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Modern methods to reduce medication errors in health care and improving patient safety

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abstract:
Understanding the causes of medication management errors is essential for creating effective prevention strategies. While nurses often face blame as the "last link in the chain of drug therapy" before a patient receives medication, the reality is that the main factors contributing to these errors often stem from organizational strategies and specific working conditions. Systems for classifying and analyzing medication errors have been designed to reflect these complexities. Directly asking individuals involved about their errors can be helpful, but caution is needed. This approach may not fully capture the intricate nature of medication errors and could reflect general nursing opinions instead of objective findings. Observing errors as they happen can offer deeper insights, revealing potential contributing factors that may go unnoticed by those involved and providing valuable information on post-error recovery.Prevention strategies include the implementation of technologies such as bar-coding systems, computerized entry systems, and medication-error analysis tools. These technologies support nurses and healthcare professionals in ensuring safe and accurate medication administration.Policies and procedures play a foundational role in medication administration, ensuring consistency and accuracy. These guidelines serve as a permanent record for all .dispensed medications and outline best practices for the ordering, storage, administration, and return of drugs
keywords: Modern methods , reduce medication errors ,health care , improving patient safety

الملخص:

فهم أسباب أخطاء إدارة الأدوية ضروري لوضع استراتيجيات فعالة للوقاية منها. رغم أن الممرضات غالبًا ما يواجهن اللوم باعتبارهن "الحلقة الأخيرة في سلسلة العلاج الدوائي" قبل تلقي المريض للدواء، إلا أن الحقيقة هي أن العوامل الرئيسية المساهمة في هذه الأخطاء غالبًا ما تنبع من الاستراتيجيات التنظيمية وظروف العمل المحددة. وقد تم تصميم أنظمة لتصنيف وتحليل أخطاء الأدوية لتأخذ هذه التعقيدات في الاعتبار. قد يكون من المفيد سؤال الأفراد المعنيين عن الأخطاء التي ارتكبوها بشكل مباشر، ولكن يجب توخي الحذر؛ فقد لا يعكس هذا النهج التعقيد الكامل لأخطاء الأدوية وقد يعبر عن آراء عامة في المجتمع التمريضي بدلاً من نتائج موضوعية. يمكن أن يوفر مراقبة الأخطاء عند حدوثها رؤى أعمق، حيث يكشف عن عوامل محتملة قد لا يلاحظها الأفراد المشاركون ويوفر معلومات قيمة حول كيفية التعافي بعد وقوع الخطأ.

تشمل استراتيجيات الوقاية تنفيذ تقنيات مثل أنظمة الترميز الشريطي، وأنظمة الإدخال المحوسبة، وأدوات تحليل الأخطاء الدوائية. تدعم هذه التقنيات الممرضات والعاملين في الرعاية الصحية في ضمان سلامة ودقة إعطاء الأدوية.

تلعب السياسات والإجراءات دورًا أساسيًا في إدارة الأدوية، مما يضمن الاتساق والدقة. تعمل هذه الإرشادات كسجل دائم لجميع الأدوية المصروفة وتحدد أفضل الممارسات لطلب الأدوية وتخزينها وإدارتها وإرجاعها.

الكلمات المفتاحية: الأساليب الحديثة، تقليل أخطاء الأدوية، الرعاية الصحية، تحسين سلامة المرضي

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Introduction:

Medication errors occur when there is a mistake in the prescription, dispensing, or administration of drugs, which can harm the patient or carry the potential for harm. These errors can happen at any stage of the healthcare delivery process, making it crucial for patients, healthcare practitioners, administrative bodies, and the pharmaceutical industry to share the responsibility of minimizing these risks. Medication errors are a major concern in the healthcare sector, contributing significantly to preventable harm and patient safety issues. Globally, medication errors are estimated to account for over $42 billion in .avoidable healthcare costs each year

In the United States alone, medication errors contribute to approximately 98,000 deaths annually, highlighting their substantial impact on patient outcomes. Studies indicate that over 7,000 deaths each year in the U.S. are directly linked to medication errors. The financial burden is also significant, with hospitalization costs related to these errors ranging from $32.59 to $136.40 per incident, adding strain to healthcare systems. Patients affected by medication errors often require extended hospital stays, which can increase hospitalization duration by an additional 4.6 to 10.3 days (Abdulmutalib & Safwat,2020)

It is estimated that 1% to 2% of hospital patients experience harm due to medication errors, emphasizing the need for robust preventive measures. Nurses, who dedicate approximately 16% of their work time to administering medications, face increased risks due to heavy workloads and frequent medication handling. Research shows that a well-educated nursing workforce is better prepared to handle inevitable human errors effectively. However, high workloads and fast-paced environments raise the .risk of mistakes

Healthcare providers worldwide prioritize patient safety and strive to improve medication safety through systemic advancements. Organizations advocate for increased awareness, open communication, and enhanced reporting systems to reduce these errors. Effective prevention strategies include identifying contributing factors such as insufficient training, poor communication, and complex medication protocols. Comprehensive training programs are essential to preparing future nurses .for the realities of clinical practice and reducing the incidence of medication errors (Rodziewicz et al.,2018)

Classification and Definition of Medication Errors

A medication error is defined as "any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is under the control of a healthcare professional, patient, or consumer" (National Coordinating Council for Medication Errors Reporting and Prevention). Such errors encompass a range of occurrences within the healthcare system, including but not limited to prescription, order communication, product labeling, packaging, nomenclature, compounding, dispensing, distribution, administration, patient instruction, monitoring, and use.The European Medicines Agency describes a medication error as an "unexpected failure in the drug treatment process that leads to or has the potential to harm patients." Errors in prescribing, dispensing, storing, preparing, and administering medications are highlighted as the most frequent preventable causes of adverse events, posing a significant public health challenge.To enhance adherence to pharmacovigilance responsibilities and promote reporting among patients and healthcare professionals for regulatory purposes, a new definition has been suggested: "an unintentional failure in the process of drug therapy that results in or causes harm to the patient." This definition emphasizes that errors stem from failures in human or procedural aspects rather than drug inefficacy. It also aims to distinguish medication errors from intentional overdose, off-label use, .misuse, and abuse to streamline documentation and reporting under pharmacovigilance guidelines (Kalke & Mundhe,2020)

Types of Medical Errors

Surgical Errors

Surgical errors pose the highest risk of severe harm or fatality to patients. Studies indicate that approximately 75% of surgical malpractice cases involve errors made during the operation itself. Surgical procedures should be conducted without any mistakes related to the patient, procedure, or surgical site. Research has identified several common causes of surgical errors, including clinician-related factors (such as being rushed, distracted, or fatigued), organizational lapses (such as improperly .discarded or mislabeled specimens), cognitive errors, medical record issues, and miscommunication Prevention strategies for surgical errors have included various proven methods. The use of radio-frequency tagged sponges helps ensure that no surgical materials are left inside a patient. Prophylactic measures, such as antithrombotic therapy, reduce the risk of deep vein thrombosis. Standard practices, such as counting surgical instruments and using detailed checklists, have also been effective in minimizing errors. One widely adopted preventive measure is the surgical time-out—a brief pause taken before surgery begins. During this time-out, the surgical team confirms the patient's identity, verifies consent documents, reviews the procedure details, and checks for appropriate markings on the patient's skin to confirm the correct anatomical site. If different surgical teams are involved in sequential procedures, separate time-outs are conducted for each. Importantly, all surgical team members must remain silent during the time-out. Should any discrepancies arise, the team is required to investigate and resolve .them before proceeding with the operation (Rodziewicz & Hipskind,2020)

Diagnostic errors

Diagnostic errors are defined by the National Academy of Medicine as failures to provide an accurate and timely identification of a patient's health issues or to communicate that diagnosis effectively. This category includes delayed or missed diagnoses. The Joint Commission reports that diagnostic mistakes contribute to the harm or death of between 40,000 and 80,000 individuals annually. Contributing factors in primary care settings include limited opportunities for consultation with peers, excessive workloads, and insufficient time, all of which elevate the risk of diagnostic mistakes. Research in the United States has found that diagnostic errors occur during treatment for approximately 12 million patients, with 33% of these errors resulting in patient harm. However, the risk is typically lower in teaching hospitals due to the involvement of various healthcare professionals, such as attendings, residents, and medical students. Adverse events from diagnostic errors impact roughly 5% .of outpatients and 17% of inpatients

The most frequently misdiagnosed conditions involve cancer, surgical complications, and issues affecting the nervous system, cardiovascular system, and urinary tract. Misdiagnoses often result from insufficient bedside assessments and flawed clinical reasoning due to a lack of understanding. Because diagnostic errors are primarily cognitive in nature rather than organizational, it is crucial to recognize these commonly misdiagnosed conditions so physicians can be better prepared. Contributing factors include inadequate clinical knowledge, clinician fatigue or distraction, failure to consider alternative diagnoses, insufficient .follow-up on diagnostic tests, and poor post-test patient care

Addressing diagnostic errors requires a comprehensive approach due to their varied causes. Solutions often involve cognitive aids and system-based safety checks. Cognitive aids can include decision-making algorithms based on established protocols, trigger tools" in electronic health records that prompt clinicians to consider alternative diagnoses, and checklists to ensure no " critical steps are missed. Recent studies show that cognitive aids and trigger tools can help reduce the frequency of misdiagnoses. Additionally, decision support systems and other alternative methods have proven effective in minimizing .diagnostic errors (Alnaser et al.,2023)

Medication Errors:

Pharmaceutical errors can occur at multiple stages, including prescription, dispensing, dosing, and administration. However, many of these mistakes are preventable. Common pharmaceutical errors include bypassing drug-use safety protocols, administering incorrect or expired medications. System enhancements such as Computerized Provider Order Entry (CPOE), barcode identification for patients and prescriptions, standardized units of measure, weight-based dosing, and pharmacist support for accurate dose calculations can significantly reduce the occurrence of medication errors. A key preventive measure .involves double-checking both the names and dosages of medications prior to administration

The integration of barcodes and portable digital tools enhances medication safety by offering real-time data on patients, medications, laboratory results, and proper documentation. Additionally, electronic medication administration systems facilitate the detection of changed or canceled orders and incorrect prescriptions, though bypassing barcode checks can compromise point-of-care safety. Automated dispensing systems improve efficiency by promptly making medications available, allowing pharmacy professionals to prioritize other safety-focused responsibilities such as medication reconciliation

To further mitigate risks, it is essential to separate look-alike drugs from those that pose greater harm and avoid storing medications in similar containers. Hospitals can enhance safety by standardizing their storage systems, removing potentially hazardous drugs from general stock, and disposing of expired items. Other measures include using standardized doses for vasoactive agents, labeling syringes immediately after preparation, implementing color-coded intravenous lines, and .emphasizing label differences for medications with similar names (Stojković et al.,2016)

Equipment and Device Mistakes

Despite the widespread belief among healthcare providers that technological advancements will lead to increased efficiency, reduced costs, improved quality, and enhanced safety, these very technologies can also introduce errors and adverse outcomes. Medical device errors are unavoidable, as millions of healthcare providers worldwide use nearly 5,000 different types of these tools. Medical errors often result from faulty design, improper handling, user mistakes, or malfunctioning equipment. Additionally, many people have dangerous medical devices implanted, such as defibrillators, pacemakers, and stimulators for the nerves and brain. These devices can malfunction and cause serious issues. Inadequate testing and maintenance, poor design, device variations between manufacturers, and inadequate upkeep are all potential causes of equipment-related mistakes. Connection errors between tubes and catheters are especially common, such as when catheters are used for unintended purposes, wrong lines are placed through pumps, or feeding tubes are mistakenly inserted into the lung. If these misconnections are not addressed promptly, the consequences could be fatal. Another complication is that these routes are often used to .administer dietary supplements and pharmaceuticals, and insertion errors can lead to improper delivery or omissions

Policymakers at the federal, state, and local levels should consult healthcare providers when formulating and reviewing initiatives related to information technology. Establishing standards for equipment maintenance, training, monitoring, and

reporting technology-related adverse events is key to enhancing safety. Clinicians also need training on how to manage equipment failure and remain vigilant when using technologies to assist with patient care. One way to reduce the likelihood of tubing misconnections is to use specialized connectors for anesthetic catheters and feeding tubes. Additionally, before initiating infusions, identifying high-risk catheters, connecting or removing equipment, or tracing lines back to their origin, .support staff and clinicians should always verify the setup.(Rodziewicz & Hipskind,2020)

Healthcare-Associated Infections

A systemic failure occurs when patients acquire an infection while receiving healthcare. Healthcare-associated infections can affect up to 20% of hospitalized patients, leading to additional complications, longer hospital stays, and higher healthcare costs. In the U.S., the annual cost of healthcare is increased by over $35 billion due to infections related to healthcare. Common causes of hospital-acquired infections include inadequate hand hygiene practices and improper technique during the insertion of indwelling urinary and vascular catheters. The most common infections include urinary tract infections caused by catheters, surgical site infections, hospital-acquired pneumonia, sepsis from central lines, and skin and soft tissue .infections resulting from medical treatments

Reducing iatrogenic infections can be effectively achieved by changing the behaviors of healthcare team members. Everyone should support hand hygiene efforts as it helps reduce the number of nosocomial infections across various diseases. To reduce the occurrence of healthcare-associated bloodstream infections, ventilator-associated pneumonia, and catheter-associated urinary tract infections, many healthcare facilities have implemented specific protocols to minimize the use of central venous and urinary catheters and protect catheter sites with preventive measures like chlorhexidine. The frequency of .infections associated with indwelling catheters has significantly decreased by reducing their duration of use

The regular use of pharmacy-driven antibiotic stewardship programs for all hospitalized patients is essential to reduce the incidence of nosocomial infections. Reducing healthcare-associated pressure injuries should be a routine practice, including continuous and focused nurse education, evidence-based treatments, and skin assessments and evaluations by wound care teams. Surgical sites should also be treated according to standard protocols. Several studies suggest using dressings .impregnated with chlorhexidine to reduce infection risks.(Rodziewicz & Hipskind,2020)

Reducing Strategies Regarding MAEs:

Understanding the causes and mechanisms behind medication management errors is crucial for creating effective interventions to reduce their frequency. Traditionally, nurses have been blamed for medication errors as they are seen as the last link" in the medication administration process before the drug reaches the patient. However, the root causes of these " errors often lie within the strategic decisions made by the organization and the specific circumstances in which the nurse .operates, rather than solely on the actions of the nurse themselves

Medication error classification systems have been developed that consider these factors, along with frameworks for analyzing medical errors. To understand who made the mistake and why, it is important to explore the motivations behind the error. Directly asking individuals involved can be one approach, but caution is required. This method may not always yield accurate results, as it may reflect subjective opinions rather than objective findings. An alternative approach is to minimize researcher bias by focusing on the errors as they happen, rather than attempting to determine causality based on .assumptions

To gain a clearer understanding of the frequency of medication administration errors, one effective method is close observation. This is because those making the errors might not always recognize them or may fail to recall how they .resolved the issue (Hassan,2018)

The Strategies:

The use of technological solutions, such as computerized dispensing cabinets, barcode systems, medication-error analysis, and computer-based input systems, can help prevent medication errors. Nurses also have a critical role in adopting these .systems to improve the accuracy and safety of medication administration

Introduction to the Policies and Procedures for Medication Administration .1

Policies and procedures for medication administration are essential for ensuring that medications are used consistently and accurately. A permanent record is maintained for all medications dispensed, and these procedures are designed to establish best practices" for the handling, transportation, administration, and disposal of medications. The goal is to ensure the safe " .and effective use of medications throughout the healthcare process

Medication Reconciliation .2

Medication reconciliation is a strategy that healthcare professionals, such as pharmacists, employ to prevent medication errors. This formal process involves reviewing and comparing a patient's medication list before discharge with the .prescriptions provided at transfer or discharge

The Irish government was one of the first to implement medication reconciliation during care transitions. Clinical pharmacists used a pre-admission medication list to identify and communicate any changes made during a patient's hospital stay. This process was carried out within 24 hours of admission and resulted in a significant number of interventions being approved and discrepancies resolved. Medication errors can be exacerbated during transitions between healthcare providers .or at discharge, especially when patients forget to take their prescribed medications

The medication reconciliation process at discharge involves a pharmacist's review to identify and correct any discrepancies, .ensuring the patient receives the correct medications upon leaving the hospital (Alenizi et al.,2022)

Education and Risk-Free Work .3

To reduce the occurrence of pharmaceutical errors, it is crucial for all healthcare providers involved in medication handling to receive proper training. Identifying the potential causes of medication errors is an essential step in mitigating their likelihood. The chances of reducing errors increase when education is mandated for everyone involved in the healthcare .process, from doctors to nurses, to ensure they are adequately prepared and aware of the risks

Procedure for Double-Checking .4

Implementing a double-check system, where a second person observes the individual administering the medication and confirms the correct procedure, is an effective way to ensure safe administration, even in the event of an error. Every step of the medication process should be double-checked by an experienced professional. Studies show that the use of double-check procedures results in fewer medication delivery errors, indicating its success. Additionally, the protocol emphasizes the importance of having the proper rights for both dispensing and administering medications, which further reduces the .likelihood of mistakes

Time on the Job and Staffing Levels (Patient-Nurse Ratio) .5

Medication errors have become more frequent, underscoring the need for nursing leaders to address this issue. A retrospective study analyzing data from hospital administrative databases explored the relationship between nurse staffing levels and medication error occurrences. The results showed that increasing the ratio of registered nurse (RN) hours to .licensed practical nurse (LPN) hours could effectively reduce prescription errors

The presence of skilled nurses can lower error rates in inpatient care, while an understaffed nursing team can negatively affect patient outcomes. A survey of 500 nurses across three hospitals revealed that 85% of medication errors were due to a shortage of licensed practical nurses. When nursing teams are understaffed, patients are more likely to receive subpar care, .as nurses may skip steps, ignore protocols, or cut corners

Most medication errors occur when nurses fail to follow established administration policies or forget to administer medications. To prevent these errors, hospitals must maintain sufficient staffing levels to avoid overburdening nurses and .ensure the five rights of medication administration are consistently observed (Shitu et al.,2018)

Medication Administration Rights Rule .6

Nurses are responsible for ensuring patient safety and the quality of care, with medication errors affecting many patients, some of whom may suffer lifelong complications, and others who may die. For years, nurses have followed the "5 rights" of medication administration: the correct patient, route, drug, dosage, and timing. However, the seven rights now include documentation and explanation to improve efficiency. Scholars have proposed adding three more rights: right action, right .form, and right response, to further enhance patient well-being

In addition to these, other experts suggest a broader set of twelve rights, which include the rights to drug, patient, dose, route, time and frequency, documentation, history, assessment, the right to refuse, the right to drug-drug interaction evaluation, and .the right to education and information

Distraction/Interruption During Medication Administration .7

Errors in medication technique or drug administration are significantly linked to increased interruptions and higher frequencies of distractions. Therefore, to ensure medication safety, it is essential that patients are not distracted while taking

their medication. Reducing interruptions during the administration process is key to minimizing errors and ensuring correct .medication handling

Barcode Medication Administration, Computerized Prescriber Orders, and Automated Medication Dispensing .8

Barcode scanning technology has proven to be a transformative tool in reducing medication errors. Studies, including seven clinical trials (CTs) and six randomized controlled trials (RCTs), have shown strong evidence supporting the effectiveness of barcoding in managing prescription errors. The system works by nursing staff scanning the patient's ID band, which contains a unique identifier linked to their medical information. This data is then displayed on a screen, allowing verification of the patient's prescribed medication details. Next, the medication's barcode is scanned to confirm it matches the patient's order, .ensuring the right drug, dose, and other specifics

While barcode verification helps reduce patient identification and medication administration errors, it does not completely eliminate them. Ongoing efforts to enhance medication safety also include practices like medication reconciliation, computerized physician order entry (CPOE), automated medication dispensing, and the use of smart pumps, all of which aim .to improve safety across the prescription, dispensing, transcribing, and administration processes (Tabibzadeh et al.,2021)

Medical Pharmacist .9

Clinical pharmacists play a key role in reducing medication errors by ensuring proper medication management. Their presence during ward rounds is crucial for maximizing the effectiveness of treatment plans and ensuring that medications are administered correctly. In emergency departments, clinical pharmacists are even more vital, as they are tasked with identifying and evaluating the various interventions made within the interdisciplinary healthcare team. Clinical pharmacists are uniquely capable of identifying specific medication errors, which makes them an indispensable part of the effort to reduce .pharmaceutical mistakes

Unlike other healthcare providers, clinical pharmacists bring specialized knowledge to the identification of medication errors, .positioning them as central figures in the multidisciplinary approach to combating pharmaceutical errors

Coordination of Care Among Medical Professionals (Doctors, Nurses, and Pharmacists) .10

Medication errors are less likely to occur when doctors, nurses, and pharmacists communicate effectively with each other. This collaboration not only improves patient care but also enhances the efficiency of healthcare practices. To build tools aimed at addressing miscommunication in the healthcare sector, it is essential to understand how communication challenges arise .and how they can be overcome

Effective communication is critical in the daily interactions among healthcare professionals. Strong communication and teamwork are essential to prevent the spread of incorrect information, which can lead to patient neglect. Research consistently highlights poor communication as a major contributing factor to patient harm, underscoring its negative impact on patient care. Ensuring clear communication between medical professionals is fundamental to improving patient outcomes and reducing .medication errors (Kiridjievska et al.,2023)

Conclusion

Reducing medication management errors requires a comprehensive understanding of their root causes and the implementation of targeted preventive measures. While nurses often receive the blame due to their direct involvement in administering medications, the true determinants often lie in organizational strategies and working conditions. Effective error prevention must go beyond individual accountability and incorporate robust classification systems, objective observation, and unbiased analysis. The use of advanced technologies such as bar-coding systems and computerized entry tools, along with clear policies and thorough medication reconciliation practices, can significantly mitigate the risk of errors. Collaborative efforts from all healthcare professionals, particularly during critical transitions like patient admissions and discharges, are essential for .minimizing adverse drug events and improving patient safety

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