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Significance of Medication Error in the Field of Pharmacy: A Comprehensive Review

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A B S T R A C T

Medicines have been commonly utilized in Healthcare (HC) and have played a significant part in treating patients for the past three decades. However, a critical challenge within the field of pharmacy practice is represented by Medication Errors (MEs), thus impacting patient safety, HC systems, and overall public health. Since MEs contribute to enhanced HC costs, they not only threaten patient safety but also execute a considerable financial burden on HC systems. As errors make HC resources a difficult one, treating harmful effects, hospital readmissions, and extended stays are significant. Quality of care is the other major problem with MEs. Administration is essential to ensure accurate medication for providing high-quality HC. Patient outcomes and overall care effectiveness could be affected by errors. For patient welfare, HC quality, and maintaining public trust in pharmacy services, recognizing MEs is also significant. Therefore, the objective of this review is to analyze the importance of MEs in the field of pharmacy. This comprehensive review delves into the various dimensions of MEs like types, risk factors contributing to a ME, preventive strategies for ME, technological solutions mitigating ME, economic impacts of MEs, and the challenges in addressing errors worldwide.

Keywords: Medication errors, Healthcare, Dispensing errors, Pharmacy, Prescribing errors, Barcode technology and Clinical Decision Support Systems

1. INTRODUCTION

Safety and quality of patient care are identified as major concerns in HC firms worldwide. Patient safety is regarded as a vital component of the quality of HC [1]. The HC providers also deemed patient safety as the most noteworthy concern in clinical settings. For HC providers, medical errors are a major risk to the welfare of the patients [2]. For HC organizations, medical errors are significant in addressing their prevalence and understanding their causes and contributory factors. Poor medication systems or human factors like tiredness and shortages of staff influence prescribing and monitoring practices, and this consequence causes disability or even fatality. These types of situations are termed as MEs [3]. The sources of MEs are explained in Figure 1. MEs may cause legal actions, malpractice claims, and potential financial penalties when it occurs. Errors related to medication can have serious consequences that range from adverse reactions to life-threatening situations. In addition, different complications like drug patients and toxicity can be caused by MEs. This kind of complications can also further cause prolonged hospital stays and improved morbidity [4]. A legal complication is that patients and their families may lose trust in the HC provider when an ME occurs [5]. HC providers have a duty of care to their patients, and this extends to prevent harm whenever possible. Ethically, prioritizing patient safety, continuously improving processes, and learning from mistakes are essential for ensuring the highest quality of care [6].

Nomenclature

HC: Healthcare

MEs: Medication Errors

CDSS: Clinical Decision Support System

eMAR: Electronic Medication Administration Records

RFID: Radio Frequency Identification

ADS: Automated Dispensing Systems

CPOE: Computerized Physician Order EntryCfurther nomenclature continues down the page inside the text bo

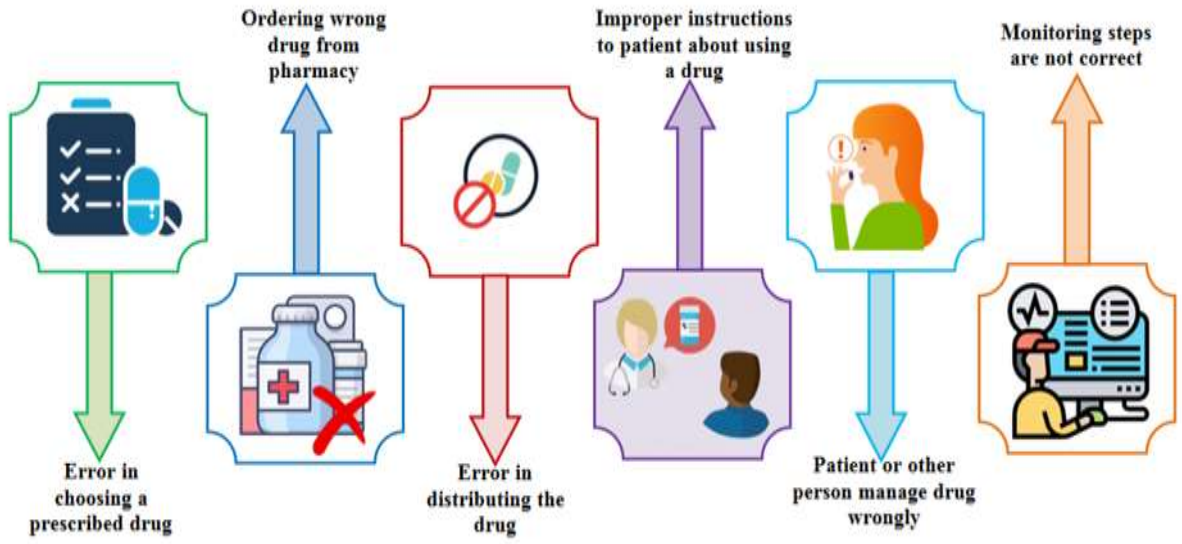

Figure 1: Sources of Medication Errors

MEs **have a major role in the pharmacy field.** For interpreting prescriptions and dispensing medications accurately, pharmacists are responsible [7]. Some of the MEs that are involved in the domain of pharmacy are as follows:

- ✓ Errors may also happen during the writing of prescriptions like illegibility or incorrect details [8].
- ✓ Pharmacists contribute significant data to patients about how to take their medications accurately. Here, the outcome can cause MEs if there is a lack of data [9].

Thus, avoiding MEs is necessary for balanced prescribing in which the choice of medicine aligns with the patient's condition and optimizes the benefit-to-harm ratio [10].

After the introduction (**"Section 1")**, the paper is structured as follows: **"Section 2"** presents the Research Questions (RQs) and article-choosing strategy to make the review clear. **"Section 3"** explains the study of the importance of ME in the area of pharmacy. **"Section 4"** describes the summary of the study to know the outcomes attained via the study. Lastly, the survey ends with significant outcomes, suggestions, and future recommendations in **"Section 5".**

2. RESEARCH QUESTIONS AND DATA SOURCE OF SELECTION STRATEGY

It is a must to explain the RQ if the work is about a systematic survey. In the literature review, the RQ plays a vital role by concentrating on the specific aspects associated with the objective. The RQ aids in assembling the review by collecting them based on question structure. Accurate research outcomes are clearly attainable and precise to the relevance of the questions.

2.1 Research questions

In Figure 2, the framed RQs are categorized into 5 types. In order to make the survey paper more innovative, the RQs must be responded.

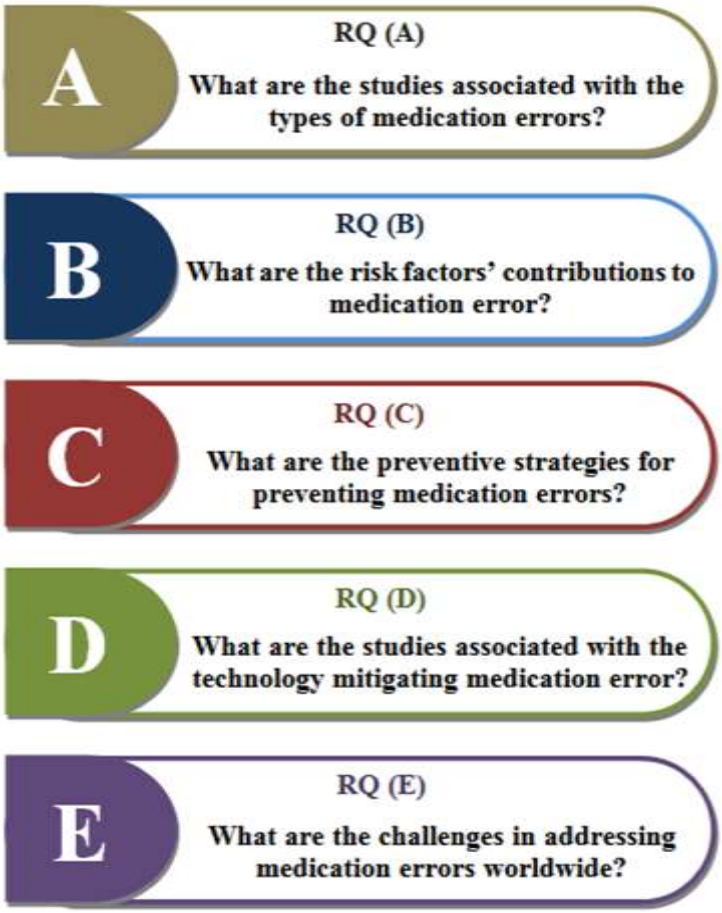

Figure 2: Framed RQs

2.2 Search strategy

For gathering useful materials from the located data, the search process should be more effective. For extracting significant and related information from the collection of data, the search was done meticulously. For the purpose of getting solutions for the questions, the related researches are searched by employing related keywords. When utilizing the provided keywords, the research process is found to be accessible.

2.2.1. Resources of search

Contributing advice on how to create the search protocol and the strategy for identifying the most associated evidence for the presented research is the main aim. Search resources will also focus on how to search the published and unpublished literature utilizing a number of online resources. Table 1 explains the significant details like sources, databases, database insights, and selection of papers in search resources.

Table 1 - Sources, Databases, Database insights, and Selection of papers in search Resources

Sources	*Databases*	*Database Insights*	*Paper selection*
In order to take data that is associated with the objective of the research, the study is performed on the respective best academic search engines like IEEE Xplore, Elsevier, Springer, and Google Scholar. The search focused on research materials associated with "Significance of MEs in the domain of pharmacy" within the time frame from 2016 to 2023.	**Significant databases include Scopus, Science Citation Index Expanded (SCIE), and Web of Science (WOS), which assist in recognizing the research papers.**	**When compared with the other important databases, Scopus is found to be distinct. Scientific journals and conference proceedings are available in the Scopus database, which will be the best resource for researchers.**	**Lastly, for this systematic review, 50 papers were chosen. The papers were picked centered on the predetermined criteria.**

Figure 3 shows the graphical representation of the search outcome of this literature survey after the analysis of significant details in search resources.

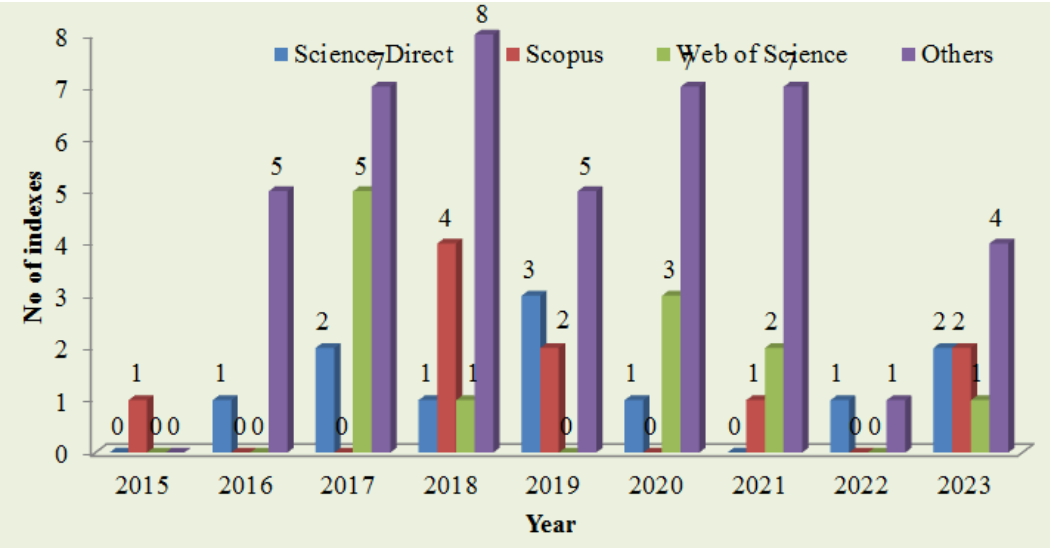

Figure 3: A graphical representation of the search outcomes of the study

2.2.2. Initial selection criteria

Language and Year: Research studies that are only in the English language have been included. The research articles that were published between 2015 and 2023 were concentrated on in this study.

Topic Association: In the analysis, the association of the topic with the desired domain has been considered.

2.2.3. Exclusion criteria

The exclusion criteria are evaluated after the inclusion criteria. Based on the following criteria, the papers were excluded. The criteria are as follows,

- Articles associated only with pharmacy were omitted.
- Articles that were published before 2015 were omitted.
- Papers explaining the issues associated with MEs have been purposely excluded.

3. LITERATURE SURVEY ON THE IMPORTANCE OF MEDICATION ERROR IN THE FIELD OF PHARMACY

Investigating MEs that assist in comprehending their prevalence, severity, and consequences is essential. In addition, for improving patient care, reducing errors, and ensuring optimal medication utilization in the domain of pharmacy, research is a must.

Therefore, this survey paper is created to offer the types of MEs, risk factors contributing to MEs, preventive strategies for MEs, technological solutions mitigating MEs, the economic effect of MEs, and the challenges in addressing errors worldwide.

3.1. Types Of Medication Error

HC professionals and patients are assisted by understanding the different types of errors to recognize potential risks [11]. Preventive measures can be taken by being aware to avoid harm. Some of the significant MEs are administration errors, prescribing errors, monitoring errors, and dispensing errors [12, 13]. The target interventions could be enabled by understanding these types of errors in depth. For example, optimizing the prescription legibility at the time of dispensing can diminish risks [14]. To increase safety and optimize patient results, addressing MEs needs a collective effort among HC professionals, patients, and systems [15]. Table 2 tabulates the studies associated with the types of MEs in the domain of pharmacy. Some of the significant parameters are Errors Detected (ED), Mean (M), Incidence (I), Filled Prescriptions (FP), Wrong Quantity (WQ), and Overall Rate of Medication (ORM).

Table 2- Studies related to the types of medication error in the pharmacy field with its attained findings and limitations

Author name	*Errors*	*Time period*	*Pharmacies*	*Findings*		*Limitations*
Yaser, *et al.* [16]	Dispensing errors	March 2016 to June 2016	7	ED 35 (0.80%)	M 2.77±1.16	Since only five pharmacies were available in one city (Ibb city), this study's sample size and location were low.
Marja, *et al.* [17]	Administration errors	2007-2016	1	ED 152 (66.4%)	*	Additional education for the safe handling as well as administration of drugs was not analyzed.
Yaser, *et al.* [18]	Dispensing errors	Jan 2017 to April 2017	5	ED 47 (0.82 %)	*	The design of the study itself was self-reported, which might cause underreporting of Dispensing errors.
Nora, *et al.* [19]	Prescribing errors	March 2016 to April 2017	*	I Prescribing errors diminished from 1660 in P0 to 622 and 401 in P1 and P2, respectively.		In the analysis, the use of perspective control groups was prohibited by the ethical issues.
Sandeep, *et al.* [20]	Dispensing errors	31 May 2017 to 13 June 2017	3	ED 68 detected in adult outpatient pharmacy	FP 2.10%	The time frame for conducting the study may be too short.
Derar *et al.* [21]	Dispensing errors	October 2019 to February 2020	350	ORM 24.60%	WQ 37.90%	Education of community pharmacists and their teams should be optimized to ensure safe dispensing practices.

Chen, *et al.* [22] assessed the monitoring of MEs to diminish the incidence of MEs in a clinical setting. January 2014 to June 2014 was the time period for the study. The ME-monitoring system was created by the Xiamen Maternity and Child Care Hospital. As per the outcomes, the success rate of pharmacy interventions elevated from 95.25% to 96.88%. Nevertheless, it was found that the non-human associated errors diminished from 44.25% in 2014 to 37.94% in 2015 after two years of time period.

Sara, *et al.*[23] explained the dispensing error analysis that was performed by 1st-year pharmacy students in a virtual dispensing assessment. Errors in drug quantity, prescriber selection, and number of repeats were analyzed quantitatively. The time period was between the years of 2017 to 2019. Results indicated that higher frequencies in the NSAID route (35%), Hormone Replacement Therapy (HRT) duration (32.9%), and HRT special instructions (50%) were exhibited by the dispensing errors.

Kumiko, *et al.*[24] presented the intravenous medication, administration errors, and frequency associated with smart infusion pumps as a multihospital observational study. In the study, a total of 10 hospitals of diverse sizes from different ranges of vendors were engaged. It was found from the outcomes that a total of 478 patients and 1164 medication administration were estimated. Errors associated with administration were present in the prescriptions of 699 (60%) patients.

Dessalegn, *et al.*[25] analyzed the community pharmacist's perception of the dispensing errors in the location of Gondar town, northwest Ethiopia. Through the normal sampling method, 47 community pharmacists were chosen for the analysis. It was found from the outcomes that when compared

with the counter group, most of the respondents were in the age group of 23 to 28, and the owners rated dispensing with wrong dosing instructions were higher ($P< 0.05$).

3.2. Risk Factors Contributing To Medication Error

Risk factors that contribute to MEs are heterogeneous and can evolve from numerous aspects of the HC system [26]. For several reasons, namely awareness, prevention, and patient engagement, explaining the risk factors contributing to MEs is crucial [27]. **Some of the significant risk factors contributing to** MEs **are** packaging issues, high workload, Look-**Alike and Sound-Alike Drugs (LASA), calculation errors, wrong dose or lack of double-checking, and communication breakdown [28, 29].** Explaining risk factors for MEs is essential for preventing errors, improving patient outcomes, and promoting a safer HC environment [30]. The research studies that are associated with the risk factors contributing to ME are as follows,

Tiina, *et al.*[31] examined the factor of communication issues related to medication incidents through mixed methodology analysis in Finland. Communication problem was noted as a significant factor like a data source, with the reports count of n=500. The outcomes showed that 28 communication pairs were identified in the analysis. The final decision concerning text excerpts along with their conversion into numerical data was made via interpretation that resulted in a risk of bias.

Johanna, *et al.*[32] investigated the relation betwixt double-checking (significant factor) and Medication Administration Errors (MAEs) through observational research. The study was performed with 1523 children at a 340-bed tertiary pediatric hospital in Sydney, Australia. As per the outcomes, an overestimation of any beneficial effect of double-checking and an underestimation of the true MAEs rate were caused by the factor.

Nestor, *et al.*[33] assessed the risk of LASA MEs in the hospital (Italian) pharmacy via the model. In the analysis, the Failure Mode and Effect Analysis (FMEA) technique was utilized. It was found from the analysis that the critical failure modes in phases 1,2,3 and 4 were optimized by 69.7% in the Risk Priority Number (RPN). In the analysis, consistent implementation of these automated systems was still needed.

Retha, *et al.*[34] described the risk factors contributing to outpatient pharmacy associated with MEs via the Malaysian prospective multi-center study. It was found from the outcomes that a total of 187 errors were identified and 59.4% were found to be medication filling errors. The wrong drug of about 39.6% was found to be the highest type of filling error when compared with other drugs.

Georgia, *et al.*[35] investigated the wrong dose as well as wrong drug (dispensing errors) detected in pharmacist professional liability claims. The study was done betwixt the time period of 2012 and 2016. To detect patterns as well as trends, the outcomes were analogized with the 2013 claims dataset. As per the analysis, the percentage of claims associated with wrong dose dispensing errors diminished from 43.8 % in the year 2013 to 36.8% in the year 2018 when compared with the 2013 dataset.

Muhammad, *et al.*[36] explained the risk factors related to MEs amongst patients. To analyze the effect of different risk factors on the prevalence of MEs in patients who suffer from chronic diseases, multiple logistic regression analysis was utilized. It was found from the analysis that minimizing the workload on a physician was positively related to averting the MEs' risk.

Kim, *et al.*[37] scrutinized the risk factors associated with the patients who were reported with MEs in the 1 community pharmacy from a total perspective. The quantitative method was utilized as a sample of participants filling their prescriptions at one pharmacy in Canada. It was found from the outcomes that knowledge of consumed medication has been minimized and was closely associated with the probability of an ME by 3.6 times.

3.3. Preventing Strategies For Medication Errors

Augmenting patient safety and minimizing the occurrence of mistakes during the medication process is the purpose of preventive strategies associated with MEs [38]. By preventing the errors, unnecessary costs associated with treating medication-associated complications could be avoided [39]. Preventive strategies play a substantial part in protecting patients and maintaining high standards of care. Preventive evidence-centric approaches assist HC providers with safe medication practices [40]. Some of the significant preventive strategies associated with MEs are **medication review,** Tall Man Lettering (TML)**, Clinical Decision Support System (CDSS), double checking,** and medication reconciliation.

- **Clinical Decision Support System (CDSS):** CDSS is combined with pharmacy software to offer real-time alerts for potential drug interactions, allergies, along with dosing errors [41].
- **Double Checking:** Double-check procedures are executed for high-alert medications at the time of dispensing and administration [42].
- **Medication reconciliation:** Medication reconciliation ensures that accurate medication lists are maintained and reviewed at each transition of care [43].

When the approaches are consistently applied, the incidence of MEs can be significantly diminished [44]. Some of the research papers associated with the prevention strategies for MEs are as follows,

Naomi, *et al.* [45] described the pharmacy guide's effect on the medication reconciliation program. The study was performed during the time period of October 1 and November 17, 2015, in the hospital of Sarasota Memorial. It was found from the outcomes that 1762 medication history inconsistencies were detected among the population of 200 patients. Attained outcomes assisted the usage of a pharmacy-led medication program for optimized continuity of care to the patient.

Amy, *et al.* [46] examined the double-checking's impact on the diagnosis of MEs. During the simulation, the evaluator recorded the double-check utilization, errors were identified, and data were observed concerning the nurse's behavior. Analysis indicated that when comparing the nurses in the double-check group, 54% of nurses in the single-check group recognized the wrong vial error.

Sara, *et al.* [47] assessed the **CDSS** to optimize medication safety. In the clinical practice, a multi-disciplinary team defined the system that focused on MEs. As per the analysis, the % of accepted interventions was the same in surgical units (68%), medical units (67%), and critical care units (63%). Nevertheless, this study didn't investigate the effectiveness in the prevention of Adverse Drug Events (ADE).

Segal, *et al.* [48] investigated medication drug prescription errors and ADE by utilizing the application of a probabilistic as well as machine learning centered on a **CDSS** in an inpatient setting. For the time frame of 16 months, all drug prescriptions were noted. It was found from the outcomes that 85% of the alerts were confirmed. In addition, variations in subsequent medical orders were caused by 43 % of the alerts.

Quentin, *et al.* [49] described the impacts of TML on the usage of diagnosing MEs. The study was performed at the University Hospital Zurich, Zurich, Switzerland. Analysis signified that an important reduction in the error rate from 5.3% (8 of 150 in non-TML-coded sets) to 0.7% (1 of 150 in TML-coded sets, $p<0.05$) was guided by TML coding of syringe labels.

Dorthe, *et al.* [50] explained the impacts of medication review in high-risk patients as a randomized controlled trial. In a Denmark hospital, the trial was conducted. Analysis was done with 64 patients only. It was found from the outcomes that a total of 63 prescribing errors in 37 patients were found by the applied strategy medication reviews, and there were no variations in the prescribing error count at the time of hospitalization.

3.4. Technological Solutions Mitigating Medication Error

It is important to understand technological solutions for reducing MEs. These solutions play an essential role in augmenting patient safety and diminishing the risks associated with medication administration [51,52]. Some of the significant technologies are bar code technology**,** telepharmacy**,** electronic Medication Administration Records (eMAR), robotic systems, Radio Frequency Identification (RFID), Automated Dispensing Systems (ADS), and Computerized Physician Order Entry (CPOE). Utilizing technological solutions can significantly diminish MEs, augment patient safety, and enhance overall HC outcomes [53, 54]. Issues Regarding Medication (IRM), Mean Number (MN), Rates of Dispensing Errors (RODE), Administrative Error Rate (AER), Savings in Average (SA), β coefficients System Quality (SQ), and Information Quality (IQ) are the parameters utilized in the findings of studies. Table 3 tabulates the studies associated with the technological solutions for mitigating MEs.

Table 3- Studies associated with the technological solutions in mitigating medication error with its time period, participation, findings, and limitations

Author name	***Technology***	***Time period***	***Participation***	***Findings***		***Limitations***
Stefan, *et al.* [55]	CPOE	1st phase: July–Nov2012 and 2nd phase : May–Sept 2014	Phase 1: 333 patients and Phase 2: 320 patients	IRM Totally, 3966 issues were observed.	MN MN per patient diminished from 1.69 to 0.71 ($p< .01$)	The effect on the frequency, as well as the incidence of ADEs with clinically relevant patient harm, was not analyzed.
Hui, *et al.* [56]	ADS	Pre-period: Sept 2019 to Feb 2020 and Post-period: Septr 2020 to Feb 2021	#	RODE Minimized 3.03 to 1.75 per 100,000 prescriptions	AER Minimized from 0.046 to 0.026%	With the ADC system, the possible human errors couldn't zbe eliminated.
Sara, *et al.* [57]	eMAR	November 2019 to January 2020	16 (84%) nurses participated	Nurses experienced that eMAR provided better control and knowledge regarding the delegated tasks.		In the analysis, the efficacy of the eMAR was not evaluated.
Nishat, *et al.* [58]	Telepharmacy	April 2019 to October 2020	191 patient records	SA $3.5 billion per year	#	It was complicated to compare percentages of patients with MEs and without MEs.
			210 participants	SQ	IQ	

Jen, *et al.* [59]	Barcode technology	Oct 16 to Nov 20, 2014	0.21 (P < .01)	0.61 (P < .001)	The study was done in one study site, limiting the capacity to generalize outcomes.

Arthur, *et al.* [60] described the self-efficacy of nursing students along with the MEs by employing eMAR. ME generations along with the variations that may occur on the basis of nursing students were examined. As per the outcomes, a total of 178 MEs were identified; also, 57 were verification-associated MEs during clinical simulation.

Pekka, *et al.* [61] explained the advanced robotic system for preventing MEs in elderly home-care patients as a pilot study and usability study. In the study, 2 phases, namely phase 1 (n=17 patients) and phase 2 (n=27), were analyzed. It was found from the outcomes that the device was utilized by 17 nursing home patients who had 457 total days in phase 1, and in phase II, home-dwelling patients found difficulty in consuming their medicines (23%).

Sara, *et al.* [62] assessed the effect of barcode patient and medication scanning on nursing workflow at the UK teaching hospital. In the hospital, a comparative analysis was done. The time frame was betwixt November 2019 and December 2019. Findings indicated that the patient identification rate was enhanced from 74 % patients to 100% by utilizing the system with 255 medication doses.

3.5. Economic Effect Of The Medication Error

Regarding both patient health and economic burden, MEs have significant consequences. During various stages of the medication use process, including prescription, preparation, dispensing, and administration, these errors can occur [63, 64]. It is essential to analyze the economic impact of the ME in a clear way since HC costs play a noteworthy role in the ME [65]. Some of the existing research associated with the ME is as follows,

Insun, *et al.* [66] described the treatment costs of ME along with the incidence in the admitted patients. From 57,554 patients, information was gathered from 2005 to 2006 from 2 hospitals in the U.S. It was found from the analysis that the treatment costs were $8,439 while utilizing the blinder–Oaxaca decomposition approach, whereas the cost was $8,898 while employing the recycled prediction approach.

Seher, *et al.* [67] examined the potential type, frequency, along with cost of prescription errors for inhaled medication. In the 1st phase, the types and costs of inhaled prescription errors were analyzed by the prospective study. In the 2nd phase, junior doctor's knowledge was tested by utilizing a quiz. Findings indicated that £45.50 was the average cost for supplied medication. Also, about 14 % of prescriptions were not correct before intervention.

Mehdi, *et al.* [68] explained the economic value of pharmacist-led medication reconciliation for diminishing MEs subsequent to hospital discharge. To note the incidence of drug-associated events, the discrete-event simulation model was generated. Outcomes showed that the $472 was the total cost of ADEs. The direct effect of medication reconciliation interventions was shown by only a few studies.

Rachel, *et al.* [69] described the economic analysis of the prevalence, clinical, and economic burden of ME in England. To compute the annual number and errors, the UK-centered prevalence of MEs was utilized. Findings signified that £98 462 582 per year was the cost of the applied ADEs. The study's limitation was that the analysis only included short-term costs and patient results.

Grainne, *et al.* [70] examined the costs as well as consequences associated with ME at hospital discharge as an expert judgment study. 4 practicing physicians in general practice participated in the analysis. It was found from the outcomes that based on all 81 cases, the mean calculated cost per case was €1009.58, 95% CI 726.64 to 1585.67. The mean Quality-Adjusted Life Year (QALY) loss was 0.03 (95% CI 0.01 to 0.05).

3.6. Challenges In Addressing Medication Errors In Worldwide

Globally, more challenges exist in HC systems, although there are technological solutions to prevent MEs [71]. These errors can happen at diverse stages of the **medication use process**, causing harm, disability, and even death [72]. The challenges associated with MEs worldwide are shown in Table 4.

Table 4- Challenges associated with medication errors worldwide

Challenges	**Explanation**
Risk situations	An emergency department improves the risk of MEs in a hospital. Stress and urgency provide risk situations [73]

Fewer resources in developing countries	Because of restricted infrastructure, training, and access to technology, there were distinct challenges in many developing countries [74]
Difficulty in the medication process	The medication use process involves multiple steps from prescribing to administration. Owing to factors like fatigue, poor environmental conditions, or staff shortages, errors can occur at any stage [75, 76]. Addressing these complexities requires coordinated efforts across HC settings.
Universal Collaboration	There is a necessity for combined efforts associated with MEs across diverse countries [77].

For patient safety, addressing ME challenges is important; also, to improve medication systems and reduce harm globally, concerted efforts are needed.

4. SUMMARY OF THE REVIEW

In the HC and pharmacy sector, ME has been a growing concern in recent years. Many pharmacists as well as physicians have been accused of MEs for the past decades. Investigating the causes, patterns, and consequences of errors associated with medication use is the purpose of ME analysis. HC professionals can identify areas for improvement, develop preventive strategies, and enhance patient safety by systematically examining these incidents. In some of the prevailing research studies, the researchers have discussed the importance of MEs in the domain of pharmacy. The error rates and mean for overall MEs are also analyzed by the research studies associated with the objective. So, a comprehensive review of the importance of MEs in the domain of pharmacy is provided in this paper. For making the review paper more creative, the RQs were categorized into A, B, C, D, and E:

- ✓ **Studies associated with the types of medication errors (A):** This question intends to understand the studies related to the types of MEs and is illustrated in Table 1 of section 3.1.
- ✓ **Risk factors' contributions to medication error (B):** This question's objective is to explain risk factors' contributions to ME, which is explained in Section 3.2.
- ✓ **Preventive strategies for preventing medication errors (C):** This question seeks to explain the preventive strategies for preventing MEs and is explained in Section 3.3.
- ✓ **Studies associated with the technology mitigating medication error (D):** The studies associated with the technology mitigating ME are mentioned in section 3.4.
- ✓ **Challenges in addressing medication errors worldwide (5):** Challenges in addressing MEs worldwide have been explained in section 3.6.

An evidence-based regulation to improve medication safety and quality across all stages of care is provided in this comprehensive review. It emphasizes the global impact of MEs and augments the necessity for coordinated efforts for addressing this critical challenge. Overall, it was found from the analysis of research studies that MEs help in clarifying processes, educating staff, and implementing evidence-centric interventions to diminish risks and optimize patient outcomes.

5. CONCLUSION WITH FUTURE SCOPE

The importance of MEs in the domain of pharmacy is explained in this systematic review. This review also analyzed the studies associated with the risk factors, technology prevention, and economic effects of MEs regarding significance. In economically developed countries, most of the studies were done on elderly populations. Few studies exhibited a significance associated with technologies like bar code technology and CPOE in preventing MEs. It was found from diverse research investigations that wide differences were seen in the ME and error-related adverse event rates. However, in the areas of incidence of MEs, administration errors, dispensing errors, and reporting, more research is needed. The study had a limitation that the attained outcomes weren't deemed for designing future research associated with medication safety. In the future, researchers should consider this limitation and find a solution for designing research toward patient safety. In order to make a clear view of the objective, this review has addressed different categories (A, B, C, D, and E) of RQs. The research is found to be more useful for recognizing the significance of MEs.

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