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Defining Medication Errors, Prescribing Errors, and Adverse Drug Events: A Narrative Review

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ABSTRACT

Background: Medication errors, prescribing errors, adverse drug events (ADEs), and side effects are critical aspects of drug-related patient safety. These errors can occur at various stages of the medication use process, posing substantial risks to patients. **Aims:** The objective of this review was to offer comprehensive definitions of key terms in the healthcare domain namely, Medication Errors, Prescribing Errors and Adverse Drug Events, to enhance healthcare practices by promoting a deeper understanding of the distinctions between these terms. **Methods:** This review explored the existing literature on medication errors, prescribing errors, adverse drug events, and side effects. Multiple databases searched for relevant articles, screened and included. The review summarized definitions and classifications, using a narrative approach to synthesize findings, and case studies were provided for practical understanding. **Results:** Medication errors are overwhelmed by inconsistent definitions, with at least 26 generic definitions identified in the literature. These variations hinder effective communication and research reliability. Standardizing terminology and definitions is crucial for enhancing research quality and patient safety. Prescribing errors encompass errors during the prescription stage and feature varying definitions, with Dean et al.'s comprehensive definition considered a benchmark. ADEs are undesirable outcomes of medical treatment, encompassing actual harm, preventable harm, and non-preventable harm categories. Adverse drug reactions, a subset of ADEs, result from a medication's pharmacological properties. Side effects are secondary effects of treatments, with varying severity and expectedness. Distinguishing between medication errors, ADEs, and ADRs is essential for patient safety and research precision. **Conclusions:** The definitions of medication errors, prescribing errors, adverse drug events, and side effects vary widely across studies, leading to a lack of consensus in the field. The need for standardized, clear-cut definitions is emphasized to improve research validity and enhance medication safety. Additionally, the review distinguished between ADEs and medication errors, highlighting that ADEs can result from factors beyond healthcare providers' control. Also, the difference between side effects and ADE was presented as these terms are mistakenly used interchangeably.

Keywords: Medication errors; adverse events; side effects; prescribing errors; adverse reactions.

Introduction

Medications can help alleviate suffering and aid in healing, however, they also carry the risk of causing various side effects, some of which can be severe or even life-threatening. As medical practices advance and new drugs emerge, the complexity of managing medications increases, making medication errors more likely [1].

Medication errors can occur at any stage of the medication process, including prescription, dispensing, administration, and patient self-management [2]. These errors have various underlying causes, involving healthcare providers in the prescribing and

dispensing stages, as well as patients who have an active role in managing their medications [3, 4].

Drug-related problems are a significant concern in the healthcare practice, encompassing various issues related to medication usage[5]. Patients may be subjected to unnecessary drug therapy, where they are prescribed medications that are not essential for their condition. Also, patients might be taking the wrong drug, which does not effectively treat their medical condition. Furthermore, some individuals may require additional drug therapy to adequately address their health issues, necessitating careful dosing to avoid sub-therapeutic doses, over-dosage, or the need for dosage adjustments [6].

Healthcare professionals must collaborate and stay vigilant to ensure safe and effective medication use, ultimately promoting better patient outcomes and reducing the burden of drug-related issues [7].

Adverse events (AEs), adverse drug reactions (ADRs), and side effects (SEs) represent different types of harmful and undesirable effects related to medications [8, 9]. AEs may not have a direct causal relationship to medications but can be associated with medication errors, incorrect dosing, or allergic reactions [10]. On the other hand, ADRs are noxious and unintended responses to drugs with a direct causal relationship. Side effects, while expected and within the therapeutic range, can still be bothersome to patients, such as antihistamines causing sedation [10].

With the varied terms related to medication use and medication errors, there is a need for properly defining these terms to uncover the misperceptions around them. Hence, the current study reviewed the literature for these terms. Hence, this article aims to comprehensively understand medication errors, prescribing errors, ADEs, and side effects. It also highlights the importance of precise definitions and their implications for patient safety.

The narrative review conducted an extensive search across designated databases, employing specific criteria to identify relevant articles. The review categorizes the terminology and definitions related to medication errors, ADEs, and prescribing errors. This categorization was undertaken to provide healthcare professionals with a comprehensive perspective on how these terms are used and understood within the literature. Additionally, the reviewers thoroughly compared and contrasted the gathered information to facilitate readers in distinguishing between these terms and comprehending their nuances.

The article includes illustrative case studies that serve to reinforce understanding of definitions. These case studies offer practical insights into the concepts discussed. The article also concludes by offering strategies to improve medication errors providing actionable recommendations that healthcare practitioners can implement for enhanced patient safety.

Methods

Study design

This review follows a narrative approach to examine existing literature on medication errors, prescribing errors, adverse drug events, and side effects.

Data search

A comprehensive search was conducted in electronic databases, including PubMed/Medline, Scopus, Google Scholar, and CINAHL, to identify relevant articles published without regard to publication dates. The search strategy incorporated a wide range of keywords and phrases, such as "medication errors," "prescribing errors," "adverse drug events", "ADE", "ADR", "side effects", "drug-related problem", "DRP", to capture a diverse spectrum of literature.

Articles were considered eligible for inclusion if they provided insights into the definitions, classifications, and characteristics of medication errors, prescribing errors, ADEs, and side effects. Articles not available in English or those lacking full-text access were excluded.

Data screening and extraction

Given the narrative nature of the review, two independent reviewers conducted the

initial screening of retrieved articles. The screening process involved a comprehensive assessment of titles, abstracts, and full-texts. Relevant data were extracted from selected articles using a generic extraction form.

The identified definitions and classifications of medication errors, prescribing errors, ADEs, and side effects were summarized in a narrative. Findings from selected articles were synthesized using a narrative approach, with a focus on distinctions and implications of the defined terms. Case studies were integrated to illustrate the practical application and consequences of the defined terms.

RESULTS

Medication errors

The definition of medication errors varies considerably across the literature. The findings from a systematic literature review in 2010 of 45 studies highlighted a significant challenge in the field of medication error research: the inconsistency in defining what constitutes a medication error [11]. According to this systematic review, there are at least 26 generic definitions of medication errors [11]. This inconsistency is compounded by a lack of clear, standardized definitions.

One noteworthy observation is that the definitions used in these studies vary widely, encompassing everything from minor deviations in medication administration to potentially fatal errors. However, there is also one definition that takes a more conservative approach, focusing exclusively on harmful or potentially harmful errors. This diversity in definitions can lead to ambiguity and potentially hinder effective communication and comparison across studies[11].

What is particularly striking is that these variations in definitions and methods of detection are not due to differences in the nature of the errors themselves but rather seem to be influenced by the individual preferences of researchers. This raises concerns about the reproducibility and reliability of research findings in the field[11].

The authors of this review rightly emphasize the need for a standardized, clear-cut definition of medication errors, as well as the use of consistent terminology and reliable detection methods. Such standardization is crucial to enhance the quality and consistency of medication error research. Achieving a commonly accepted definition that clearly defines the scope and content of medication errors should be a priority in future studies. This will not only improve the validity of research findings but also contribute to more effective strategies for preventing and addressing medication errors in healthcare settings [11].

One of the most comprehensive definitions comes from the National Coordinating Council for Medication Errors Reporting and Prevention (NCC MERP), which defines medication errors as "any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer. Such events may be related to professional practice, health care products, procedures, and systems, including prescribing, order communication, product labeling, packaging, and nomenclature, compounding, dispensing, distribution, administration, education, monitoring, and use" [12].

Narrower definitions have been proposed as well. The National Patient Safety Agency (NPSA) defines medication errors as any errors in the medication use processes, encompassing prescribing, dispensing, administering, transcribing, and monitoring [13].

A recent publication regarding defining medical errors as a Continuing Education Activity [14]. The term "medical error" differs from "medication errors" as it covers a broad range of events that differ in their potential to harm patients. The definition of a medical error is "an unintended injury caused by medical management," resulting in "measurable disability." Some experts criticize this definition as "outcome-dependent" and propose a "process-dependent" definition that focuses on the causes of errors, including near misses. This shift would enable more effective preventive strategies.

Defining a medical error as an "omission or commission in planning or execution that

contributes or could contribute to an unintended result" encompasses all measurable adverse outcomes and near misses, including errors in healthcare planning and execution.

According to the Institute of Medicine, an "error" is the failure of a planned action to be completed as intended or using the wrong plan to achieve a goal. Adverse events resulting from medical management, rather than the patient's underlying condition, are categorized as "preventable adverse events." A subset, "negligent adverse events," results from care failing to meet the standard and causing harm.

Regardless of the definition, medical errors have significant impacts, including high morbidity, mortality, and economic burden. They affect patients, families, healthcare providers, support staff, healthcare facilities, and communities, posing a serious threat to patient safety and public health [15].

Prescribing Errors

Prescribing errors refer to medication errors that occur during the prescribing stage [16]. Any definition of prescribing errors should consider the main elements of the prescribing process; for example, the choice of medicine should be appropriate to the patient and the condition. The prescribing process should minimize harm and consider the balance between harm and benefit [17]. Several definitions of prescribing errors have been reported in the literature [18]. Prescribing/ordering of drugs includes a decision-making component and a technical component. Errors can occur in both parts of this process. For example, one definition is an error in the process of prescribing medication that leads to or has the potential to lead to patient harm [17]. Dean and colleagues (2000) used a two-stage Delphi method with healthcare professionals (physician, pharmacists and nurses) having a special interest in medication errors and risk management, to develop an operational definition, concluding that "A clinically meaningful prescribing error occurs when, as a result of a prescribing decision or prescription writing process, there is an unintentional significant [1] reduction in the probability of treatment being timely and effective or [2] increase in the risk of harm when compared with generally accepted practice". In this definition, the word "unintentional" was used to exclude the risk of harm from malicious acts [16, 19]. The statement "compared with generally accepted practice" was included because the preventability of the prescribing error depends on the generally accepted practice. The word "significant" was used to include only clinically meaningful prescribing errors and cognitive errors with adverse consequences, and to ensure that the findings would be relevant and worthy [19]. This definition was accompanied by 27 scenarios that should be included as prescribing errors, eight that should be excluded, and seven where judgment depends on the individual clinical situation. These scenarios provide some clarity on potentially controversial cases to help decide on the inclusion and exclusion of prescribing errors. This definition is widely accepted and has been used in several studies. [19-23]

Another definition of prescribing errors was given by the American Society of Hospital Pharmacists (ASHP). The ASHP defined prescribing errors as "incorrect drug selection (based on indications, contraindications, known allergies, existing drug therapy, and other factors), dose, dosage form, quantity, route, concentration, rate of administration, or instructions for the use of a drug product ordered or authorized by the physician (or other legitimate prescriber); illegible prescriptions or medication orders that lead to errors that reach the patient" [24]. Agalu et al. (2011) defined prescribing errors as a deviation from standard practices (as indicated in national standard treatment guidelines, textbooks, handbooks, and software), excluding dosage form errors, illegible handwriting, and failure to authenticate the prescription with signature and/or date [25]. Dale et al. (2003) defined prescribing error as an error that caused an adverse drug event (ADE) (ADE is an injury resulting from medical intervention related to a drug) or was judged to represent a potential ADE (an error that has the capacity to cause injury but fails to do so either by chance or because it is intercepted) [26]. The Pharmaceutical Care Network Europe [27] classification of drug-related problems was

also used by a few studies [28]. This classification consists of drug selection (the cause of the MPE can be related to the selection of the drug, i.e., no indication for the drug, inappropriate combination of drugs (interactions), indication for drug treatment not noticed, and too many drugs prescribed for indication), drug formulation (the cause of the MPE is related to the selection of the drug formulation), dose selection (the cause of the MPE can be related to the selection of the dosage schedule), treatment duration (the cause of the MPE is related to the duration of therapy), drug use process (the cause of the MPE can be related on the way the patient gets the drug administered), or other problems [27].

Studies investigating prescribing errors in Saudi Arabia have not used a standard definition of prescribing errors[29]. For example, Al-Dhawailie (2011) categorized prescribing errors as "wrong patient, wrong drug, wrong dose, wrong strength, wrong frequency, wrong drug combination, and unclear written medication orders or inpatient drug charts". Another Saudi study defined prescribing errors as "an incorrect or inappropriate drug selection (based on indications, contraindications, and other factors), dose, route, rate of administration, or frequency. A prescription error also included illegible handwriting, an incomplete order (missing the dose, route, or frequency), incompatibility, incorrect instructions for using the drug product, and the use of non-standard nomenclature or abbreviations that require further interpretation." [30]

Both studies provided different definitions of prescribing errors. These differences in definitions led to some inconsistencies. For example, an incomplete medication order was considered a prescribing error by one study [30] and not by the other study [31].

The definition of Dean et al. (2000) is considered the most comprehensive definition available [16]. It provides scenarios of prescribing errors that are very easy to follow and helps to classify the types of prescribing errors. In addition, this definition was widely used by many studies to investigate the incidence of prescribing errors worldwide.

Adverse Drug Events

An adverse event, on the other hand, refers specifically to an undesirable and harmful outcome or reaction that occurs as a result of medical treatment, including the use of drugs[32]. Unlike side effects, adverse events are generally unexpected and may not be directly related to the pharmacological actions of the treatment [33]. Adverse events can range from mild to severe and can pose risks to the patient's health or well-being. For example, an allergic reaction to a medication leading to hives or difficulty breathing would be considered an adverse event.

An adverse drug event (ADE) is an injury resulting from medical intervention related to a drug [34]. ADEs can be classified as potential or actual. Potential ADEs, also known as 'near misses,' do not cause harm but have the potential to do so [13]. Actual ADEs involve harm caused by medication and include both adverse drug reactions (ADRs) and medication errors [18].

The WHO defines an ADR as "A response to a drug which is noxious and unintended, and which occurs at doses normally used in man for the prophylaxis, diagnosis, or therapy of disease, or for the modifications of physiological function" [35].

ADEs can be further categorized as preventable or non-preventable. Preventable ADEs occur due to medication errors and result in patient harm. Examples include prescribing a medication to a patient with a known allergy to that drug or prescribing the correct medication but through the wrong route of administration [13]. Non-preventable ADEs are not caused by medication errors and may include side effects from a medication prescribed for the first time [13].

Different types of ADEs

Various types of ADE exist, and their interrelations are presented in Figure [1]. Preventable ADEs pertain to incidents that could have been forestalled through proactive measures aimed at enhancing medication safety. In contrast, non-preventable ADEs represent occurrences that could not have been

averted, even with the most rigorous and diligent care. Serious ADEs encompass events that result in severe consequences, encompassing outcomes such as death, significant injuries, or necessitating hospitalization. Unexpected ADEs deviate from the anticipated risks associated with a particular medication, standing apart from the known risk profile of the medication [36, 37].

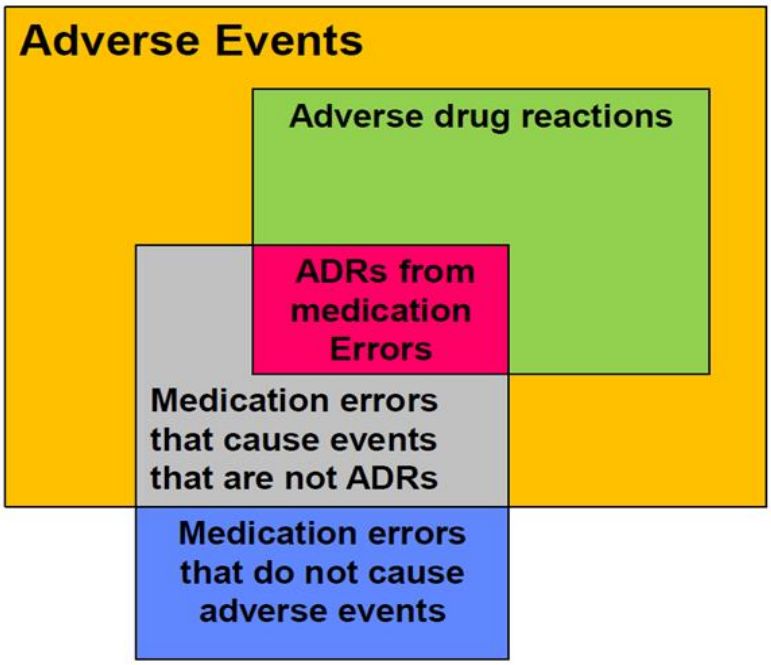

Figure (1): The Different Types of Adverse Drug Events [17].

Side effects

A side effect refers to any secondary or unintended effect of a medical treatment or intervention, such as a drug [38]. These effects can be both beneficial and undesirable and are typically anticipated based on the known pharmacological actions of the treatment. Side effects can be mild or severe, and they may or may not require medical attention. For example, drowsiness caused by an antihistamine is a common side effect that is expected due to the drug's sedative properties [38].

Side effects, although sometimes also referred to as adverse events, it is obvious from the definition of both that they are different in terms of the reason behind their occurrence. Side effects encompass the undesired or unwanted effects that accompany drug usage. These effects can range in severity from mild to serious, necessitating medical attention or even discontinuation of the drug. Additionally, they may vary in frequency, being classified as common, less common, or rare occurrences [39].

It is essential to recognize that all drugs carry the potential to elicit undesirable effects. Some common examples of such side effects include gastric erosion resulting from aspirin use[40], sedation caused by 1st generation antihistamines[41], hypoglycemia induced by insulin[42], and excessive fluid loss triggered by diuretics[43].

To mitigate the incidence and severity of adverse events, proper drug utilization is paramount. This involves various measures, such as identifying high-risk patients susceptible to adverse reactions, ensuring correct and appropriate drug administration, and educating patients about avoiding activities that might precipitate adverse events [44].

By adhering to these guidelines and promoting responsible drug use, healthcare professionals can significantly reduce the occurrence of unwanted side effects and ensure the safety and well-being of patients.

The terms "side effect" and "adverse event" are often used interchangeably in the context of medical and pharmaceutical

discussions, but there is a subtle distinction between them. Table (1) summarizes the differences between these two terms.

Table (1): Comparison of Side Effects and Adverse Effects.

Feature	Side Effect	Adverse Effect
Definition	Any unintended effect of a drug that is not the desired therapeutic effect	Any unintended and unwanted effect of a drug that is harmful or even life-threatening
Frequency	Can be expected or unexpected	Not expected
Effect on treatment	Does not hinder the main effect of the drug	Can hinder the treatment and lead to more complications
Severity	Mild and self-resolving	More severe and life-threatening

Adverse Drug Reaction

Adverse Drug Reactions (ADRs) and side effects are related concepts, but they are not synonymous. While they both describe undesirable outcomes associated with medication use, there are key differences between them. Both are adverse events that result from the pharmacological properties of a medication when taken at therapeutic doses. Also, both are types of adverse events of a drug.

However, side effects are considered as a subset of ADRs. Side effects typically refer to known and expected effects of a medication, often listed on the drug's label or in prescribing information. They are usually dose-dependent and are a natural consequence of the drug's intended action. Classifications of ADRs are shown in Table [2].

The severity of ADRs can vary widely; some may be mild and self-limiting, while others can be severe and life-threatening. The harm caused by ADRs can range from discomfort to organ damage or failure. While not all ADRs are preventable, healthcare providers strive to minimize their occurrence by carefully assessing the risks and benefits of medication use, monitoring patients for potential adverse effects, and adjusting treatment plans as needed.

Table (2): classification of ADRs (Rawlin and Thompson classification)[45]

Type **A**	**A**ugmented	**Dose related – expected pharmacological effects** e.g. respiratory depression with opioids and bleeding with warfarin Not directly related to the desired pharmacological action of the drug. e.g Gastrointestinal Bleeding with NSAIDs
Type **B**	**B**izarre	**Non dose related – more serious – non expected** e.g. anaphylaxis with penicillin or skin rashes with antibiotics
Type **C**	**C**ontinuing	**Dose and time related – related to cumulative drug use, persist for a longer time** e.g. osteonecrosis of the jaw with bisphosphonates
Type **D**	**D**elayed	**After the use of a medicine,** more difficult to detect. e.g. Teratogenicity
Type **E**	**E**nd of use	**Due to withdrawal of the drug** e.g. insomnia, anxiety and perceptual disturbances following the withdrawal of benzodiazepines
Type **F**	**F**ailure	**Failure of therapy, unexpected failure of efficacy** common, may be dose-related and are often caused by drug interactions. e.g. antimicrobial resistance, inadequate dose, or oral contraceptives with specific enzyme inducers.

Relationship between Medication Errors and ADEs

It is important to differentiate between ADEs and medication errors. ADEs are unintended responses to a drug's pharmacological properties, whereas medication errors involve preventable mistakes in the medication use process, such as prescribing, dispensing, or administering the wrong medication [46].

Sometimes, use the terms "adverse drug event" (ADE) and "medication error" interchangeably. It is important to note that these are two different concepts. An ADE is any injury that results from medical intervention related to a drug. At the same time, a medication error is any preventable event that may cause or lead to inappropriate medication use or patient harm. An ADE can be caused by a medication error, but it can also be caused by other factors, such as a patient's underlying condition or a drug interaction [47].

An adverse drug event (ADE) is any injury that results from medical intervention related to a drug. This can include medication errors, but it can also be caused by other factors, such as a patient's underlying condition or a drug interaction [48].

A medication error is any preventable event that may cause or lead to inappropriate medication use or patient harm. Medication errors can occur at any stage of the medication use process, from prescribing to dispensing to administration[49].

ADEs are mostly harmful, but medication errors may or may not cause harm. Additionally, ADEs can be caused by factors beyond the control of the healthcare provider, such as a patient's underlying condition or a drug interaction. Medication errors, on the other hand, are always preventable [46].

On the other hand, ADRs are a subset of ADEs. They specifically refer to adverse events or reactions that are directly related to the pharmacological properties of a medication and occur at therapeutic doses [50].

ADRs are not necessarily the result of medication errors but can occur when a medication interacts with a patient's body in an unexpected or harmful way.

ADRs may be dose-dependent or idiosyncratic (unpredictable), and they can occur even when medications are used appropriately.

Case Studies

These real-life scenarios provide a compelling illustration of the critical distinction between medication errors and adverse events in healthcare settings [51-53].

Medication Error Scenario

A 65-year-old patient is admitted to the hospital for a routine surgical procedure. The nurse is responsible for administering medications to the patient post-surgery. The patient is prescribed a pain medication, but due to a busy shift and distractions, the nurse accidentally administers the wrong dosage of the pain medication. The patient experiences severe drowsiness and confusion shortly after receiving the medication. The error is identified when another nurse cross-checks the medication administration record. The patient's condition is closely monitored, and the error is reported to the healthcare team immediately. Fortunately, the patient does not experience any long-term harm, and corrective actions are taken to prevent similar errors in the future.

Adverse Event Scenario

A 40-year-old woman with a history of allergies is prescribed a new medication for a respiratory condition by her primary care physician. The patient takes the medication as instructed, but after a few days, she develops a severe skin rash and difficulty breathing. She rushes to the emergency department, where she is diagnosed with a severe allergic reaction (an adverse drug reaction) to the prescribed medication. The healthcare team treats her allergic reaction promptly, and she recovers after a few days of medical care. However, she experiences significant discomfort and distress due to the adverse reaction, and her treatment plan needs to be revised to find a suitable alternative medication.

Comparison between scenarios

In the medication error scenario, the harm to the patient results from a preventable mistake made during the medication administration process. The nurse's distraction and subsequent administration of the wrong dosage caused an adverse effect on the patient, but the error was identified and managed promptly, preventing any long-term harm.

On the other hand, in the adverse event scenario, the harm to the patient is a result of the inherent risk associated with the prescribed medication. The patient had a severe allergic reaction, which was not preventable through standard medication administration practices. While this reaction was not due to a medication error, it still resulted in significant harm to the patient and required immediate medical attention.

The key difference between the two scenarios is that the medication error was preventable and resulted from a mistake in the medication administration process. In contrast, the adverse event was an unexpected and unintended reaction to the prescribed medication, unrelated to any error in the administration. Both scenarios emphasize the importance of medication safety and vigilance in monitoring patients for any adverse effects to ensure optimal patient care.

Strategies to improve medication safety

Strategies on how to reduce these errors are out of the scope of the current review. Further literature review is needed to provide a comprehensive understanding of the strategies. However, in general, to improve medication safety and prevent adverse events, healthcare systems should consider the following strategies and interventions: implement standardized policies and procedures to prevent medication errors, ensuring that they involve multiple departments, including pharmacy, medicine, nursing, risk management, legal authorities, and administrative organizations [54].

Encourage the use of health information technologies, electronic prescribing, electronic health records, and computerized drug orders to minimize errors in medication management [55, 56]. Foster a culture of safety and open communication where healthcare professionals feel empowered to report errors and near misses without fear of retribution [57]. Conduct regular training and educational programs for healthcare professionals to enhance their knowledge and skills in medication management and error prevention [58].

Enhance medication reconciliation processes during transitions of care to ensure accurate and up-to-date medication information for patients [59]. Implement mechanisms for error analysis and root cause investigation to identify system weaknesses and areas for improvement. By adopting these measures, healthcare organizations can proactively address medication errors and adverse events, ultimately improving patient safety and the overall quality of care.

DISCUSSION

Medication errors, a persistent issue in healthcare, create significant challenges due to the inconsistency in their definitions across the literature. Research, such as a systematic literature review in 2010, reveals that there are at least 26 generic definitions of medication errors [11]. This lack of standardization can be traced to individual researcher preferences, leading to ambiguity and hindering effective communication and comparison among studies. These inconsistencies raise concerns about the reliability and reproducibility of research findings in this field. To address this issue, there is a pressing need for a standardized, clear-cut definition of medication errors that encompasses the entire spectrum of potential errors, from minor deviations in administration to those with potentially fatal consequences. Establishing a universally accepted definition will not only enhance the validity of research findings but also contribute to more effective strategies for preventing and addressing medication errors in healthcare settings.

Prescribing errors, a subset of medication errors, occur during the prescribing stage and have their definitions rooted in the core elements of the prescribing process. The choice of medication must be appropriate for the patient and their condition, minimizing harm while considering the balance between risk and benefit. Various definitions of prescribing errors exist, but one of the most

comprehensive is the one developed by Dean and colleagues in 2000 [16]. This operational definition identifies clinically meaningful prescribing errors as those resulting in a significant reduction in treatment efficacy or an increase in the risk of harm compared to generally accepted practice. It is accompanied by scenarios that provide clarity on potentially controversial cases, aiding in the classification of prescribing errors. This definition has gained widespread acceptance and use in numerous studies, making it a valuable tool in researching and addressing prescribing errors on a global scale.

The three studies by Cecil Dean in 2008, B. Dean in 2002, and B. Dean, M. Schachter, C. Vincent, and N. Barber in 2002 collectively offer valuable insights into the pervasive issue of medication errors in healthcare [60-62]. These studies underscore the complexity of medication errors, their causes, and the profound impact they can have on patient safety and healthcare practices.

Cecil Dean's 2008 Australian study highlights medication errors among registered nurses. It pinpoints documentation issues as a significant contributor, such as illegible handwriting and misinterpretation of written orders. It also identifies human factors like stress and fatigue and environmental factors like interruptions during medication administration as potential causes of errors. Importantly, it emphasizes that medication errors are not solely the responsibility of one professional group, advocating for collaboration among healthcare professionals to establish processes and policies that reduce errors. Nurses' desire for more time with patients during medication administration underscores the importance of workload management [62].

B Dean's 2002 study delves into the critical need to learn from medical errors, focusing on prescribing errors. It highlights barriers to learning from errors, including the failure to discover many errors and a culture that does not encourage reflection and prevention. The study calls for systemic and cultural changes to foster an environment where lessons can be learned from errors and put into practice. This includes promoting error discovery, providing feedback, and encouraging reflection at individual, team, and organizational levels [61].

The study by B. Dean, M. Schachter, C. Vincent, and N. Barber in 2002 applies human error theory to investigate the causes of prescribing errors. It identifies slips in attention and the failure to apply relevant rules as common factors leading to errors. Risk factors identified by doctors include the work environment, workload, communication, physical and mental well-being, and lack of knowledge. Organizational factors like inadequate training, hierarchical team structures, and low perceived importance of prescribing also contribute to errors. The study recommends training junior doctors in drug dosing principles, improving documentation practices, and creating a culture that values prescription writing.

Adverse drug events (ADEs) and adverse drug reactions (ADRs) are critical concepts in medication safety. ADEs encompass any injury resulting from medical intervention related to a drug, which can include medication errors but also extends to other factors. ADRs, on the other hand, specifically refer to unintended and noxious responses to a drug's pharmacological properties occurring at therapeutic doses. ADEs can be preventable or non-preventable, depending on the cause. For instance, preventable ADEs arise from medication errors and result in patient harm, while non-preventable ADEs may include side effects from a medication prescribed for the first time. Distinguishing between these concepts is vital for accurate reporting and effective prevention efforts, as they necessitate different approaches and interventions [60].

Side effects, often confused with adverse events, are distinct outcomes of medical treatment, including drug usage [63]. These effects can be beneficial or undesirable and are generally anticipated based on the known pharmacological actions of the treatment. They may vary in severity, from mild to severe, and can require medical attention. It is crucial to educate both healthcare professionals and patients about the differences between side effects and adverse events to facilitate informed decision-making

and ensure proper management of medication-related effects.

Standardizing the definitions of medication errors and related concepts is imperative for enhancing patient safety and the reliability of research in this field. Clear definitions can guide healthcare professionals, researchers, and policymakers in addressing these issues effectively. Additionally, promoting a culture of safety, implementing standardized policies and procedures, and leveraging technology are essential strategies to prevent medication errors and improve overall medication safety in healthcare settings.

CONCLUSION

This review has undertaken a comprehensive exploration of medication errors, adverse drug events, prescribing errors, and side effects. It has explored the varying definitions and classifications of these terms to provide healthcare professionals with a cohesive understanding of their nuances. The review has emphasized the critical need for standardization in the definitions of medication errors to improve communication, research reliability, and, ultimately, patient safety.

The distinctions between ADEs, ADRs, and side effects have been elucidated to enhance clarity in reporting and intervention strategies. Understanding that ADEs can be preventable or non-preventable, while ADRs are specific to pharmacological properties at therapeutic doses, is essential for accurate categorization and mitigation.

Furthermore, the review has underscored the importance of differentiating between medication errors and adverse events, providing case studies to illustrate the crucial distinctions. Moreover, preventable medication errors, unlike non-preventable adverse events, result from mistakes in the medication administration process and emphasize the need for standardized policies and a culture of safety within healthcare organizations.

Standardizing the definitions of medication-related terms, coupled with proactive strategies to prevent errors, is paramount for enhancing patient safety and the overall quality of healthcare. This review contributes to a more comprehensive understanding of these concepts and their implications for healthcare practice.

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Competing interests

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Ethical considerations

This review involved analysis of the published literature, and no primary data collection from human subjects was conducted. Therefore, ethical approval was not required for this study.

Abbreviations

ADEs: Adverse Drug Events

ADRs: Adverse Drug Reactions

NCC MERP: National Coordinating Council for Medication Errors Reporting and Prevention

DRPs: Drug-related problems

ASHP: American Society of Hospital Pharmacists

NPSA: National Patient Safety Agency

WHO: World Health Organization

AEs: Adverse events

SEs: Side effects

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