Nurses"[MeSH] OR nurse* OR "nursing staff") AND ("Incident Reporting"[MeSH] OR "error reporting" OR "reporting system*") AND ("Swiss Cheese Model" OR "Safety	9

	Management"[MeSH] OR "organizational culture")	
Scopus	(TITLE-ABS-KEY("medication error*" OR "drug error*" OR "prescription error*")) AND (TITLE-ABS-KEY(nurse* OR "nursing staff")) AND (TITLE-ABS-KEY("incident reporting" OR "error reporting" OR "reporting system*")) AND (TITLE-ABS-KEY("Swiss Cheese Model" OR "systems approach" OR "patient safety culture"))	13
Web of Science	TS=("medication error*" OR "drug error*" OR "prescription error*") AND TS=(nurse* OR "nursing staff") AND TS=("incident reporting" OR "error reporting" OR "reporting mechanism*") AND TS=("Swiss Cheese Model" OR "systems thinking" OR "organizational culture")	4
ScienceDirect	("medication error" OR "prescription error" OR "drug error") AND (nurse OR nurses OR "nursing staff") AND ("incident reporting" OR "error reporting" OR "reporting mechanism") AND ("Swiss Cheese Model" OR "systems approach" OR "patient safety culture")	5
Google Scholar	"Medication error reporting" AND nurses AND "Swiss Cheese Model" OR "nurse" AND "incident reporting system" AND "patient safety" OR "medication error" AND "root cause analysis" AND "safety culture"	458

The databases approach, combined with controlled vocabulary and structured Boolean logic, enhanced the comprehensiveness of the search and reduced the likelihood of missing relevant studies. Thus, by applying variety of search layers MeSH terms, keywords, truncation and field-specific queries captured both indexed and non-indexed articles across discipline-spanning sources (nursing, safety science, pharmacology and organizational studies). This method was consistent with best practices for scoping reviews in safety and healthcare research.

Risk of Bias Assessment

The methodological quality of the included studies was evaluated using the JBI Critical Appraisal Tools tailored to the study designs in question, in accordance with the Joanna Briggs Institute's (JBI) scoping review process. For assessing validity, bias and methodological rigor in qualitative, cross-sectional and mixed-methods research, these instruments are well known.

The following JBI tools were used appropriately since cross-sectional surveys, qualitative research and mixed methods designs made up most of the studies included in this review:

-Clearly stating the goals of the study

-Suitability of the sample and environment

-Valid and trustworthy techniques for gathering data

-Moral considerations

-Transparency in data analysis

-Qualitative interpretations that are reflexive (for relevant studies)

-Two reviewers separately evaluated each study based on standards like:

Disagreements were resolved through discussion and consensus. In line with JBI guidelines, studies were not excluded for methodological quality; instead, appraisal findings contextualized the strength of evidence. Furthermore, grey literature such as abstracts, theses and non-peer-reviewed papers was excluded to ensure rigor and only English-language studies published between 2015 and 2025 were considered. Even though a meta-analysis or quantitative synthesis was not the goal of this scoping

review, the quality appraisal assisted in identifying common methodological strengths and limitations throughout the included literature. Notably, a few cross-sectional studies lacked strong support for sample size and a few qualitative studies omitted important details on participant-researcher relationships and researcher reflexivity.

Data Synthesis

Data synthesis was conducted using a narrative, descriptive and thematic approach, consistent with the Joanna Briggs Institute (JBI) methodology for scoping reviews. Because scoping reviews aim to map the breadth and characteristics of available evidence rather than generate pooled effect estimates, no meta-analysis was performed.

First, extracted data from all 33 included studies were organized into a structured evidence matrix capturing authorship, year, country, design, population, reporting practices and alignment with the Swiss Cheese Model (SCM) defense layers. Studies were then coded inductively and deductively. The deductive phase used the six SCM defensive layers error detection, reporting mechanisms, feedback systems, organizational culture, training/competency and system learning as an a priori analytical framework to map system-level strengths and failures across the Malaysian and international literature.

Subsequently, an inductive thematic synthesis was performed to identify recurrent concepts such as fear of blame, lack of anonymity, weak feedback loops, limited training and pharmacist-dominated reporting, which were repeatedly highlighted across Malaysian studies. International studies were similarly synthesized to reveal contrasting themes such as non-punitive environments, the presence of anonymized electronic reporting platforms (e.g., MEDMARX, CIRS), interdisciplinary participation and structured feedback cycles.

Throughout synthesis, patterns were compared within and between countries, enabling the identification of systemic gaps and global best practices. Findings from the appraisal process (e.g., reliance on cross-sectional surveys, self-report bias) were considered during interpretation but did not influence study inclusion. The final synthesis is presented narratively and supported by tables, thematic summaries and SCM-based mapping to illustrate variations in reporting culture, system design and learning mechanisms across healthcare systems.

Grey literature was considered to maintain transparency. As shown in Figure 1, five electronic databases were searched, yielding 489 records. After removing 89 duplicates, 400 articles remained for title and abstract screening, from which 103 proceeded to full-text review. Following application of the inclusion and exclusion criteria, 33 studies were included in the final scoping review. The remaining publications were excluded for reasons such as non-nursing populations, lack of application of the Swiss Cheese Model, or absence of focus on prescription error reporting (Table 2).

Although only 33 studies were included (Figure 1), this number is acceptable for a scoping review because the purpose is to map available evidence, identify patterns and highlight gaps rather than perform statistical generalization. The final number also reflects strict inclusion criteria, especially the focus on medication error reporting, nurses or healthcare professionals and system-level or Swiss Cheese Model-related analysis.

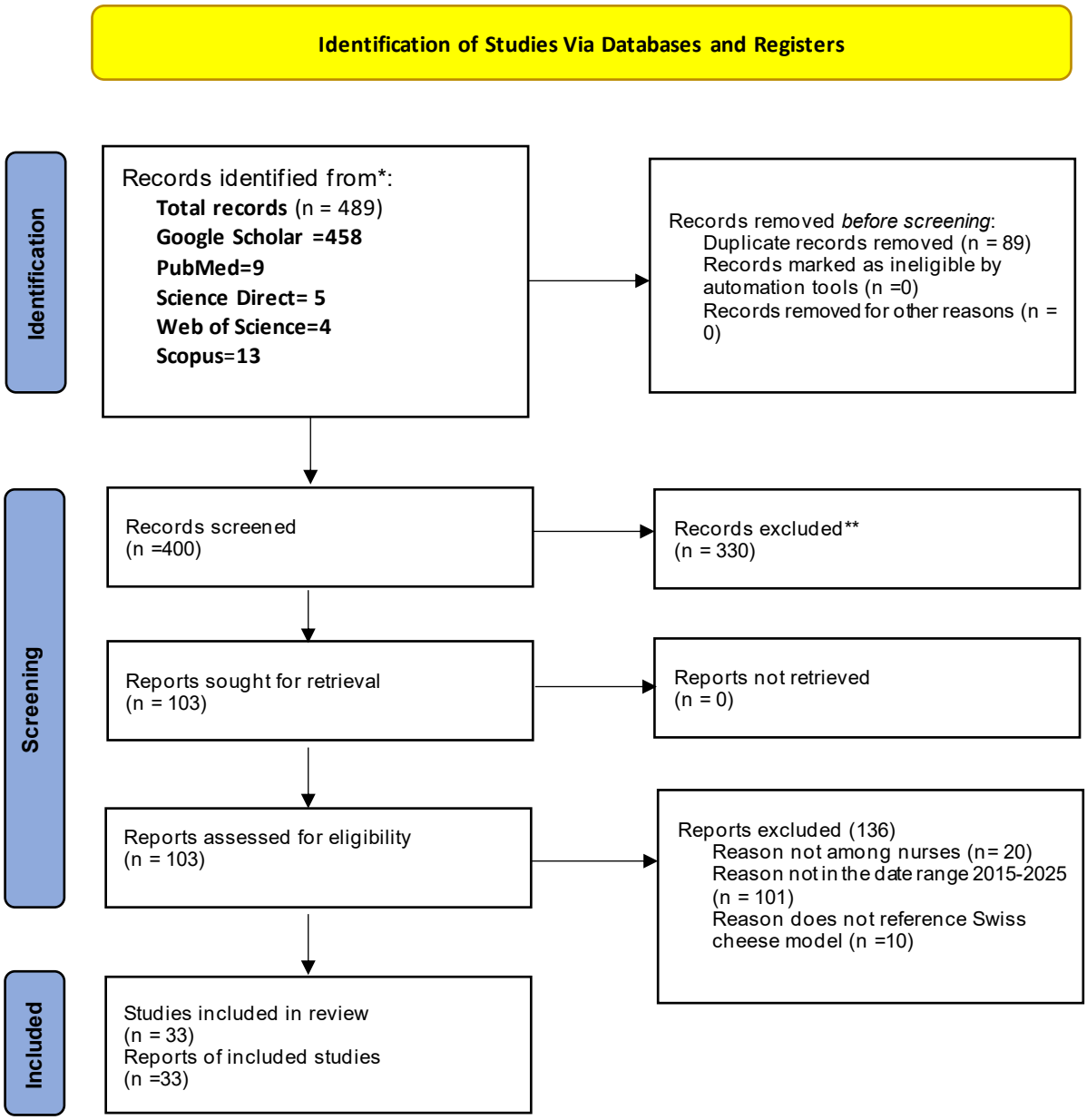

Figure 1: Prisma Chart Describing the Inclusion of the Articles

Description of the Included Studies

This scoping review included 33 studies published between 2015 and 2025, representing a wide geographical distribution across Malaysia, Saudi Arabia, Qatar, China, South Korea, Turkey, Egypt, Indonesia, Kuwait, Lebanon, the Philippines, the United States, the United Kingdom, Ireland, Australia, Japan and the UAE. Malaysia contributed the highest number of studies (n = 8), followed by Saudi Arabia (n = 6) and Qatar (n = 3), reflecting substantial regional interest in medication error reporting (MER). Study designs varied considerably, with cross-sectional surveys dominating the evidence base (n = 18), supported by qualitative interviews and focus groups (n = 7), retrospective incident analyses (n = 3), mixed methods designs (n = 2) and integrative/systematic reviews. Collectively, these studies involved more than 12,000 healthcare professionals, with nurses forming the largest participant group.

Across the 33 studies, a strikingly consistent finding was persistent underreporting of medication errors, driven largely by fear of blame, punitive consequences and hierarchical organizational cultures. Additional barriers included lack of feedback, unclear reporting protocols, high workloads and limited training particularly evident in Malaysia, Saudi Arabia, Indonesia, China and South Korea. Malaysian

studies further highlighted underuse of the national MERS-MOH system and uncertainty about what constitutes a reportable error. In contrast, studies from high-income settings such as Ireland, Switzerland, the United States and Australia described more mature safety infrastructures, including anonymous electronic reporting systems, structured audit-and-feedback loops, non-punitive policies and stronger leadership engagement, which collectively improved reporting transparency and learning.

Only a minority of studies applied established theoretical frameworks such as the Theoretical Domains Framework (TDF) or the Swiss Cheese Model (SCM) revealing a gap in theory-informed MER research globally. Overall, the synthesis shows that while high-income countries demonstrate stronger system-level defenses, middle-income settings, including Malaysia, continue to face cultural and organizational challenges that weaken medication safety systems and inhibit reliable reporting.

Description of the Flow Diagram (Figure 2)

Below the diagram (Figure 2) has described that the Systemic differences in medication error reporting were evident between Malaysia and international systems when mapped through the Swiss Cheese Model (Reason, 2000). In Malaysia, underreporting persists due to pharmacist-dominated reporting, weak feedback, punitive culture and limited training (Chew *et al*., 2022; George *et al*., 2018; Yatim & Othman, 2022; Samsiah *et al*., 2016). By contrast, countries like the US, Switzerland and Ireland demonstrate stronger interdisciplinary reporting, anonymous electronic platforms, feedback loops and non-punitive cultures that foster learning (Afaya *et al*., 2021). Targeted reforms remain necessary to address Malaysia's limitations in culture, feedback, training and technology.

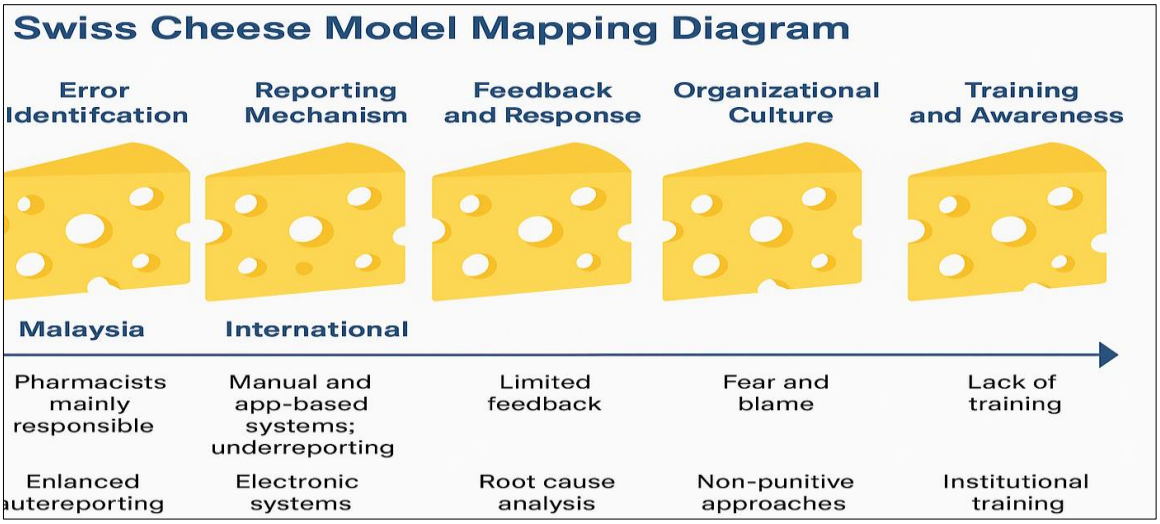

Figure 2: The Flow of Swiss Cheese Model

Description of the flow diagram

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This appendix presents the complete literature matrix of the 33 studies included in the scoping review. Each study is characterized by author, year, country, title, design, key findings, recommendations and whether the Swiss Cheese Model (SCM) was applied.

Table 3: Literature Matrix Table

Author	Country	Title	Study Design	Findings	Recommendations	Framework Used
Stewart *et al*., 2018	Qatar	Exploring facilitators and barriers to medication error reporting among healthcare professionals in Qatar using the theoretical domains framework: A mixed method approach	Mixed methods	1,649 surveys were gathered, with nurses accounting for the majority (67.9%), followed by physicians (13.3%) and chemists (12.9%). Motivation, effort, action and impact, feedback and support, knowledge and abilities in error reporting and emotions were the six categories into which the responses were divided. Pharmacists ($p < 0.05$), older age ($p < 0.001$) and more professional experience ($p < 0.001$) were significantly positively viewed. 54 healthcare professionals participated in focus groups and the results showed emotional hurdles to report, including worries about confidentiality, damaged relationships, fear of consequences and influence on career advancement. Nine of the fourteen Theoretical Domains Framework (TDF) domains were in line with the themes.	More studies, on theoretically informed interventions is encouraged in the future for medication error reporting	Theoretical domains framework
Gleeson *et al*., 2020	**United States**: 10 studies **Spain**: 2 studies	Interventions to improve medication error reporting in hospitals	A Systematic review and narrative synthesis	According to the review, critical incident reporting systems, audit and feedback, education role expansion were prevalent	To enhance medication error reporting, the review suggests creating theory-	No framework use.

	Australia: 1 study **Saudi Arabia**: 1 study **United Kingdom**: 1 study **Japan**: 1 study **Ireland**: 1 study			treatments to enhance drug mistake reporting. Conclusions regarding effectiveness are limited because just one study employed a control group, despite the fact that all trials shown higher reporting rates. The majority of studies lacked theoretical foundations and were of mediocre quality. Fear of being held accountable, lack of anonymity and worry about the consequences were major deterrents to reporting, underscoring the necessity of a supportive, non-punitive reporting culture.	based, thoroughly tested interventions and encouraging a friendly, anonymous non-punitive reporting culture.	
Samsiah *et al*., 2016	Malaysia	Perceptions and attitudes towards medication error reporting in primary care clinics: A qualitative study in Malaysia	Qualitative	According to the study, physicians, nurses, chemists and assistants working in primary care clinics in Malaysia were largely aware that medication mistakes (MEs) happened and had to be reported. Nonetheless, the seriousness of the error frequently affected reporting, with more serious occurrences being reported more frequently. Despite the availability of several reporting options, the official Medication Error Reporting System (MERS) was not used to its full potential. Time	The study suggests establishing a non-punitive culture, improving the clarity and usability of the reporting system and regularly offering training on when and how to report errors. Encouraging more consistent use of the MERS system in primary care also requires leadership backing and streamlined reporting procedures and by applying theorectical framework and	No

				restraints, blame-averseness, a lack of feedback and a poor comprehension of the reporting procedure were the main obstacles. Leadership organizational culture were important and employees valued reporting when it resulted in education and patient safety enhancements.	organizational model such as the SCM.	
Samsiah *et al*., 2020	Malaysia	Knowledge, barriers, facilitators of medication error reporting a quantitative survey in Malaysian primary care clinics	Qualitative-	Three primary topics emerged from the study: First, some participants were unsure about which drug errors needed to be reported, even though the majority acknowledged the importance of doing so. Second, time limits, imprecise procedures, lack of feedback and blame-related anxiety were important obstacles. Finally, error reporting was promoted by facilitators like continuous training, a blame-free culture and supportive leadership.	The study suggests making reporting protocols more transparent and outlining precisely what qualifies as a pharmaceutical error that needs to be reported. Creating a blame-free atmosphere is essential to lowering healthcare workers' anxiety about consequences. To increase understanding and trust in reporting procedures, it is important to offer ongoing education and training. Support from the leadership should be increased and individuals who disclose mistakes should receive prompt, helpful criticism. To lessen	No

					the workload for employees and promote more reporting compliance, the reporting system must also be made simpler.	
George *et al*., 2018	Malaysia	Medication Error Reporting: Underreporting and Acceptability of Smartphone Application for Reporting among Health Care Professionals in Perak, Malaysia	Cross-sectional	After the initial survey invitation two follow-up emails, 334 distinct replies were gathered, resulting in a 28.8% response rate. With an interquartile range (IQR) of 29 to 36 years and a median of 7.5 years of service (IQR 5–11 years), the respondents' median age was 32 years. Pharmacists made up 61.7% (209 respondents) of the participants and women made up the majority (66.8%, 223 respondents). These demographics imply that mid-career female chemists made up the majority of the responder group.	Since it may increase reporting rates in hectic work contexts and was well-received by respondents, the passage's main recommendation is that a smartphone-based medication error (ME) reporting application be created to supplement the current MER-S system.	No
Teoh *et al*., 2015	Malaysia	Perceptions of Doctors and Pharmacists towards Medication Error Reporting and Prevention in Kedah, Malaysia: A Rasch Model Analysis	Cross-sectional	Eight clinics completed a total of 67 surveys, yielding a 100% response rate. Pharmacists stressed standard operating procedure compliance, workload reduction and patient understanding, whereas doctors recognised patient education and	Therefore, in order to improve on the current programs and actions in Malaysia, reporting medication errors has to be promoted in the primary care environment in Malaysia. This might encourage pharmaceutical	No

				pharmacist counselling as important components in minimising prescription errors. Regarding the reporting of pharmaceutical errors, both groups held similar opinions. They somewhat agreed that there is a propensity to place responsibility on specific people when mistakes are reported, even if they did not think that their workload made it more difficult for them to report.	safety and error reporting even more.	
Anderson & Abrahamson, 2017	USA	Effectiveness of MEDMARX reporting system	Observational	Anonymous reporting increased reports	Adopt electronic systems	Yes
Alshammari *et al*., 2021	Saudi Arabia	Medication Error Concept and Reporting Practices in Saudi Arabia: A Multiregional Study Among Healthcare Professionals	Cross-sectional	The study discovered that just 28.3% of healthcare professionals (HCPs) had a solid comprehension of drug mistake stages, despite the fact that the response rate was 100% among doctors, pharmacists and nurses. Most (58.8%) had never reported medication errors and 37.7% said that one of the biggest obstacles was their concern of facing legal repercussions. 54.8% of respondents said they had not received any training on reporting prescription errors in the previous year and more than half (53.5%) said hospitals lacked clear	To enhance medication error reporting and safety in Saudi Arabia, the study recommends curriculum modifications, a blame-free culture, specialised safety positions improved training.	No

				computerised reporting procedures.		
Afaya *et al*., 2021	Global	Improving patient safety through identifying barriers to reporting medication administration errors among nurses: an integrative review	Integrative Review	14 studies out of 10,929 examined publications were selected, highlighting organisational problems (such as inadequate systems and ambiguous terminology) and personal factors (such as ignorance and fear of guilt or lawsuits) as the main obstacles to reporting drug errors.	In order to encourage nurses to report medication errors, the passage highlights the importance of establishing a straightforward, anonymous reporting system, clear definitions and a non-punitive, blame-free environment. Additionally, it suggests offering incentives and feedback to encourage reporting and the use of data for system-level enhancements.	No
Chew *et al*., 2022.	Malaysia	Medication administration errors reporting by Neonatal Intensive Care Nurses in Malaysia: A nationwide study	Cross-sectional	91.2% (n=166) of the 182 nurses from 15 participating institutions were willing to report medication errors, with patient safety being the top reason for doing so. Concerns about getting into trouble (87.5%), supervisors receiving information (56.3%), disciplinary actions and medico-legal difficulties (50.0%) were among the reasons given by nurses (n=16, 8.8%) for not reporting prescription errors.	The obstacles preventing the minority of NICU nurses from reporting medication errors should be addressed, as the majority were willing to do so. Repercussions: The incident reporting policy should highlight the management's assurance that nurses who report errors won't face	No

					consequences.	
Yatim & Othman, 2022	Malaysia	A Retrospective Analysis of Medication Errors at a Tertiary Hospital in a Northern State of Malaysia	Retrospective	Just 2.5 percent of reported medication errors were true; the majority (97.5%) were nearly missing. The majority involved elderly patients, with an average age of 47.6 years and took place in hospital wards. The majority of errors (97.4%) occurred during prescription, with incorrect dosages accounting for the majority of errors (52.3%). Cardiovascular medications were most commonly involved (25%) and the majority of errors (99.4%) did not result in any harm.	Reducing and eradicating MEs would improve clinical procedures and guarantee patient safety if appropriate guidelines and current preventive techniques were implemented effectively.	No
Thomas *et al*., 2021.	Qatar	Investigating the incidence, nature, severity and potential causality of medication errors in hospital settings in Qatar	Retrospective review	Pharmacists reported 91.5% (n = 4,667) of the 5,100 drug mistake reports, with prescribing errors accounting for 87.9% (n = 4,485) of these reports. The most commonly reported pharmaceuticals were nervous system drugs (17.2%, n = 876) and systemic anti-infectives (22.0%, n = 1,123). One error resulted in temporary harm needing initial or protracted hospitalisation, while only three errors caused temporary harm requiring intervention. In terms of causality, active failures	To improve the reporting system's efficacy and efficiency, work is needed. The theoretical framework's application made it possible to identify possible causality, mostly in relation to active failures, which might serve as the foundation for interventions aimed at enhancing medication safety.	Yes

				accounted for 91.5% (n = 4,671) of the mistakes.		
Saada, 2023	Kuwait	Healthcare professional's knowledge and awareness of the medication error reporting systems in the Kuwaiti hospitals	Survey	Just 46% of interviewees said their hospital had a drug error reporting mechanism in place. Only 49% of respondents used electronic prescribing and handwritten prescriptions were still frequently used, even though 60.7% of respondents said they would be prepared to report problems if anonymity was maintained and the system wasn't used for performance management. Furthermore, 20% of medical personnel reported lacking any training in patient safety or pharmacovigilance.	The Kuwaiti Ministry of Health should create a nationwide electronic incident reporting system and set uniform guidelines and procedures for anonymous incident reporting that all public and private institutions must follow.	No
Mutair *et al*., 2021	USA, UK, Canada, Australia, Japan and Saudi Arabia	The Effective Strategies to Avoid Medication Errors and Improving Reporting Systems	Integrative Review	Fewer studies were conducted in nations including Canada, Australia, Japan and Saudi Arabia, with the majority coming from the United States and the United Kingdom. The assessment highlights the need for an active strategy that promotes reporting, staff participation and root cause investigation in order to address prescription errors. It also emphasizes how medication error incidents can be	A successful medication error reporting program should ensure reporter safety, lead to meaningful improvements, involve all staff and be well-resourced. Health organizations must create a supportive environment to improve medication practices.	No

				categorized and examined using the NCC MERP taxonomy.		
Ali *et al*., 2017	Saudi Arabia	Analysis of medication errors at a large tertiary care hospital in Saudi Arabia: a retrospective analysis	Retrospective analysis	Out of 912,500 prescriptions, 13,677 medication errors were reported, giving an incidence rate of 1.5%. Most errors (42.2%) occurred during the transcription stage, with 70% being near misses. Nearly half of the errors involved wrong frequency or wrong concentration.	The clinical effects of MEs at a medical facility should be investigated in more detail.	No
Mahfodz *et al*., 2024	Malaysia	Knowledge, attitude and practices about pharmacovigilance activities among hospital nurses: a multicenter cross-sectional survey	Cross-sectional	The average KAP score of the participants was 57 and many of them had inadequate reporting procedures (48.9%) and ADR understanding (37.4%). Being over 30 and having more than 10 years of work experience were strongly linked to better ADR reporting and expertise.	Despite being well aware of PV actions, Malaysian nurses lacked sufficient knowledge of ADR and had weak reporting habits. Initiatives that should be taken into consideration to empower and encourage nurses' involvement in medication safety surveillance include formal training, ongoing education and knowledge of PV and ADR reporting.	No
Keefer *et al*., 2017	USA	Variability in Threshold for Medication Error Reporting Between Physicians, Nurses, Pharmacists and Families	Survey	Physicians, nurses, pharmacists and families' perceptions of what constitutes a reportable pharmaceutical error, especially in administration and prescribing, varied significantly according to	Reduce variation in what constitutes a reportable medication error by implementing improved education and training on error-reporting criteria that are	No

				the study. Uncertainty about reporting responsibilities and a general lack of knowledge on what constitutes a reportable error were indicated in free-text comments.	specific to each carer category.	
Burns *et al*., 2018	UK	Doctors' attitudes toward medication errors	Comparative study	Varied blame attitudes over time	Promoting cultural shift	No
Alotaibi, 2024	Saudi Arabia	Causes of medication administration errors and barriers to reporting as perceived by nurses in Saudi Arabia: A qualitative study	Qualitative descriptive design	Regarding the reasons behind medicine administration errors, the following themes surfaced: malpractice, excessive workloads and staff shortages and order problems. The following themes emerged as barriers to reporting errors: a lack of feedback, a lack of understanding and awareness regarding reporting and a fear of punishment and lack of support.	This is essential for improving patient care quality and fostering safety in the medical environment. In order to encourage nurses to report errors and improve patient safety, the study also emphasizes the necessity of a workplace culture that encourages error reporting and does not place blame on them and also integration of the SCM could avoid medication errors.	No
Jang *et al*., 2021	South Korea	Perceptions of patient safety culture and medication error reporting among early-and mid-career female nurses in South Korea	Cross-sectional	Compared to mid-career nurses, early-career nurses reported a worse opinion of patient safety culture. However, early-career nurses were more likely to report medication errors appropriately if they had fewer than three years of experience and a greater sense of safety	Future research should examine how early-, mid- and late-career nurses' positive perceptions of patient safety culture affect their reporting of errors while taking into account a variety of	No

				culture. In mid-career nurses, no such association was discovered.	multifaceted factors, including hospital contextual factors.	
Lee, 2017	South Korea	Reporting of medication administration errors by nurses in South Korean hospitals	Cross-sectional	Although overall incident reporting rates were low (6.3% to 29.9%), nurses in Korea had comparable opinions about what constitutes a medicine delivery error across all hospital types. Fear of unfavorable outcomes or legal action was the primary reason why nurses were more inclined to inform doctors about errors than to submit official reports.	Fear was the main excuse given for failing to report drug mistakes. Therefore, more work should be done at the organizational and administrative levels to establish a supportive atmosphere that removes blame from others and the fear of sanctions in order to remove obstacles to error reporting.	No
Elden & Ismail, 2015	Egypt	The Importance of Medication Errors Reporting in Improving the Quality of Clinical Care Services	Descriptive	The majority of medication errors (38.1%) and administration (20.9%) happened during the prescription phase. Patients were impacted by about 45% of errors, of which 1.4% were hazardous and 43.5% were not. 7.7% were possible errors and nearly half (47%) were avoidable. The error rate dramatically decreased from 6.7% to 3.6% following an intervention (P≤0.001).	There is an urgent need for a methodical strategy to reduce organizational mistake susceptibility by allocating the necessary resources for monitoring, analyzing and putting into practice successful initiatives.	No
Alqubaisi *et al*., 2016	UAE	Exploring behavioral determinants relating to health professional	Qualitative	Nine physicians, ten chemists and ten nurses were interviewed. The results showed that while	Therefore, more study should concentrate on these areas,	Yes (TDF)

		reporting of medication errors: a qualitative study using the Theoretical Domains Framework		objectives such as patient safety and organizational improvement encouraged reporting of medication errors, fear, time constraints, a lack of feedback and worries about harming one's professional reputation and future employment opportunities were the main obstacles.	utilizing strong and exacting mixed method research approaches that take into account the opinions of all stakeholders.	
Braiki *et al*., 2024.	Indonesia	Factors Influencing Novice and Beginner Nurses' Intention to Report Medication Errors and Near Misses	Survey	Low intent to report	Strengthen motivation	Yes
Dirik *et al*., 2019	Turkey	Nurses' identification and reporting of medication errors	Descriptive Survey	Despite their ability to spot medication errors, nurses are hesitant to report them. The primary excuse offered for failing to report medication errors was fear of the repercussions. Physicians are most likely to be notified when errors are detected.	A universally recognized definition of pharmaceutical errors and open reporting procedures should be the first steps in enhancing patient safety. Employee reporting should be rewarded, not penalized and their suggestions should be implemented to improve the system.	No
Mahmoud *et al*., 2023	Malaysia	Barriers and facilitators to improving patient safety learning systems: A systematic review of qualitative studies and meta-synthesis	Systematic review and Meta-analysis	One-third of barriers related to poor leadership, blame culture & lack of feedback; organizational barriers were strongest predictors	Multiple barriers and facilitators to uptake of PSLS exist. These factors should be considered by decision makers seeking to enhance the impact of PSLS.	No

Ishak & Ibrahim, 2024	Malaysia	Critical Care Nurses' Perception of Medication Administration Errors in Kelantan, Malaysia: A Cross-Sectional Study	Cross-sectional	Nurses in high workload units were 1.9× more likely to avoid reporting; fear of blame and punitive climate remained major barriers.	Understanding perceptions is crucial for developing strategies to mitigate MAEs and enhance patient safety in critical care environments.	No
Henry Basil *et al*., 2024	Malaysia	Prevalence and factors associated with medication administration errors in the neonatal intensive care unit: A multicenter, nationwide direct observational study	Observational study	92.4% of neonates affected by errors; workload and complex dosing were key contributors	It is vital, to implement of effective and sustainable interventions to target the factors identified in reducing medication administration errors among neonates in the neonatal intensive care unit	No
Yang *et al*., 2025	South-west China	The barriers to medication error reporting by nurses and factors associated with it: a cross-sectional study in a tertiary hospital of south-west China	Cross-sectional	Fear of consequences scored highest among reporting barriers (mean = 3.42 ± 1.11). Face-saving tendency, hierarchical authority and poor work environment significantly predicted higher reporting barriers ($R^2 = 0.826$, $p < 0.001$). Nurses reported that fear of blame, punishment and damage to professional image discouraged reporting.	Hospitals should promote a non-punitive culture, reduce power distance and improve the working environment to encourage transparent reporting. Leadership training and simplified systems are advised to enhance psychological safety	No
Pongprom *et al*., 2025	Thailand	Effectiveness of the ME Online Program to Reduce Medication Errors among Primary Health Care Units in the City Areas of the Thai Cambodian Border Provinces, Thailand	Quasi-experimental	ME rate decreased from 7.4% → 4.5% ($p<0.001$).	It is vital to integrate Scale e-reporting programs nationwide	No
Guo *et al*., 2025	China	Exploring multidimensional determinants of medication error reporting in China: a	Qualitative study	Lack of training and punitive culture inhibited reporting; recommends simplified systems.	It is vital to Integrate SCM-based policy redesign.	No

		qualitative study using the theoretical domains framework				
Del Puerto, 2024	Philippines	Nurses' medication administration error, reporting practices and challenges in tertiary hospitals: Descriptive analysis	Descriptive study	Hierarchical culture and fear of seniors suppressed reporting.	Promote peer mentoring and non-punitive feedback	No
Alrasheeday *et al*., 2024	Saudi Arabia	Estimating Proportion and Barriers of Medication Error Reporting Among Nurses in Hail City, Saudi Arabia: Implications for Improving Patient Safety	Cross-sectional	34.3%Nurses reported and experienced Mes during their practice. Most nurses perceive the lack of knowledge and fear of blame or disciplinary actions as barriers to reporting	Healthcare administrators should implement educational programs and workshops to increase nurses' awareness of ME reporting.	No

Synthesis of the Included Studies (Table 3)

The 33 studies included in this review collectively demonstrate that medication-error (ME) reporting remains a widespread global challenge shaped by interrelated behavioral, organizational and systemic factors. Research conducted across Malaysia, Saudi Arabia, Qatar, Indonesia, China, South Korea, Turkey, Egypt, the United States, the United Kingdom and Ireland consistently highlight persistent barriers such as fear of blame, punitive organizational cultures, unclear reporting processes, heavy workload, lack of digital systems and limited knowledge of reporting requirements. Malaysian studies spanning NICU, ICU, primary care, tertiary hospitals and general wards reveal particularly strong influences of punitive climate, insufficient managerial support, lack of feedback and inadequate training (Chew *et al*., 2022; Ishak & Ibrahim, 2024; Mahfodz *et al*., 2024; Mahmoud *et al*., 2023; Samsiah *et al*., 2020).

Methodologically, most studies employed cross-sectional survey designs, providing useful descriptive insights but limiting causal interpretation. A smaller number of qualitative and mixed-methods studies enriched understanding by revealing emotional and cultural barriers such as shame, confidentiality concerns, hierarchical pressure and fear of career repercussions that strongly suppress reporting behavior. Retrospective audits confirmed that reported incidents are overwhelmingly near-misses rather than actual harmful errors, reinforcing substantial underreporting across settings.

Only a few studies used structured theoretical frameworks (e.g., Theoretical Domains Framework, Swiss Cheese Model), while most lacked a behavioral or systems-based lens, limiting their ability to explain how individual intentions interact with organizational conditions. The scarcity of intervention studies with the exception of digital reporting trials and training-based programs further underscores the need for more robust, theory-driven research.

Overall, the evidence from all 33 studies reveals highly consistent patterns: nurses recognize the importance of reporting but are constrained by fear, workload, limited support and systemic deficiencies. These collective gaps justify the need for a comprehensive, such as the SCM to understand and improve medication-error reporting behavior among nurses in Malaysia.

Comprehensive Review of the Selected Studies

The final review comprised 33 studies published between 2015 and 2025, spanning a wide range of health-system contexts. Malaysia contributed the largest share of evidence, with studies conducted in primary care clinics and hospitals across several states, while additional work came from Saudi Arabia, Qatar, South Korea, the United States, the United Kingdom, Ireland, Turkey, Egypt, Indonesia, Kuwait and the United Arab Emirates. Settings were predominantly acute hospitals and primary care clinics, although several multi-country integrative and systematic reviews synthesized findings from mixed settings. Across all studies, the combined sample exceeded 10,000 healthcare professionals, with nurses as the primary focus, but many studies also included pharmacists, physicians and other clinical staff, reflecting the interdisciplinary nature of medication error reporting.

Methodologically, the body of evidence was dominated by cross-sectional survey designs, which examined knowledge, attitudes, self-reported practices and perceived barriers to reporting among nurses and other healthcare professionals (Alshammari *et al*., 2021; Teoh *et al*., 2015; Chew *et al*., 2022; Mahfodz *et al*., 2024). These were complemented by qualitative studies from Malaysia, Saudi Arabia, the UAE and South Korea that used interviews or focus groups to explore deeper emotional, cultural and organizational influences on reporting behavior (Alotaibi, 2024; Alqubaisi *et al*., 2016; Samsiah *et al*., 2016). Retrospective incident-report analyses from Malaysia, Qatar and Saudi Arabia mapped the frequency, stage and severity of reported errors, highlighting large volumes of near misses and prescribing-stage errors (Ali *et al*., 2017; Yatim & Othman, 2022; Thomas *et al*., 2021). In addition, mixed-methods studies from Qatar used the Theoretical Domains Framework (TDF) to link behavioral determinants to reporting, while integrative and systematic reviews (Afaya *et al*., 2021; Gleeson *et al*., 2020; Mutair *et al*., 2021) synthesized global evidence on reporting interventions, barriers and systems-level strategies.

Only a minority of the primary studies explicitly adopted formal frameworks, but several showed clear alignments with system-safety principles. Theoretical work drew on the TDF to structure attitudinal and motivational barriers (Alqubaisi *et al*., 2016; Stewart *et al*., 2018) and on the NCC MERP taxonomy to categorize medication incidents (Mutair *et al*., 2021). Others implicitly reflected the Swiss Cheese Model (SCM) by examining latent organizational factors such as leadership, workload, staffing and safety culture, as well as active failures at the point of prescribing and administration. Across Malaysian and international studies, recurrent barriers included fear of blame and legal consequences, lack of anonymity, time pressure and workload, unclear definitions of what constitutes a reportable error and limited or absent feedback once a report was submitted. Several studies also showed that pharmacists were often the main reporters, with nurses and physicians less likely to submit formal incident reports despite recognizing errors (Afaya *et al*., 2021; Ali *et al*., 2017; Chew *et al*., 2022; George *et al*., 2018; Stewart *et al*., 2018; Thomas *et al*., 2021).

At the same time, the evidence identified important facilitators and system-level solutions. International studies reported that anonymous electronic reporting systems, combined with audit and feedback, education and role expansion, were associated with higher reporting rates and stronger engagement of frontline staff (Anderson & Abrahamson, 2017; Gleeson *et al*., 2020). Integrative reviews and qualitative work highlighted the importance of non-punitive, "just" cultures, clear reporting policies, visible management support and regular training in medication safety and reporting procedures (Afaya *et al*., 2021; Alotaibi, 2024). In Malaysia, studies suggested that smartphone-based applications, clearer protocols and leadership-endorsed assurance against punishment could increase use of the national Medication Error Reporting System (MERS) and improve reporting in busy clinical environments (George *et al*., 2018; Samsiah *et al*., 2020). Collectively, the 33 studies show that while awareness of medication error reporting is high, practice remains constrained by cultural and organizational barriers and that systems aligned with SCM principles anonymous platforms, multidisciplinary involvement, feedback loops and non-punitive cultures are more likely to achieve sustained reporting and learning.

Ethical Approval

Since this scoping review was conducted without the use of human subjects or personal data and was solely based on an examination of publicly available literature, ethical approval was not necessary. By

using the Joanna Briggs Institute (JBI) methodology and the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews) guidelines, the review complied with ethical research standards. No unpublished or private information was used and all sources are properly referenced.

Results

Nurses' underreporting of prescription errors was consistently identified in both Malaysian and international studies. Contributing factors included inadequate feedback, lack of anonymity, fear of blame or legal consequences and poor integration of safety practices into daily routines (Chew *et al*., 2022; George *et al*., 2018; Samsiah *et al*., 2016). Fear of punishment and limited institutional support further discouraged reporting (Yatim & Othman, 2022; Alotaibi *et al*., 2022). Several studies also noted that pharmacists were the primary reporters particularly in Malaysia meanwhile doctors and nurses were less involved (Samsiah *et al*., 2020). In low- and middle-income countries, nurses frequently report insufficient training and low confidence in using MER systems.

Geographical Distribution of The Included Studies

The included studies were mainly concentrated in Asia and the Middle East. Malaysia contributed 8 studies (24.2%), Saudi Arabia contributed 6 studies (18.2%) and Qatar contributed 3 studies (9.1%). Other countries included China, South Korea, Indonesia, Thailand, the Philippines, Kuwait, the UAE, Egypt, the United States, the United Kingdom, Ireland, Australia and Japan. Representation from Africa and Latin America was minimal.

System-Level Defenses and Gaps in Medication Error Reporting: Evidence from Malaysia and International Healthcare Systems.

This scoping review, guided by the Swiss Cheese Model (Reason, 2000) critically examined 33 studies published between 2015 and 2025 to compare medication error reporting (MER) practices in Malaysia and internationally, map system-level defenses and propose reforms to strengthen reporting culture.

Across the 33 included studies, medication-error reporting systems are clearly intended to function as key system-level defenses, yet they are weakened by structural and cultural gaps. In Malaysia, the Medication Error Reporting System (MERS) and hospital incident-reporting platforms provide formal mechanisms for capturing errors and near misses, with large national datasets demonstrating that most reported events are intercepted before reaching patients (Yatim & Othman, 2022; Ab Rahman *et al*., 2025). Smartphone and electronic solutions have also been piloted and were well accepted by staff as a way to reduce time burden and improve accessibility (George *et al*., 2018). Training and pharmacovigilance initiatives such as those described by (Mahfodz *et al*., 2024) represent additional system defenses designed to enhance nurses' knowledge, attitudes and practices regarding adverse drug reaction and error reporting.

However, the same body of evidence shows that these defenses are perforated by multiple "holes" consistent with the Swiss Cheese Model. Malaysian primary-care and hospital studies report that nurses frequently encounter unclear definitions of reportable errors, complex or time-consuming forms and limited feedback after reporting (Chew *et al*., 2022; Ishak & Ibrahim, 2024; Samsiah *et al*., 2020). Cross-sectional surveys and qualitative syntheses identify punitive culture, hierarchical leadership and poor organizational support as central system-level gaps; nearly one-third of barriers in Malaysian safety-learning systems relate directly to weak leadership, blame and lack of feedback (Mahmoud *et al*., 2023). These conditions discourage use of existing systems and result in selective or minimal reporting, especially among nurses working in high-risk units such as ICU and NICU where workload is intense and dosing is complex (Chew *et al*., 2022; Henry Basil *et al*., 2024).

International studies echo these weaknesses while also illustrating potential defenses. National and hospital-level incident-reporting systems in Qatar, Saudi Arabia, China, South Korea, Turkey, Egypt and Thailand are widely implemented, yet cross-sectional and review evidence shows they are underused because staff fear blame, litigation and reputational harm, or perceive reporting as futile

(Afaya *et al*., 2021; Alrasheeday *et al*., 2024; Stewart *et al*., 2018; Yang *et al*., 2025). Systematic reviews highlight that many interventions to improve reporting education sessions, audit and feedback, or role expansion lack theoretical grounding and are rarely evaluated with robust designs, limiting their long-term impact (Gleeson *et al*., 2020; Mutair *et al*., 2021). At the same time, successful examples such as Thailand's Medication Error Online Program demonstrate that simple, well-designed e-reporting tools integrated into workflow can reduce error rates and enhance system learning (Pongprom *et al*., 2025).

Overall, the 33 studies show that while formal reporting structures, training programs and digital tools exist as defensive layers, they are compromised by organizational culture, leadership behavior, inadequate guidance and technological limitations. Addressing these system-level gaps through non-punitive policies, leadership development, streamlined digital reporting and theory-driven interventions grounded in frameworks such as SCM and TPB is essential to transform reporting systems from passive repositories into active defenses that genuinely strengthen patient safety in Malaysia and internationally.

Across the 33 included studies, application of the Swiss Cheese Model demonstrates substantial variation between Malaysia and international healthcare systems. In Malaysia, persistent organizational and cultural barriers most notably hierarchical structures, punitive climates, inadequate supervisory support and limited digital infrastructure continue to suppress nurses' willingness to report medication errors (Chew *et al*., 2022; Ishak & Ibrahim, 2024; Samsiah *et al*., 2020). System inefficiencies such as heavy workloads, unclear reporting procedures and insufficient leadership feedback further weaken internal safety defenses.

However, the 33 included studies, Malaysia contributed the highest number of studies (n = 8, 24.2%), followed by Saudi Arabia (n = 6, 18.2%) and Qatar (n = 3, 9.1%). Cross-sectional studies formed the largest design group (n = 18, 54.5%), followed by qualitative studies (n = 7, 21.2%), retrospective studies (n = 3, 9.1%), mixed-methods studies (n = 2, 6.1%) and review studies (n = 3, 9.1%).

In contrast, several international settings have introduced stronger system-level safeguards, including electronic incident-reporting platforms, non-punitive reporting policies, structured leadership feedback and regular safety education (Afaya *et al*., 2021; Stewart *et al*., 2018; Yang *et al*., 2025). These interventions have shown measurable improvements in reporting participation and safety culture.

Overall, findings indicate that while global systems increasingly adopt proactive, technology-driven and learning-focused reporting mechanisms, Malaysian healthcare continues to face entrenched organizational and cultural gaps. Strengthening leadership behavior, enhancing psychological safety, expanding digital reporting systems and implementing theory-driven interventions are essential to improving nurses' reporting practices and reducing preventable medication-error harm.

Malaysia and International Systems in Comparison

Across the 33 included studies, Malaysian and international healthcare systems show markedly different levels of maturity in medication error reporting structures. Malaysian evidence from primary care, general wards, ICU and NICU settings consistently highlights under-reporting driven by fear of blame, unclear procedures and weak follow-up, despite the presence of a national Medication Error Reporting System (MERS) (Chew *et al*., 2022; George *et al*., 2018; Ishak & Ibrahim, 2024; Mahfodz *et al*., 2024; Samsiah *et al*., 2020). Reporting is often manual or semi-digital, variably used across units and rarely embedded within theory-driven learning frameworks, while high-risk environments such as NICU and ICU continue to experience substantial error burdens (Ishak & Ibrahim, 2024; Henry Basil *et al*., 2024). In contrast, studies from Qatar, Europe, East Asia and the Middle East describe more developed system-level defenses, including electronic or web-based reporting platforms, audit-and-feedback cycles and programs explicitly designed to strengthen patient-safety culture (Gleeson *et al*., 2020; Guo *et al*., 2025; Stewart *et al*., 2018; Thomas *et al*., 2021). Interventions such as online ME programs and structured safety-culture initiatives have been shown to increase reporting rates and reduce error incidence (Afaya *et al*., 2021; Pongprom *et al*., 2025). Nevertheless, even in these settings, fear of punitive consequences, face-saving norms and workload pressures remain prominent, particularly in Asian contexts such as Saudi Arabia, South Korea, China, Indonesia and the Philippines

(Alrasheeday *et al*., 2024; Del Puerto, 2024; Jang *et al*., 2021; Prihartono & Wibowo, 2020; Yang *et al*., 2025). Overall, the comparison suggests that while international systems have moved further toward non-punitive, digitally enabled, learning-oriented reporting infrastructures, Malaysian practice remains largely descriptive and under-theorized, reinforcing the need for an integrated the SCM, multi-site study focused specifically on nurses' reporting behavior.

Benefits and Integration of the Swiss Cheese Model

The Swiss Cheese Model (SCM) (Reason, 2000) provided a framework for mapping system-level barriers to safe medication practices. Many studies aligned their findings with SCM defense layers organizational culture, training, feedback, reporting systems and error detection even when not applied directly (Dirik *et al*., 2019; Relihan *et al*., 2010). Globally, SCM has been effective in identifying latent system failures and promoting systemic learning through layered interventions such as staff training, automated reporting and just culture leadership. Although its adoption in Malaysia remains limited, local research highlights its potential to strengthen reporting systems (Chew *et al*., 2022; George *et al*., 2018; Ishak & Ibrahim, 2024; Mahfodz *et al*., 2024; Samsiah *et al*., 2020).

Discussion

Guided by the Swiss Cheese Model (SCM), this scoping review synthesized evidence from 33 studies and demonstrates substantial variation in medication error reporting (MER) practices, system defenses and organizational learning across Malaysia and international healthcare settings. Across Malaysian studies, pervasive structural weaknesses particularly hierarchical authority, fear-driven reporting climates, limited organizational support and low digital integration continue to inhibit transparent reporting among nurses. Although awareness of reporting systems such as MERS exists, Malaysian research consistently revealed underutilization due to punitive cultures, poor feedback, unclear reporting criteria and substantial workload pressures. These weaknesses reflect gaps across multiple SCM layers, particularly organizational influences, supervisory processes and situational conditions.

In contrast, international studies spanning Qatar, Switzerland, Ireland, China, Indonesia, South Korea, Thailand and Saudi Arabia demonstrate comparatively stronger systemic defenses, characterized by multidisciplinary reporting, electronic or web-based incident platforms (e.g., MEDMARX, CIRS), structured audit-and-feedback systems and leadership-driven patient safety initiatives (Gleeson *et al*., 2020; Stewart *et al*., 2018; Thomas *et al*., 2021). These systems more effectively operationalize SCM principles by establishing non-punitive policies, standardizing reporting workflows and embedding reporting into organizational learning cycles. Several interventions, such as Thailand's Medication Error Online Program, showed measurable improvements in error reductions and increased reporting (Pongprom *et al*., 2025), highlighting the potential of digital and system-level enhancements.

However, even in technologically advanced international settings, behavioral and cultural barriers persist. Studies from Indonesia, South Korea, China, Saudi Arabia and the Philippines reported continued dominance of face-saving norms, hierarchical pressure and fear of administrative consequences mirroring patterns observed in Malaysia (Alrasheeday *et al*., 2024; Del Puerto, 2024; Jang *et al*., 2021; Prihartono & Wibowo, 2020; Yang *et al*., 2025). These global consistencies reaffirm that while system design is crucial, nurse behavior is profoundly shaped by cultural context, perceived psychological safety and leadership response all key constructs embedded within SCM.

Overall, the evidence indicates that Malaysia exhibits vulnerabilities across several SCM layers organizational (leadership, culture), supervisory (feedback, accountability) and situational (workload, unclear guidelines) which collectively weaken reporting defenses and sustain underreporting. International systems, though not free of cultural barriers, demonstrate greater alignment with SCM-based best practices through stronger digital infrastructure, structured learning systems and non-punitive environments and the dominance of cross-sectional studies (54.5%) indicates that most available evidence remains descriptive rather than interventional. This limits causal interpretation and highlights the need for more longitudinal and intervention-based studies.

The concentration of studies in Asia and the Middle East suggests that this review is more strongly weighted towards these regions. Therefore, the findings should not be interpreted as fully representative of all international healthcare systems. This regional imbalance highlights the need for more research from underrepresented regions, particularly Africa, Latin America and other low- and middle-income countries.

Future Malaysian research must therefore move beyond descriptive analysis to theory-driven, system-level evaluation. Embedding SCM-guided policies, strengthening digital reporting tools and fostering psychologically safe reporting cultures are essential for improving reporting behavior and enhancing long-term patient safety outcomes.

Future research direction

Future research should adopt interventional and longitudinal designs to evaluate the impact of system-level changes on reporting behaviors and patient safety culture (Dirik *et al*., 2019). In Malaysia, multi-center studies are needed to track cultural shifts, while integrating behavioral frameworks such as the Theory of Planned Behavior with the Swiss Cheese Model could deepen understanding of nurses' reporting intentions and barriers. Standardized MER curricula within nursing education, alongside evaluations of training effectiveness, are also essential. Additionally, qualitative studies exploring nurses' perspectives and lived experiences can provide valuable insights for advancing safety culture and reporting practices.

The Swiss Cheese Model was useful for mapping system-level weaknesses across Malaysian and international medication error reporting systems. It allowed this review to identify failures in organizational culture, leadership, feedback, training and digital reporting infrastructure. However, the model has limitations. It does not fully explain individual behavioral factors such as attitude, perceived control, intention or psychological safety. Therefore, future studies may benefit from integrating the Swiss Cheese Model with behavioral theories such as the Theory of Planned Behavior or Theoretical Domains Framework (Guo *et al*., 2025; Stewart *et al*., 2018).

Furthermore, the inclusion of 33 studies limits the ability to claim full global representation. Therefore, the findings should be interpreted as a synthesis of available published evidence rather than a complete assessment of all international medication error reporting systems. However, this limitation is also an important finding, as it shows that theory-driven research on medication error reporting remains limited.

Based on the results of this scoping assessment, a number of important suggestions are put forth to improve nurse reporting systems for medication errors, especially in Malaysia and to bring local procedures into compliance with international safety standards:

Develop a National Platform for Electronic Reporting

Findings across the 33 studies clearly show that Malaysia urgently needs a centralized, anonymous and user-friendly electronic medication error reporting platform. Malaysian studies consistently highlight that current paper based or fragmented systems are burdensome and discourage reporting, especially due to time constraints, fear of blame and lack of feedback (Chew *et al*., 2022; Mahfodz *et al*., 2024; Samsiah *et al*., 2020). Evidence also shows strong acceptance of digital solutions Malaysian healthcare professionals responded positively to a proposed smartphone reporting app, indicating high readiness for electronic systems (George *et al*., 2018).

International findings reinforce this direction. Countries using national electronic platforms such as MEDMARX and CIRS demonstrate higher reporting rates, better data quality and improved organizational learning (Anderson & Abrahamson, 2017; Gleeson *et al*., 2020; Thomas *et al*., 2021). Digital platforms also successfully reduced medication errors in intervention studies, such as Thailand's online ME programme that significantly lowered error rates (Pongprom *et al*., 2025).

Overall, the evidence supports Malaysia adopting a national electronic MER platform that is anonymous, simple to use, mobile-enabled and integrated with feedback mechanisms. Such a system would reduce

reporting barriers, strengthen transparency and enhance system-level learning aligning with global best practices and the Swiss Cheese Model's emphasis on strong organizational defenses.

Establish a Culture of Non-Punitive Reporting

Across the 33 studies reviewed, fear of blame, legal consequences and punitive organizational cultures consistently emerged as the strongest barriers to medication error reporting, especially in Malaysia. Nurses commonly withheld reports due to fear of disciplinary action, damaged professional reputation, or managerial repercussions (Chew *et al*., 2022; Ishak & Ibrahim, 2024; Samsiah *et al*., 2016). Similar patterns were observed internationally, where hierarchical structures and fear-based environments suppressed reporting (Alotaibi, 2024; Lee, 2017; Yang *et al*., 2025). These findings reinforce the need for Malaysian healthcare organizations to adopt an explicit non-punitive "just culture", supported by leadership behavior, accreditation standards and clear policies that protect staff who report errors (Afaya *et al*., 2021; Mutair *et al*., 2021).

The evidence further shows that multidisciplinary participation significantly strengthens reporting systems. In several international studies, pharmacists reported the majority of errors (Ali *et al*., 2017; Thomas *et al*., 2021), while physicians and nurses contributed complementary insights into causes and system gaps (Keefer *et al*., 2017; Stewart *et al*., 2018). However, Malaysian research revealed inconsistent engagement across professions and underutilization of reporting systems (George *et al*., 2018; Samsiah *et al*., 2020). Encouraging all healthcare professionals not only pharmacists to participate, supported by targeted training and feedback loops, improves data completeness, organizational learning and shared accountability.

Together, these findings underscore that strengthening medication error reporting requires non-punitive culture reform and active, multidisciplinary involvement, ensuring that nurses and all healthcare workers feel safe, supported and responsible for contributing to patient safety.

Include Organized Instruction in Patient Safety and Reporting

Across the studies, lack of structured education on patient safety and reporting consistently emerged as a barrier, especially in Malaysia and other Asian settings. Nurses frequently reported uncertainty about what constitutes a reportable error, how to use reporting systems and the legal implications of reporting (Alshammari *et al*., 2021; Mahfodz *et al*., 2024; Saada, 2023; Samsiah *et al*., 2020). International work using behavior-change frameworks such as the TDF showed that motivation, emotion and knowledge are core determinants of reporting behavior (Guo *et al*., 2025; Stewart *et al*., 2018). These findings support integrating competency-based training on patient-safety frameworks (e.g. SCM), error identification and reporting protocols into undergraduate curricula and continuing professional development, supported by simulation, case reviews and unit-level coaching (Chew *et al*., 2022; Dirik *et al*., 2019; Jang *et al*., 2021).

Create Feedback Loops and Mechanisms for System Learning

The review showed that lack of feedback after reporting is one of the most demotivating factors for nurses. Malaysian, Gulf and Asian studies all highlighted that staff rarely receive information about what happened to their reports or whether any changes were implemented (Alotaibi, 2024; Chew *et al*., 2022; Ishak & Ibrahim, 2024; Del Puerto, 2024; Samsiah *et al*., 2016). Conversely, systems that combined reporting with root-cause analysis, visible policy changes and regular feedback demonstrated better engagement and learning (Elden & Ismail, 2015; Gleeson *et al*., 2020; Mutair *et al*., 2021; Thomas *et al*., 2021). Establishing structured feedback loops such as unit safety briefings, dashboards and debriefs would signal to nurses that reporting leads to real system improvements, thereby reinforcing trust and sustaining reporting behavior.

Investigate Reporting Practices in Malaysian Settings

Malaysian evidence is still dominated by single-site, cross-sectional, self-report studies focusing on specific units such as NICU, ICU, or primary care (George *et al*., 2018; Ishak & Ibrahim, 2024; Henry Basil *et al*., 2024; Mahfodz *et al*., 2024; Mahmoud *et al*., 2023; Samsiah *et al*., 2020). These studies

consistently identify fear of punishment, workload, digital limitations and weak leadership as key barriers, but cannot clarify causal pathways or long-term effects. In contrast, international work has started to test interventions (e.g. online reporting programs, motivation programs, culture initiatives) with quasi-experimental designs and theory-driven approaches (Massah *et al*., 2021; Pongprom *et al*., 2025; Stewart *et al*., 2018). There is a clear need for multi-center Malaysian research that uses longitudinal, mixed-methods and intervention designs to evaluate how leadership, culture and digital health tools influence nurses' reporting behavior over time.

Nursing Implications

The 33 studies collectively reaffirm that nurses are the frontline detectors of medication errors but cannot fulfil this role without supportive systems. Consistent implications include the need for: (a) psychologically safe, non-punitive environments that reduce fear of blame (Chew *et al*., 2022; Lee, 2017; Yang *et al*., 2025); (b) practical training that strengthens knowledge and confidence in using reporting systems (Alshammari *et al*., 2021; Mahfodz *et al*., 2024; Wake *et al*., 2021); and (c) simple digital tools such as mobile apps, online platforms and e-MAR that reduce workload and streamline documentation (George *et al*., 2018; Pongprom *et al*., 2025; Saada, 2023). When combined with strong leadership, coaching behaviours and interprofessional collaboration (Chegini *et al*., 2020; Stewart *et al*., 2018; Thomas *et al*., 2021), these strategies can convert errors into opportunities for learning, ultimately improving patient safety and reinforcing nurses' professional contribution to medication-safety systems.

Limitations

The study is that most included research relied on cross-sectional surveys and qualitative designs, which are descriptive and cannot establish causal relationships. Many studies used self-reported data, introducing potential bias, and Malaysian evidence was often limited to single-site settings, reducing generalizability. Additionally, few studies applied formal theoretical frameworks, limiting understanding of how individual behavior interacts with systemic factors in medication error reporting.

Future Scope

Future work should move beyond descriptive surveys toward intervention-focused, theory-driven research and experimental studies are needed to assess the impact of anonymous e-reporting platforms, just-culture policies and feedback interventions on reporting rates and patient outcomes in Malaysian hospitals, building on promising results from Thailand, Iran and Egypt. Mixed-methods and ethnographic designs can unpack the lived emotional and cultural dynamics such as fear, face-saving and power distance highlighted in China, Indonesia, the Philippines and Korea. Integrating behavioural models such as TPB or TDF with SCM will allow researchers to test how attitudes, subjective norms, perceived control and latent system factors jointly influence nurses' reporting behaviour. Multi-centre national studies will be crucial to track cultural change and guide scalable policy reform.

Conclusion

The application of Swiss Cheese Model as an analytic lens, this review of 33 studies shows that medication-error reporting systems remain fragile, with different levels of maturity across countries. Internationally, several systems have moved towards anonymous electronic platforms, clearer definitions and non-punitive cultures, supported by leadership and structured feedback. In Malaysia, however, persistent "holes" in the organisational and supervisory layers hierarchical cultures, fear of blame, inadequate training and under-developed digital systems continue to suppress reporting among nurses despite high expressed willingness. Embedding SCM principles into policy, technology design and leadership practice offers a structured pathway for strengthening defences and transforming error reporting into a routine learning mechanism.

CRediT Authorship Contribution Statement

P.A.V: Study development, collaboration of ideas, literature review writing, data analysis, manuscript writing, and overall manuscript revision. K.T.A: Academic supervision, methodological guidance, and reviewed the manuscript critically and approved the final version for submission. A.B.A: Manuscript

evaluation, provided professional feedback. S.B.M.A: Reviewing the manuscript and provided constructive comments and suggestions. L.S.P: Expert feedback, critical revision of the manuscript, comments and suggestions accordingly.

AI Assistance Declaration

The author hereby declares that, during the preparation of this manuscript, generative AI tools such as ChatGPT, Microsoft Copilot, and Google Gemini were utilized to assist with language enhancement and grammar correction. Following the use of these tools, the author thoroughly reviewed and revised the content and takes full responsibility for the final version of the manuscript, ensuring its accuracy and adherence to the required academic standards.

Conflict of Interest

The authors declare that they have no conflicts of interest.

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