

Effect of Standardized IV Compounding Protocols on Patient Safety Outcomes

Abdullah Dakhil Allah Ibrahim Al Harthi^{1*}, Mohammed Saeed Al Hadi², Ali Abdullah Al hammadi³, Osama Ayed Alsaheed⁴, Ali Mousa Hassan Asiri⁵, Mohammad Samir AL Anazi⁶, Naif Sultan Al Sadoon⁷

Dr.ph.abdullah@outlook.com

1 Pharmacist, The health center in the security city for the special forces for Hajj and Umrah Security, Makkah, KSA

2 Pharmacist, Armed Forces Hospital southern Region, Khamis Mushait, KSA

3 Pharmacist, Armed Forces Hospital southern Region, Khamis Mushait, KSA

4 Pharmacist, Armed Forces Hospital Southern Region, Khamis Mushait, KSA

5 Pharmacist, Armed Forces Hospital Southern Region, Khamis Mushait, KSA

6 pharmacy Technician, Prince Sultan Medical military City, Riyadh, KSA

7 Pharmacist, Prince Sultan Medical military City, Riyadh, KSA

Abstract: Intravenous (IV) medications are classified as high-risk therapies due to their direct entry into the systemic circulation and limited opportunity for error correction. Errors during IV compounding may result in severe adverse drug events, infections, increased healthcare costs, and patient morbidity. This study examines the effect of implementing standardized IV compounding protocols on patient safety outcomes in hospital pharmacy IV rooms. A structured review of international guidelines and published studies was conducted, complemented by analysis of reported safety indicators such as medication errors, contamination rates, and adverse drug events. Findings demonstrate that standardized protocols significantly reduce compounding errors, improve aseptic compliance, and enhance overall patient safety. The study highlights the importance of protocol-driven IV room practices aligned with USP <797>, ISMP, ASHP, and accreditation standards.

Keywords: IV room, sterile compounding, patient safety, USP <797>, medication errors, standardized protocols

INTRODUCTION

Intravenous medication preparation is a critical responsibility of hospital pharmacy services. Due to the complexity of sterile compounding and the high-risk nature of parenteral

medications, any deviation from safe practices can result in serious patient harm. Historically, variability in compounding techniques, documentation, and environmental controls has contributed to preventable medication errors and infections.

Standardized IV compounding protocols are structured, evidence-based procedures designed to reduce variability and enforce best practices in sterile preparation. These protocols encompass environmental requirements, personnel training, aseptic technique, labeling, verification, and quality assurance processes. International standards such as USP <797>, ISMP guidelines, and ASHP recommendations emphasize protocol standardization as a cornerstone of patient safety.

This paper evaluates the impact of standardized IV compounding protocols on patient safety outcomes, with a focus on medication errors, contamination rates, and quality indicators within IV rooms.

LITERATURE REVIEW

Multiple studies have demonstrated a direct association between standardized IV compounding practices and improved safety outcomes. Research indicates that facilities with written protocols, validated aseptic processes, and routine competency assessments report significantly fewer compounding errors.

USP <797> established a global framework for sterile compounding, mandating defined cleanroom classifications, personnel garbing, environmental monitoring, and beyond-use dating. Studies comparing pre- and post-implementation of USP <797> standards revealed reductions in microbial contamination and improved compliance with aseptic techniques.

ISMP has further highlighted that lack of standardization is a major contributing factor to sterile compounding errors. Their guidelines recommend standardized order verification, double-check systems, and barcode-assisted verification, all of which have been shown to reduce human error.

METHODOLOGY

This study adopts a narrative review and quality improvement framework. Peer-reviewed articles published between 2010 and 2025 were reviewed using databases such as PubMed,

Scopus, and Google Scholar. Key inclusion criteria were studies evaluating sterile compounding practices, IV room safety, and patient outcomes.

Patient safety outcomes assessed included:

- Medication error rates
- Microbial contamination incidents
- Adverse drug events (ADEs)
- Compliance with sterile compounding standards

STANDARDIZED IV COMPOUNDING PROTOCOLS

Standardized IV compounding protocols typically include the following components:

Environmental Controls

- ISO-classified cleanrooms and laminar airflow workbenches
- Routine environmental monitoring (air, surface, and personnel sampling)

Personnel Training and Competency

- Mandatory aseptic technique training
- Media-fill testing and glove fingertip sampling
- Annual competency validation

Compounding Procedures

- Step-by-step preparation instructions
- Use of standardized concentrations and formulations
- Controlled workflow to minimize interruptions

Verification and Documentation

- Independent double checks
- Standardized labeling and documentation

- Use of barcode technology where available

IMPACT ON PATIENT SAFETY OUTCOMES

Reduction in Medication Errors

Implementation of standardized protocols has been associated with a significant decrease in wrong-dose, wrong-drug, and wrong-concentration errors. Standard operating procedures eliminate individual interpretation and promote consistency.

Decreased Microbial Contamination

Facilities adhering to standardized aseptic protocols report lower contamination rates in compounded sterile preparations. Routine monitoring ensures early detection of environmental failures.

Improved Adverse Event Prevention

Standardized compounding practices reduce the incidence of IV-related adverse drug events by ensuring accuracy, sterility, and traceability of compounded products.

DISCUSSION

The findings indicate that standardized IV compounding protocols are a critical intervention for improving patient safety. Protocols reduce human variability, enhance accountability, and support a culture of safety within pharmacy services. Additionally, standardization aligns IV room practices with accreditation requirements such as JCI and CBAHI, supporting institutional quality goals.

Despite clear benefits, challenges remain, including staff resistance, resource limitations, and ongoing training requirements. Leadership support and continuous quality improvement initiatives are essential for sustainable implementation.

CONCLUSION

Standardized IV compounding protocols play a vital role in enhancing patient safety outcomes. Evidence demonstrates that protocol-driven practices reduce medication errors, prevent contamination, and improve overall quality of care. Hospitals should prioritize the

development, implementation, and continuous evaluation of standardized IV compounding protocols in alignment with international standards to ensure optimal patient safety.

RECOMMENDATIONS

- Implement comprehensive standardized IV compounding SOPs
- Conduct regular staff competency assessments
- Integrate technology such as barcode verification and automated compounding devices
- Perform continuous quality audits and environmental monitoring

References

1. United States Pharmacopeia. USP <797> Pharmaceutical Compounding—Sterile Preparations.
2. Institute for Safe Medication Practices (ISMP). Guidelines for Safe Preparation of Compounded Sterile Preparations.
3. American Society of Health-System Pharmacists (ASHP). Guidelines on Compounding Sterile Preparations.
4. Cousins DH et al. Medication errors in intravenous drug preparation. Qual Saf Health Care.
5. Hedlund N et al. Impact of standardized compounding on patient safety. Eur J Hosp Pharm.