

# Strategies for Reporting Medication Errors in Hospitals; An Integrative Review

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## Abstract

**Background:** Despite focused efforts on error prevention, the incidence of medication errors (MEs) occurring in the health care system continues a concern. Patient harm can be diminished or prevented by adequate reporting processes that include identifying, analyzing, and correcting MEs on time. Both medication error prevention and reporting strategies are critical components in advancing patient safety. **Methods:** To analyze the strategies used by the Health Care Professionals (HCPs) to facilitate reporting medication errors in a health care setting, an integrative review of the literature, guided by Whittemore and Knaf'l's (2005) five-step process, was applied for the period between 2011-2021. With a comprehensive search conducted using PubMed, DSL, Google Scholar databases, nine articles only met our inclusion criteria which are, in the English language, performed by peers and full-text articles that answered the guiding questions included in this review. **Result:** The articles were analyzed in terms of objectives, methodological path, main results, and recommendations for improvement. The analysis reveals that MEs reporting strategies are varied either web-based, paper-based, or Technician Enhanced Administration of Medication (TEAM) model. Staff awareness and non-blame culture are influencing HCPs' ability to adopt the proper strategy for reporting MEs, understanding of HCPs' characteristics and organizational factors that influence error reporting can foster the development of effective strategies to report MEs and enable organizations to enhance patient safety.

**Keywords:** medication errors, medication errors reporting, reporting medication errors strategies, automated errors reporting system, improving medication errors reporting, MAER, MEs reporting nurses, Saudi Arabia, strategies, incident report, the computerized system.

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## 1. BACKGROUND

The goal of medication treatment is the achievement of the best therapeutic effects and the improvement of the patient's life quality, with less or no harm (Alomi, Al-Shubaar, Lubad, & Albusalih, 2019). MEs refers to any unintended error which can arise during the prescribing, dispensing, preparing, or administration of medication while in control of a HCPs' or by the patient (Aboshaiqah, 2014). All medication errors are possibly avoidable (Jember *et al.*, 2018). It can be greatly diminished or even prevented by developing the systems and safety practices of medication in all medication management stages (WHO, 2017). Many studies showed that errors occur frequently in the

administration stage (WHO, 2017), as nurses are the main responsible personnel for administering most of the medication to patients, so, they need to understand these complicated issues of being secure while engaged in any facet of medications management (Edwards & Axe, 2018).

Errors can be a result of combination factors either human, defective system, or environmental factors (Edwards & Axe, 2018). Saleh & Barnard (2019) stated that errors can be a result of simple, unpredictable reasons as, monotony, the variety of daily patient care and paperwork, or basically miscommunication (Almutairi, McCarthy, & Gardner, 2015; Al-Otaibi *et al.*,

2018). Other studies displayed that, human factors like work fatigue, staff shortages, workload, conflicts among colleagues, stress from home or poor environmental conditions were the main factors that lead to error and affecting medication error reporting (MER) (WHO, 2017; Saleh & Barnard, 2019).

Error reporting is a vital practice, if not done, medication safety will not be improved (Saleh & Barnard, 2019). Up to 65% of nurses have either experienced medication administration errors (MAEs) directly or perceived it from colleagues working at same shifts. However, most of the errors are never reported (Saleh & Barnard, 2019). Numerous studies were examined the barriers to reporting MEs. Saleh & Barnard (2019) in their study stated that the reporting process is not standardized across healthcare systems and it is difficult for nurses, other said, organizations often focus on the error instead of utilizing the reported data to improve knowledge or using reported information as a learning tool (Edwards & Axe, 2018). Jember and his colleagues (2018) found that, HCPs not aware that an error had happened, or forgot to make a report on a busy day, lack of time to report, and lack of awareness in the importance of reporting all considered as barriers to reporting MEs. Moreover, nurses recognized that an error was made but the problem was resolved without any noticeable effects on the patient or quality of care, and thus discouraged them from reporting (Saleh & Barnard, 2019).

Edwards & Axe (2018) said, to reduce MEs nationally as well as internationally, medication management requires to be at the lead of nursing care, that doesn't mean nurses are exclusively responsible for errors, but they the only professional practitioners who play a dynamic role in preventing of medication errors in administration phase. Recognition of effective measures and strategies to improve reporting errors is very crucial and should be based on acknowledging causes, barriers, and facilitators perceived by HCPs to facilitate reporting system (Samsiah *et al.*, 2020). Perception plays a vital role in deciding how HCPs understand the error reporting system and how change over HCPs view to reporting procedure and the importance to report all types of errors (Alghamdi, & Urden, 2016; Saleh & Barnard, 2019; Kim, M & Kim, C, 2019). Enhancing patient safety culture with supportive leadership where HCPs feel safe to disclose and discuss errors without constraints is a key institution-based strategy to improve error reporting (Murray, Sundin & Cope, 2018; Samsiah *et al.*, 2020). Therefore, the HCPs require an administrative encouragement attitude and organizational culture that encourages voluntary medication error reporting in addition to providing them with sufficient knowledge, training, and time for completing the incident reporting process (Samsiah *et al.*, 2020; Hailu *et al.*, 2018).

It is showed in the literature that, basic strategies should be applied to establish reporting

mechanisms (Jember *et al.*, 2018; Edwards & Axe, 2018). The system must help in better managing errors, solving mistakes without punishment, with higher levels of efficiency, and guaranteeing less fear and less stress among HCPs concerning report any errors (Ala'a, Aljasser, & Sasidhar, 2016; Saleh & Barnard, 2019). This type of system is essential, not only to ensure patient safety but to enables and encourages HCPs to report any type of ME regardless of its severity (Samsiah *et al.*, 2020). Therefore, the system needs to develop by understanding the reasons behind the incidence of errors and key obstacles to medication error reporting (MER) (Ala'a, Aljasser, & Sasidhar, 2016; Saleh & Barnard, 2019).

The process for implementing such a system would require education and training for all HCPs from the orientation period and continuing at all levels to meet the demands of the HCPs involved in the medication use cycle (Kim, M & Kim, C, 2019; Samsiah *et al.*, 2020; Al-Otaibi, Moawed, & Al-Harbi, 2018; Saleh & Barnard, 2019). The error reporting system also needs changes in the organization policy to support non blaming environment, reduce the criminalization afford to errors that are reported (Saleh & Barnard, 2019). Developing a unified system to facilitate error reporting will contribute to the reduction or prevention of MEs in hospitals (Al-Dossari, Alnami, & Qureshi, 2020).

This review will help gain insight into the various strategies for reporting medication errors which will assist the organizational leaders and policymakers know the effectiveness and impacts of each strategy in improving patient safety and creating a supportive environment for reporting that is far from blaming or punishment.

## 1.2 Aim of the Study

This review aims to analyze the available literature about strategies of reporting MEs in hospitals, which was published between 2011 and 2021, the review conducted using Whittemore and Knafl's (2005) integrative review method.

## 2. METHOD

This review was conducted by using Whittemore and Knafl's (2005) integrative review method which is the widest type of research review methodology, allowing for the inclusion of experimental and non-experimental research at the same time to reach a full understanding of the phenomenon under the study. It also incorporates data from both theoretical and practical sources (Whittemore and Knafl, 2005). The process of conducting integrative review encompasses these stages: problem identification, literature search, data evaluation, and data analysis and conclusion presentation.

### 2.1 Problem identification stage

The first stage of any review process is the consistent identification of the problem that will be addressed by the review and the review aims (Whittemore and Knafl, 2005). All other stages of the review will be aided by having a well-defined review objective and variables of interest, especially the ability to distinguish between relevant and irrelevant data in the data extraction stage. So, the stage is very important because it will make the review process easier and clear (Whittemore and Knafl, 2005).

### 2.1.1 Problem Statement

Ensuring the safe utilization of medications is the main priority of health organizations worldwide as the aim of the third Global Patient Safety Challenge on Medication Safety is to advance worldwide commitment and action to diminish severe, avoidable medication error by 50% in the next five years, explicitly by addressing harm subsequent from errors or unsafe practices attributable to weaknesses in health systems (WHO, 2017). Several associations support safety measures to examine and improve medication administration to boost patient safety (Al-Otaibi, Moawed, & Al-Harbi, 2018). Medication administration represents one of the routine, extremely complicated, essential nursing care responsibilities and the most potentially nursing risky tasks due to liability to errors (Jember *et al.*, 2018). Saleh & Barnard (2019) said, MEs adversely influence HCPs practices, quality of care, and patient safety, a single MEs may lengthen hospital stay or even lead to death (Jember *et al.*, 2018).

Internationally, MEs represent one of the five medical error classifications ranked by the American Institute of Medicine (WHO, 2017). More than 7000 patients deaths every year consequently of Medication errors (Abdali, Abdulmutalib, & Al Nagshabandi, 2017). According to WHO (2017), the cost related to MEs has been estimated at \$ 42 US billion each year. Studies showed that (26–38%) of medication errors are nursing-associated during the administration stage, even though they may be underreported or not reported due to a variety of factors (Saleh & Barnard, 2019; Edwards & Axe, 2018). A study by Samsiah & his colleagues (2020) found that more than two-thirds of the participants (70%) definite they had never reported ME ( $n = 152$ ), 40.4% were unaware about near misses necessitated reporting, ( $n = 101$ ) 26.9% expected omission errors should not be reported, and ( $n = 180$ ) 47.9% not know the Medication Error Reporting System (MERS) is applicable in healthcare facilities (Samsiah *et al.*, 2020).

Samsiah & his colleagues (2020) has been drawn that, errors signify a problem in a health care system, which warrants examination, error reporting system must allow healthcare administrations to alleviate the reasons, prevent a repetition of errors, and build up a positive culture related to errors reporting system among health care practitioners. (Leistikow *et al.*, 2017; Mitchell *et al.*, 2016). Error reporting needs professional

systems, which facilitate more proficient detection of errors and enable prevention (Saleh & Barnard, 2019). This system should encourages and empowers HCPs to recognize, and report unsafe practices (Saleh & Barnard, 2019; Alomi *et al.*, 2019).

**This review aimed to answer these questions:** a) What are the effective strategies for reporting medication errors adopted by hospitals? And b) What are the impacts of these strategies on reporting rate of error was recorded after utilizing such strategies?

### 2.2 Literature Search Stage

Since incomplete searches may result in an insufficient database and the possibility for incorrect results, well-defined literature search strategies are vital for improving the rigor of any type of review (Whittemore and Knafl, 2005). The literature search stage aims to provide as many eligible primary sources as possible within a predetermined frame (Whittemore and Knafl, 2005).

#### 2.2.1 Search Process

A structured database search was done, using (PUBMED, GOOGLE SCHOLAR, and SDL). Broad search terms were customized for each database and included key ward “medication errors,” “medication errors reporting” “reporting medication errors strategies,” and “automated errors reporting system,” “improving medication errors reporting,” “MAER,” “MEs reporting” nurses, Saudi Arabia, strategies, incident report, computerized system “alone or in combination.

#### 2.2.2 Eligibility Criteria

**Inclusion Criteria:** The criteria for selecting the papers for review involve all studies published in the English language, peer-reviewed journals, and full text published between 2011 and 2021, and focused on effective strategies for reporting MEs.

**Exclusion Criteria:** Studies were published before 2011, reviews, commentary, and editorial. Studies that focused on special types of medication as chemotherapy or anesthetic medications and studies on medical errors, in general, were excluded.

#### 2.2.4 Search outcomes

The screening procedure was adapted from the process defined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement for reporting of systematic reviews by (Moher *et al.*, 2009; Prompahakul & Epstein, 2019). The initial result of searching yielded found 26,838 articles retrieved from (Google Scholar  $n = 16,800$ , PubMed  $n = 763$ , and SDL  $n = 9,275$ ) using key wards; medication error reporting medication errors reporting strategies, automated errors reporting system, improving medication errors reporting, nurses, Saudi Arabia, strategies, incident report, computerized system. Most of the retrieved articles did not correspond to our inclusion

criteria exactly, we observed a large number of duplicate studies located in the databases included in our search strategy.

After removing duplicates, and narrowing the search scope to papers published from 2011 to 2021, we got 486 papers were retrieved (Google Scholar n= 225,

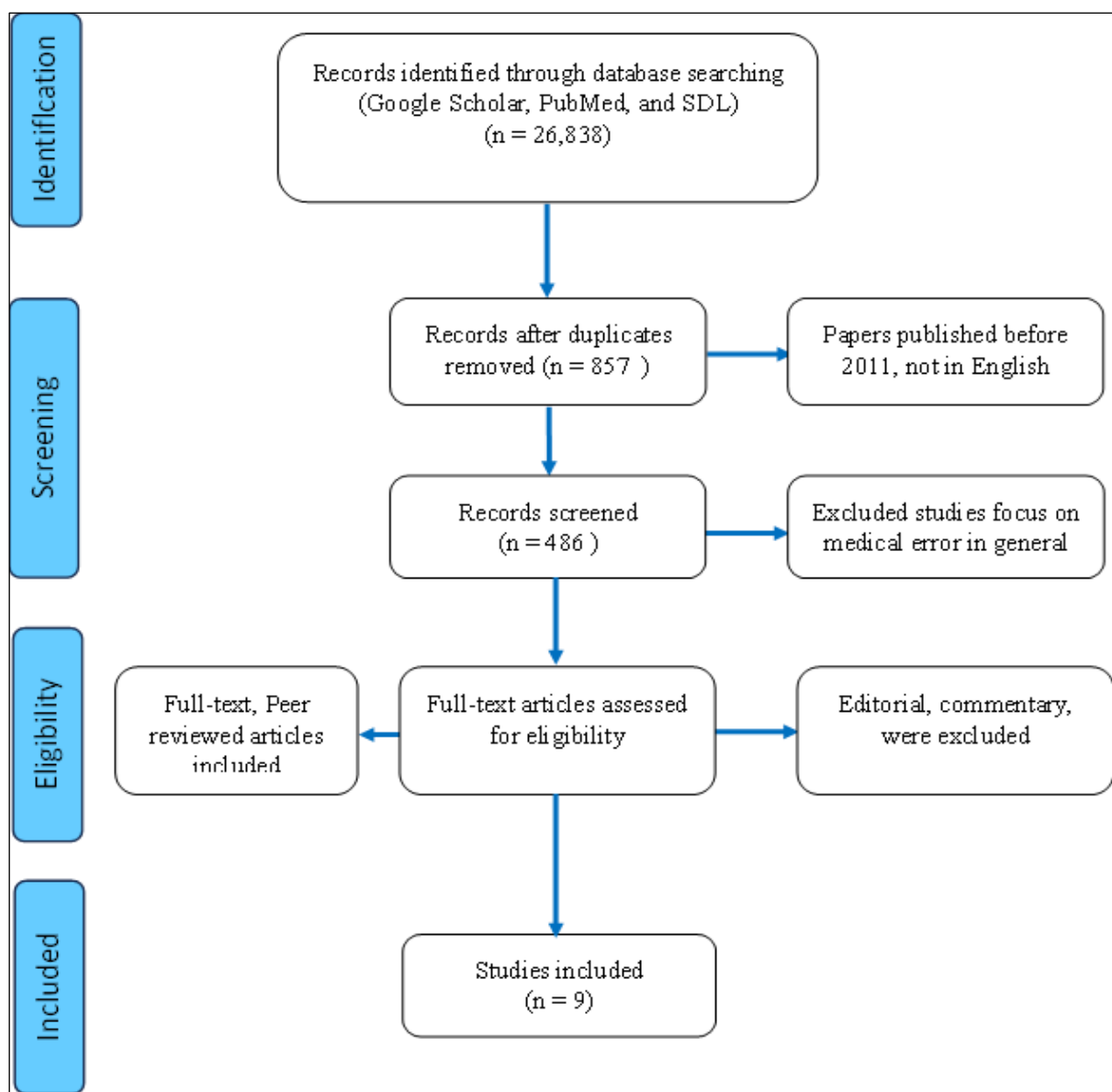
PubMed n= 94, and SDL n= 167) see Table. 1. In the next phase, we remove duplicated study and narrowing our search to only includes studies that focus mainly in reporting medication errors only and excluded studies focus on a medical error in general and the result shows (Google Scholar n= 5, PubMed n= 0, from SDL n= 4), see Table. 1.

**Table 1: Search Strategy**

Database	Initial search	Second search	Final search
Google Scholar	16,800	225	5
PubMed	763	94	0
SDL	9,275	167	4
Total			9 Articles

The residual 9 articles chosen as they met our selection criteria, particularly, they examine the medication errors reporting strategies, see figure.1. The

data extracted from the 9 studies are presented in Table 2.



**Figure 1: PRISMA 2009 flow diagram [Colour figure can be viewed at wileyonlinelibrary.com]**

Table 2. Characteristics of included articles

Author/year	purpose /where	Study design	Data collection tool	Response rate	Rate of medication errors	Finding
Unal, Intepeler, 2020	To develop a web-based, reporting system to increase reporting of ME, blood transfusion errors and patient fall in the pediatric department of a research hospital in Turkey.	Comparative study quasi-experiment	The researcher offered practical Training for 72 doctors and 77 nurses on the reporting of events worked in clinics, numbers of the reports sent to the new system from 2014 to 2015 were monitored and compared to the reports sent the previous year using the written system.	100% All nurses and physicians agreed to participate in the study	reporting rates using a web-based system increased by 21.6% compared to the number of reports sent using the written system. The greatest number of reports involved the inaccurate calculation of dosages or infusion rates (44.4%). The least number of reports implicated on the system was inaccurate packaging and labeling (4%). the near-miss incidents had the highest rate (56.9%) Analysis of patient outcomes indicated that the rate of actual events that affected patients was 43%.	The web-based reporting system makes reporting easy, endorsed the development of a safety culture among nurses and doctors. There was a significant increase in reporting rates 234% increase in MER rate, near-miss errors were not reported while the written system was being used.
Haw, C. & Cahill, C., 2011	to define the first 2 years of working of an electronic system for MER in psychiatry (Medi-Event system). In Andrew's Healthcare charity, Northampton, UK	descriptive analysis of all medication events reported (near misses, errors, adverse effects).	2 year study period from 1 March 2008 to 28 February 2010	Nursing staff (88.8%). involved psychiatrists (6.3%) and pharmacists. (4.5%).	446 incidents reported, 406 (91.0%) were medication errors, 40 (9.0%) were near misses and no adverse drug reactions	Using the Medi-Event system improved the reporting of medication errors, the study period, indicating an incredible increase in reporting rate concerning the prior paper system. The majority (88.8%) of events were MAEs. The greatest common error forms were failure to sign for medication and omission of a medication without valid clinical justification. Although the greatest errors were of minor severity, 6.3% were ranked as moderate or serious.

Silverio et al, 2020	to assess the effect of a new working practice called: Technician Enhanced Administration of Medications [TEAM] on two specialist wards within a children's hospital in the North West of England, and to identify evidence of any potential effect of a ward-based PhT on the reporting of MEs.	Xu et al, 2017	Hutchinson <i>et al.</i> , 2020
to investigate the potential impact of TEAM., an observational pre-and-post cohort design was implemented to detect any effects of TEAM on MEs on two units. implementation.	to investigate the utility of facilitated MRE reporting in finding system weaknesses and relationship between MREs and nurses' work in the ICU. a study conducted in three ICUs in three distinct teaching hospitals in California: two medical-surgical adult ICUs and one medical surgical pediatric ICU.	A quasi-experimental implementation study.	To improve and test the impact of an audit with feedback application strategy that was expected to increase the rate of voluntary MER by nurses at one large, private, nonprofit hospital in Melbourne, Australia.
data collected at two distinct points, before the change in practice arose and after the change has arisen. Each unit was monitored for three months and ME reports were analyzed for the number of reported medication events recorded on the Ulysses risk management system.	observational study	Data collected over a 7 month period. Length of the observations 4 hours. based on the behavioral task analysis (BTA), a formally structured observation that provides quantitative measures used, 124 observations performed during either the day shift (n = 98; 8 AM to 5 PM) or night shift (n = 26; 10 PM to 4 AM). The mean observation length 194 minutes	Data collected from two pair of matched wards (two medical and two surgical) at acute care hospital, conducted from March 2015–Sep 2016. One unit from each pair was randomized to the intervention group, whilst the other was randomized to the control group. Intervention wards obtained the audit with feedback strategy, while control units undertook audit only without feedback. The Template for Intervention Description and Replication (TIDieR) the checklist was utilized to ensure the reporting of execution strategy was complete.
none	none	none	A nonsignificant intervention impact was found in the rate of MER per month. Remarkably, when combining data from both parties, a significant increasing in time trend was observed for MER per month through pre-implementation and implementation phases by an 80% increase.
Ulysses data sets covered six incidents in the pre-intervention time, and no incidents reported by nurses during the intervention time. Throughout the initial three-month period, the TEAM PhT's log of events for the first ward included 152 recorded incidents, prompting 226 actions by the TEAM PhT. The subsequent three months on the second unit saw 88 incidents reported, with 126 associated actions taken by the TEAM PhT.	MREs were reported in 35% of observations. The 60 total MREs included (four medication errors and seven adverse drug Events Of the 49 remaining MREs), 65% were associated with negative patient impact. Task/process deficiencies were the most common contributory factor for MREs. MRE occurrence was associated with increased overall task volume. MREs are also associated with an increased workload, mainly during night shifts.	The audit with feedback strategy established in this study did not effectively impact voluntary reporting of MEs by nurses.	The feedback implementation strategy did not effectively impact the voluntary reporting performances of nurses of MEs. Remarkably, when data from both parties were collected, an improving significant time trend was observed for medication errors reported per month through pre-implementation and implementation phases.
MEs are significantly under-reported in hospital settings, but TEAM PhTs can quickly identify them. Further, putting TEAM PhTs on units may generate opportunities for inter-professional information exchange and improve nurses' awareness of impending MAEs, although this necessitates more facilitation.	The observational study collected and analyzed ICU nurses' self-reported MREs which had related factors that reflected system-level latent errors. Most of the MREs were linked to degraded care processes that either contributed to or could have lead to adverse patient outcomes.		

<p>Guerrero-Aznar <i>et al</i> 2013</p> <p>To analyze the effect of a multidisciplinary and decentralized safety committee in pediatric management ward, and the combined implementation of a computing network implementation for MER, monitoring of the errors, and an analysis of the advances introduced</p> <p>An observational descriptive, cross-sectional, pre-post intervention study</p> <p>Medication errors reports collected by a computer application</p> <p>In the preintervention period, 100% of the errors were reported by the nursing staff were in the postintervention phase 79% were reported by nurses, 7% by physicians, and 14% by pharmacists</p> <p>MER increased 4.6-fold, from 7.6 notifications of medication errors per 10,000 days of stay in the pre-intervention period to 36 in the post-intervention period</p> <p>The rate of medication error reporting was rise post-application of the system. All professional collectives became engaged during the postintervention period. The motivation of healthcare professionals to report has increased, as shown by the significant increase in the reporting of probable errors</p>	<p>Boyle TA, Scobie AC, MacKinnon NJ, Mahaffey T., 2012</p> <p>To determine how staff evaluation of key quality-related event (QRE) reporting process attributes (e.g. ease of use, time to use) and QRE learning (e.g. extent that continuous improvement ensues) vary in community pharmacies in which the QRE reporting process is manual versus computerized. In Nova Scotia, Canada, in 2010</p> <p>Cross-sectional study</p> <p>Mail-based surveys comprise a list of key QRE process attributes that affect error reporting was discovered based on a review of the health care literature and piloted in 2009. The “learning from incidents” create, as captured by Ashcroft and Parker was used to evaluating QRE learning.</p> <p>121 questionnaires, pharmacy managers completed 28 (23.1%), pharmacists 53 (43.8%), and pharmacy technicians 40 (33.1%)</p> <p>community pharmacy QRE reporting processes seem to be easy to complete, cost-effective and involve minimal risk in operations. For the time to complete reporting an error, ease of completion, and cost-effectiveness, no differences were noted between manual and computerized reporting processes. ease of achievement was highlighted as the most widespread strength for both manual and computerized QRE reporting processes. Successively, based on staff assessment, it seemed that computerizing the process did not certainly make it faster or easier to document QREs contrasted with a simple manual type.</p> <p>computerizing the QRE reporting process may lead to a more positive assessment of the reporting process and QRE learning, enhancing analysis capabilities and being well integrated into daily operations, thus facilitating quality improvement. Further, the deficiencies of computerized reporting processes had limitations in lack of anonymity, fear of punitive acts, and low degrees of feedback.</p>	<p>Chalasan, S.H., Ramesh, M., and Gurnumrthy, P. 2018</p> <p>To create and implement medication error-reporting and a monitoring system applying the principles of prospective, voluntary, open, and stand-alone surveillance, in a tertiary care teaching hospital in South India</p> <p>A prospective observational design conducted for three years</p> <p>Data gathered from, MEs including in-patients of either sex admitted to the wards of Emergency Medicine, General Medicine, Surgery, Obstetrics Intensive care units and Gynecology were included in this study</p> <p>none</p> <p>A total of 1310 errors were reported using a paper-based system as it may relatively protect the privacy of the reporter compared to telephonic and electronic systems. The doctors, nursing staff, and clinical pharmacists reported 227 (17.3%), 409 (31%), and 674 (51.4%) errors, respectively, in five selected various study units.</p> <p>Successful creation of medication error-reporting and monitoring program in a tertiary care teaching hospital and is supporting significantly towards the patient safety.</p>
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Kaspar Küng, Thierry Carrel <i>et al.</i> , 2013	to determine the rate and type of MEs, to review the number of MEs avoided by registered nurses, to assess the effects of MEs for patients, and to compare the number of MEs reported by a newly established medication error self-reporting tool to the number reported by the traditional incident reporting system	cross-sectional study	Data on ME were collected using an investigator-developed medication error self-reporting tool (MESRT)	response rate 84%.	288 MEs were reported via MESRTs The incidence of ME was 1.2% based on reported ME with the total administered medication doses	Comparatively, many more MEs were reported via MESRT (n = 288) than with the traditional system CIRS (n = 7). The MESRT established is simple to use, and it is clear for nurses what to report as an ME. No login to a computer system is necessary to complete a MESRT. MESRT respects anonymous reporting rigorously. The identical pocket-size booklet lets nurses anonymously report an ME right after its incident. By reporting the ME anonymously, fear of blame as a cause of reporting an error can be avoided.
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**Table 3: Quality Appraisal of studies**

Item	Guerrero-Aznar <i>et al.</i> , 2014	Küng <i>et al.</i> , 2013	Silverio <i>et al.</i> , 2020	Hutchinson <i>et al.</i> , 2020	Xu <i>et al.</i> , 2017	Unal & Intepeler, 2020	Haw & Cahill, 2011	Boyle <i>et al.</i> , 2012	Chalasan, <i>et al.</i> , 2018
Selection biases	1	2	2	2	3	2	2	2	2
Study design	2	2	3	1	2	1	2	2	2
Confounders	N/A	1	3	2	3	2	N/A	N/A	2
Blinding	1	1	1	1	1	1	1	1	1
Data collection method	2	2	3	1	1	3	2	1	2
Withdrawal and dropouts	N/A	N/A	N/A	2	N/A	N/A	N/A	N/A	N/A
Intervention integrity	1	1	Can't tell	Can't tell	Can't tell	1	2	1	2
Analysis	1	1	1	1	1	1	1	1	1
Overall Quality	Strong	Strong	Weak	Strong	Weak	Moderate	Strong	Strong	Strong

Note: 1= Strong (no weak rating); 2= moderate (one weak rating); 3= weak (two or more weak ratings); N/A Not applicable

### 2.3 Data Evaluation Stage

Because of the various methodologies of primary resources included in an integrative review, evaluating its quality is might be difficult. As a result, the data evaluation stage is relying on the sampling frame chosen (Whittemore and Knafl, 2005). All studies included in this review were quantitative studies. The quality of these articles was assessed by using the Quality Assessment Tool for Quantitative studies which were developed by the Effective Public Health Practice Project (EPHPP) (1998), see (Table.3). This standardized assessment method was created to evaluate the quality of quantitative studies and make recommendations based

on the result. Its final result is divided into eight parts: selection biases; study design; confounders; blinding; data collection methods; withdrawal and dropouts; intervention integrity and analysis, each with a methodological rating of strong, moderate, or weak.

The overall assessment of the studies included according to quality assessment tool used for articles appraisal showed that 6 of these articles are strong while 1 is moderate and 2 weak as for evaluation of study sample and whether it is representative for the target population, only one article is strong in this point while 7 are moderate and 1 weak. In the study design, most of



the articles were cross-sectional and observational studies, so their rate is moderate as per the assessment tool and 2 were strong as they adopted experimental design. The data collection tools used in the studies were valid and reliable in 3 among 9 articles while validity assessment was conducted in 3 articles but reliability assessment was not mentioned. The withdrawal was not assessed because it is not applicable, appropriate analysis method was used in all of the studies so in this section all of them rated as strong.

## 2.4 Data Analysis Stage

Data analysis in research reviews necessitates the ordering, coding, categorization, and summarization of primary source data into a cohesive and coherent conclusion about the research topic, data analysis in an integrative review includes data reduction, data display, data comparison, conclusion drawing, and verification (Whittemore and Knafl, 2005).

### 2.4.1 Data reduction and Display

The first step in data reduction is to come up with a general classification system for handling data from various methodologies (Whittemore and Knafl, 2005). To allow analysis, the primary sources included in the integrative review must be split into subgroups according to some logical system (Whittemore and Knafl, 2005), because the articles in this review are limited and have many similar aspects, therefore, subgrouping was not used. The articles are only organized according to the type of strategy used to report medication error whether computer or paper-based system.

The next step in data analysis is data display, which entails combining data from various primary sources into a display that assembles data from different primary sources around specific variables or subgroups. Data visualizations may take the form of matrices, graphs, or charts, and they serve as a starting point for comparing data from various primary sources. These exhibits help with the visualization of the associations within and across main data sources (Whittemore and Knafl, 2005), all identical data extracted from the articles were arranged into a spreadsheet (Table 2).

### 2.4.2 Data comparison

Data comparison is an interactive process of investigating primary source data displays to find patterns, themes, or relationships among them is known as data comparison (Whittemore and Knafl, 2005). Five of these articles compared computer-based or software-based strategies with a paper-based system, two among the reviewed articles were compared the error reporting rate before and after implementing such strategy, one article only examined the strategy of hiring pharmacist technician to assess nurses with medication process and examine the impact of his presence on medication error

occurrence and rate of medication error reporting, one article assessed the effect of pharmacist initiative reporting system in which the reporter can choose whether paper, electronic or telephone-based system to report MEs.

Medication error reporting rate varies according to the reporting strategy adopted. Most of the studies indicated that the use of computerized or electronic software to report medication errors had a significant impact on increasing the rate or number of reports of MEs, using medical error reporting software increased the number of reports to 216% compared with a written system (Unal & Intepeler, 2020). Network computerized system contributes to increasing the rate of reporting to 3.7 per 10000 days of hospitalization (Guerrero-Aznar *et al.*, 2014). Haw & Cahill (2011) reported that within 2 years of using a computerized reporting system around 406 MEs reported and it was higher in frequency compared with the previous paper-based system of MEs reporting, structure observation of the medication process filling a self-reporting error strategy were showed improvement in MEs reporting rate compared to the traditional paper-based system as one ME reported in each one-third of 4 hours observation (Xu *et al.*, 2017).

On the other hand, a study revealed that most of the medication errors reported were through the paper-based system rather than by electronic or telephone-based strategy and they were a total of 1310 reports during the study period (Chalasan, Ramesh & Gurumurthy, 2018). In the study conducted by Küng and his colleagues (2013) in Swiss, they found that self-reporting tools developed in the hospital, which is a pocket-size booklet composed of 13 items specified to medication error frequency and types, resulted in 288 MEs were reported compared to 7 MEs were only reported using the traditional incident reporting system. Other strategies as the Audit with Feedback strategy and Technician Enhanced Administration of Medication model did not affect the increasing rate of MER as shown in studies conducted by (Hutchinson *et al.*, 2020 & Silverioa *et al.*, 2020).

Only 3 articles examined the ease of using such a strategy in reporting MEs. The finding was contradictory as the study conducted by Unal & Intepeler (2020) revealed that using computer-based strategy was easier while Küng, *et al.*, (2013) and Chalasan Ramesh, & Gurumurthy (2018) found that paper-based is easiest to use as it does not require access to a computer.

## 2.5 Discussion and Limitation

Analyze of the included articles revealed that whether the strategy applied is a computer or software or it relies on the paper-based system it will not affect the rate of reporting of MEs but, rather the features associated with the strategy adopted to play a significant role such as anonymity and non-punitive system, there is no unified and consistent finding between the studies on

computer-based or paper-based system. A study performed by Küng & his colleagues (2013) displayed that paper-based system was associated with a high reporting rate of medication error due to anonymous reporting and easiness of use, other study found that there is no difference between the computer-based and paper system on a term of time-consuming, ease of using and cost-effectiveness while the computer-based had a limitation on lack of confidentiality of the reporter (Boyle *et al.*, 2012).

In the study where the web-based system was modified to ensure the confidentiality of reporters the rate of reporting became higher than the traditional paper system (Unal & Intepeler, 2020). Staff awareness and training in using such a strategy were showed to increase the effectiveness of its implementation and lead to the desired expected outcome (Haw & Cahill, 2011). Some strategies like hiring pharmacist technician to support nurses with medication administration process and error reporting and using of audit and feedback strategy did not significantly affect the reporting rate among the nurses while it may provide a chance for sharing information between them, raise nurses awareness regards the pharmacist role in medication management (Hutchinson *et al.*, 2020; Silverioa *et al.*, 2020). To make the strategy effective it should be modified so that it combines all features that make its use easy and successful such as adding an anonymity feature and providing open and accessible login in. Non- blame culture should be rooted and disseminated as the fear of punishment is one of the main obstacles and barriers to reporting MEs.

This review has a limitation as the majority of articles were outdated. In one of nine studies, the sample was not representative so the finding can't be generalized, these studies did not investigate the impact of strategies used to enhance patient safety culture. For a broader and clear understanding of the phenomena, more future research is recommended.

### 3. Implication for Nursing Management

This review added to the body of knowledge about the different strategies for reporting medication errors and it will contribute to assisting the leaders and policymakers in examining the most effective among them or modifying the existing one to become more effective. Features such as anonymity and non-punitive reporting, non-blame culture must be disseminated for enhancing the reporting. Nursing leaders need to collaborate with the pharmacist to design a feasible and unified system for reporting MEs and they have to train the staff in operating it. Staff involvement and awareness about the system will assess in raising its applicability so, it's worthy for the leaders to provide the nurses with appropriate training on any system they utilized for reporting. Nursing leaders have to recognize the barriers against reporting medication errors and formulate an action plan to overcome these barriers. Periodic and continuous assessment of the reporting system must be

applied to examine its applicability or notifying any drawbacks that may inhibit achieving the desired goal for implementing the reporting system.

Apprehending staff perceptions of the reporting process is important as it eases the use. Therefore, such assessments will help nurse managers identify possible reasons why reporting process may not be extensively used by nursing staff. Any newly designed reporting systems should be suitable for integration with the systems used in health institutions. Systems should be designed to enable a comparative analysis of the data (e.g. the types, causes of errors) using standardized terms to classify them.

It is also important for a nursing leader to ensure that new staff is given time to familiarize themselves with the medication administration process, they have to understand the error reporting process and they must ensure that will be used for improvement aim not for punishment. Dissemination of non- blame culture should be in place and it is recommended for the nursing leader to embody this culture. Error reported having to be analyzed to know the gaps and defect and formulate an action plan for improvement followed by continuous measurement of the impact of the action taken on medication error accruing.

## CONCLUSION

Nurses are the primary care provider for the patients. Their ability to report medication errors is a vital competency they must master because it is linked directly to medication safety. Either utilizing the web or computer-based strategy or adopting a paper-based method itself not affect the reporting rate, however, features associated with the reporting system, which granted anonymity and a non-punitive system, had a significant role in the rate of the reporting system. Other factors had limited effectiveness in improving reporting systems, including staff awareness and training to apply reporting strategies. Adequate understanding of HCPs characteristics and organizational factors that influence error reporting can foster the development of effective strategies to report medication errors and enable organizations to enhance patient safety.

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