MINI REVIEW

High-Alert Medications: Strategies for Safe Use in Hospitals

Kaunava Roy Chowdhury

Pharmacology Department
School of Pharmaceutical Sciences,
Ct University,
Ludhiana, Punjab, India.

Correspondence:
Mr. Kaunava Roy Chowdhury,
Pharmacology Department
School of Pharmaceutical Sciences,
Ct University,
Ludhiana, Punjab, India.
E-mail: roypharmacology@gmail.com

How to cite this article: Chowdhury K. High-Alert Medications: Strategies for Safe Use in Hospitals Innov Pharm Planet (IP-Planet) 2014;02(2) 10-13.

Source of Support: Nil.
Conflicts of Interest: None declared.

Date of Submission: 06-04-2014
Date of Revision: 14-05-2014
Date of Acceptance: 27-05-2014

ABSTRACT

High-alert medications (HAMs) are drugs that carry a heightened risk of causing significant patient harm when used incorrectly. Errors involving these medications can lead to severe complications, prolonged hospitalization, or even fatal outcomes. This review explores the classification, risk factors, and evidence-based strategies for ensuring the safe use of HAMs in hospital settings. Factors contributing to medication errors include human-related issues such as fatigue and miscommunication, system-based deficiencies like poor workflow design, and drug-related challenges such as look-alike/sound-alike names. To mitigate risks, hospitals implement standardized protocols, advanced storage and labeling practices, computerized physician order entry (CPOE), automated dispensing systems, and infusion pumps with dose-error reduction software. The role of healthcare professionals, particularly pharmacists and nurses, in monitoring, verification, and patient education is also emphasized. Furthermore, technological advancements, including electronic health records (EHRs) and artificial intelligence (AI)-driven alerts, play a crucial role in enhancing medication safety. Case studies highlighting successful HAM safety initiatives and challenges in implementing these measures are discussed. A multidisciplinary approach, continuous staff training, and policy updates are essential to reducing medication errors. This review underscores the need for ongoing research and innovation to enhance the safe administration of high-alert medications in hospital environments.

KEYWORDS: High-alert medications, medication safety, hospital drug administration, medication errors, risk mitigation strategies.

INTRODUCTION

High-alert medications (HAMs) are drugs that carry a heightened risk of causing significant patient harm if used in error. These medications often have a narrow therapeutic index, meaning small changes in dosage can lead to severe adverse effects, including life-threatening conditions or death. Common examples of high-alert medications include anticoagulants, insulin, narcotics, and sedatives.

To ensure the safe use of high-alert medications in hospitals, several strategies are employed. One approach is to eliminate the possibility of error by reducing the number of drugs on a facility's formulary, minimizing the number of concentrations and volumes available, and removing high-alert drugs from critical areas. Standardizing ordering, storage, preparation, and administration processes is also crucial[1].

Another strategy involves making errors visible. This can be achieved by implementing double checks, where two individuals independently verify medication and equipment settings, helping to identify potential errors before they occur. Automated alerts and auxiliary labels can also enhance visibility.

Access this article online	
Website: https://innovationaljournals.com/index.php/ip	**e-ISSN:** 2348-7275

Minimizing the consequences of errors is another key strategy. This includes using smaller vials or ampules, reducing the total dose in continuous IV drip bags, and lowering drug concentrations when possible. Employing redundancies and system redundancies, such as automated dispensing units with alerts, further supports safety.

Hospitals often rely on the Five Rights of Medication Administration (right patient, right drug, right dose, right route, right time) to ensure accurate medication delivery. The Institute for Safe Medication Practices (ISMP) provides a list of high-alert medications to guide hospitals in implementing specific safeguards. Regular updates to these lists and education for clinical staff are essential to maintain effective risk-reduction strategies[2].

CLASSIFICATION AND EXAMPLES OF HIGH-ALERT MEDICATIONS

High-alert medications (HAMs) are
significant harm if used incorrectly. These categories include:

Anticoagulants: These medications prevent blood clotting and include drugs like warfarin, low molecular weight heparin (LMWH),

unfractionated heparin, and direct oral anticoagulants such as dabigatran and rivaroxaban. The risk associated with anticoagulants is primarily related to bleeding complications, which can be severe and life-threatening if not managed promptly.

Opioids: Opioids are used for pain management and include drugs like morphine and fentanyl. They are available in various forms, including oral, intravenous, and transdermal. Opioids pose a significant risk due to their potential for overdose, leading to respiratory depression, which can be fatal.

Insulin: Insulin is used to manage blood glucose levels in diabetic patients. All forms of insulin, including subcutaneous and intravenous, are considered high-alert medications due to the risk of hypoglycemia if administered in excess. Hypoglycemia can lead to seizures, coma, and even death.

Chemotherapy Agents: These are drugs used to treat cancer and can be administered orally or parenterally. Chemotherapy agents are highly toxic and require precise dosing to avoid severe side effects, including organ damage and increased risk of infections[3].

Neuromuscular Blockers: These medications are used to induce muscle paralysis during surgical procedures. Examples include cisatracurium, succinylcholine, and vecuronium. The primary risk with neuromuscular blockers is respiratory failure if not properly monitored and managed.

Common High-Alert Medications in Hospital Settings include potassium chloride for injection, sodium chloride for injection (hypertonic), magnesium sulfate, and epoprostenol. These medications are frequently used in critical care settings and require careful handling due to their potential for causing severe harm if administered incorrectly.

Mechanisms of Action and Associated Risks:

Anticoagulants work by inhibiting blood clot formation, which can lead to bleeding complications if not monitored properly.

Opioids act on the central nervous system to reduce pain perception but can cause respiratory depression if overdosed.

Insulin lowers blood glucose levels by facilitating glucose uptake into cells; excessive insulin can lead to hypoglycemia.

Chemotherapy Agents target rapidly dividing cancer cells but can also harm healthy cells, leading to severe side effects.

Neuromuscular Blockers induce muscle paralysis by blocking acetylcholine receptors at the neuromuscular junction, requiring careful monitoring to avoid respiratory complications[4].

RISK FACTORS CONTRIBUTING TO ERRORS WITH HIGH-ALERT MEDICATIONS

High-alert medications (HAMs) pose significant risks due to their potential for causing severe harm if used incorrectly. Several factors contribute to errors involving these medications, including human, systemic, and medication-related factors.

Human Factors: These include fatigue, miscommunication, and lack of knowledge. Fatigue and stress are common among healthcare professionals, with stress being identified as the most significant contributor to medication errors (24.32%) and workload being the second most common factor (21.47%). Miscommunication can arise from illegible handwriting, verbal misunderstandings, or language barriers, leading to errors in dosage or administration route. Lack of knowledge or experience with specific medications can also lead to mistakes, emphasizing the need for regular training and updates.

Systemic Factors: Poor workflow design and inadequate monitoring systems can significantly increase the risk of errors. Insufficient staffing levels can lead to missed doses or errors, while a lack of a culture of reporting medication errors hinders improvement efforts. Additionally, high perceived workload and environmental factors such as peak hours or emergency situations can contribute to errors.

Medication-Related Factors: Look-alike/sound-alike (LASA) medications are a significant concern, as they can be confused with one another due to similar names, packaging, or appearance. Complex dosing regimens also pose a risk, as they require precise calculations and monitoring to avoid overdosing or underdosing, which can be particularly challenging with medications like insulin or anticoagulants. The use of multiple concentrations or formulations of a medication

can further complicate administration and increase the likelihood of errors[5].

STRATEGIES FOR SAFE USE OF HIGH-ALERT MEDICATIONS

Ensuring the safe use of high-alert medications (HAMs) in hospitals involves multiple strategies across various stages of medication management.

Standardized Protocols and Policies

Developing and implementing hospital guidelines for high-alert medications is crucial. These guidelines should include standardized dosing procedures and protocols for handling specific medications. Medication reconciliation plays a vital role in ensuring that patients receive the correct medications upon admission, transfer, and discharge, reducing potential errors. Standardization of medication orders helps minimize confusion and ensures consistency in treatment protocols.

Medication Storage and Labeling Improvements

Improving storage and labeling practices for HAMs is essential. Segregation of HAMs from other medications helps prevent mix-ups. Using color-coded labels and barcoding technology enhances visibility and accuracy during medication retrieval and administration. Clearly labeling storage areas with "High Alert" stickers or using red bins can further highlight these medications.

Prescribing and Order Verification

Computerized Physician Order Entry (CPOE) systems and clinical decision support systems help reduce errors by providing real-time alerts and checks during the ordering process. Pharmacists play a critical role in verifying prescriptions, ensuring that orders are appropriate and safe before medications are dispensed[6].

Safe Dispensing Practices

Implementing double-checking and independent verification by pharmacy staff ensures that medications are accurately prepared and dispensed. Automated dispensing cabinets (ADCs) can be programmed to require additional checks or alerts for high-alert medications, enhancing safety.

Administration Safety Measures

Adhering to the "Five Rights" of medication administration (right patient, right drug, right dose, right route, right time) is fundamental. Using infusion pumps with dose-error reduction systems (DERS) helps prevent dosing errors, especially with continuous infusions. Training nurses and healthcare professionals on the safe handling of HAMs is essential for maintaining a culture of safety.

Monitoring and Patient Education

Therapeutic drug monitoring (TDM) and the involvement of clinical pharmacists are crucial for ensuring that medications are used effectively and safely. Patient education on self-administration techniques and potential adverse effects empowers patients to manage their medications safely outside the hospital setting[7].

ROLE OF TECHNOLOGY IN ENHANCING SAFETY

The role of technology in enhancing safety, particularly in the context of high-alert medications, is multifaceted and increasingly critical. Technology plays a pivotal role in reducing medication errors and improving patient safety through various tools and systems.

Electronic Health Records (EHR) Integration: EHRs have revolutionized medication management by providing real-time access to patient data, facilitating e-prescribing, and enhancing clinician workflows. Studies have shown that EHRs can significantly reduce medication errors by automating processes and providing decision support tools that alert clinicians to potential drug interactions or contraindications. However, the implementation of EHRs can sometimes lead to an increase in reported medication errors due to improved detection and reporting mechanisms.

Smart Infusion Pumps and Automated Alerts: Smart infusion pumps equipped with dose-error reduction systems (DERS) are designed to prevent errors in intravenous medication administration. These pumps alert healthcare providers if programmed doses exceed predefined limits, helping to avoid overdosing or underdosing. While smart pumps significantly reduce errors, their effectiveness depends on maintaining accurate drug libraries and addressing alert fatigue, which can lead to overrides.

Artificial Intelligence (AI) and Machine Learning for Error Detection: AI and machine learning systems offer advanced capabilities in identifying medication errors that might be missed by traditional clinical

decision support systems. These technologies can analyze complex data patterns to generate clinically valid alerts, potentially preventing adverse events and reducing healthcare costs. By leveraging AI and machine learning, healthcare systems can enhance their ability to detect and prevent medication errors more effectively than traditional rule-based systems[8].

CONCLUSION

High-alert medications pose significant risks in hospital settings, requiring stringent safety measures to prevent errors. Implementing standardized protocols, advanced technology, and multidisciplinary collaboration enhances medication safety. Continuous staff training, improved storage, labeling, and real-time monitoring play vital roles in risk mitigation. Future advancements in artificial intelligence and automated systems hold promise for further improving patient safety. A proactive approach is essential to minimizing harm and ensuring optimal medication management.

REFERENCE

1. Federico, F. (2007). Preventing harm from high-alert medications. *The Joint Commission Journal on Quality and Patient Safety*, *33*(9), 537-542.
2. Cohen, M. R., Smetzer, J. L., Tuohy, N. R., & Kilo, C. M. (2007). High-alert medications: safeguarding against errors. *Medication Errors. 2nd ed. Washington (DC): American Pharmaceutical Association*, 317-411.
3. Rosa, M. B., Perini, E., Anacleto, T. A., Neiva, H. M., & Bogutchi, T. (2009). Errors in hospital prescriptions of high-alert medications. *Revista de Saúde Pública*, *43*, 490-498.
4. De Coster, S., & Van Larebeke, N. (2012). Endocrine-disrupting chemicals: associated disorders and mechanisms of action. *Journal of environmental and public health*, *2012*(1), 713696.
5. Belknap, S. (2001). High-alert'medications and patient safety. *Int J Qual Health Care*, *13*(4), 339.
6. Graham, S., Clopp, M. P., Kostek, N. E., & Crawford, B. (2008). Implementation of a high-alert medication program. *The Permanente Journal*, *12*(2), 15.
7. Paparella, S. (2010). High-alert medications: shared accountability for risk identification and error prevention. *Journal of Emergency Nursing*, *36*(5), 476-478.
8. Kimmel, K. C., & Sensmeier, J. (2002). *A technological approach to enhancing patient safety*. Healthcare Information and Management Systems Society.