Power System Technology
ISSN:1000-3673

Received: 16-09-2024 *Revised: 05-10-2024* *Accepted: 22-11-2024*

Roles of Pharmacists in the Preparation of Inpatient Intravenous Medication and Administration Error Recognition

1Hayam Rabie Alshafai, 2Saeed Mohammed Abdullah Alzahrani, 3Abdulelah Abdullah Rudayd Almalawi, 4Mohammed Hassan Mohammed Asiri, 5Awadh Moeed S Alamery, 6Majed Ali K. Alharthi, 7Naif Odah Alzahrani, 8Ahmed Ali Khobrani, 9Abdullah Yahya Sharifi

1Pharmacy Technician, Prince Sultan Military Medical City
2Pharmacy Technician, East Jeddah Hospital
3Pharmacist, Al-Muzhailif General Hospital
4Pharmacy Technician, Rijal Alma Hospital
5Pharmacy Technician, Medical Supply In Aseer Cluster
6Pharmacist Assistant, King Faisal Medical Complex In Taif
7Pharmacy, Dental Center In Al-Mandaq
8Pharmacy Technician, King Fahd Central Hospital In Jazan
9Pharmacy Technician, King Fahd Central Hospital In Jazan

Abstract

1. Introduction

The inpatient service in the hospital is increasing in importance as more seriously ill patients are admitted in the era of the aging society. Inpatient IV medication administration can be applied immediately to patients' conditions, and is an important method in initiating drugs in emergency and critical conditions. IV medication also has a strong effect in comparison to oral administration. However, the incidence of occurrence of adverse drug events (ADE) caused by IV medication is higher than by other drug administration methods, for example oral, rectal, and transdermal administration. To observe whether fluid accumulations exist in the peripheral vein, generally in 20-30 min, thereby recognizing Drip infusion phlebitis (DIV), which occurs in association with IV medication. Further surveillance omits some error. Healthcare personnel including pharmacists may exercise constant vigilance with regard to inpatient IV medication to protect patients against ADEs. It is hoped that harmful events can eventually be prevented.

Power System Technology
ISSN:1000-3673
Received: 16-09-2024 Revised: 05-10-2024 Accepted: 22-11-2024

Inpatient IV medication therapy can be used to deal with emergency and seriously ill patients. The primary treatment approach uses IV medication owing to its rapid pharmacological effects. It is also possible to perform advanced emergency medical service. Some injections are known to infiltrate or form clots which can damage tissues due to irritant effects. There are several sources mentioning the actual number of serious adverse events by these phenomena; 90% of these are reported to arise from drugs. However, IV administration is commonly used because the drug can immediately reach the patient's bloodstream, and this route can maintain the drug concentration for a certain time. The system of the hospital pharmacy does not correspond to these errors. Nevertheless, the preparation of drugs for administration to patients can result in errors in many types. Reports also provide the actual ratios regarding these errors. Written prescriptions are compared before being dispensed to make sure that what has been written is what is needed by the patient. But there are currently no standards in place for what is compounded or used for these prescriptions.

Methods

The study was conducted at a non-profit health care organization and was IRB exempt. A for-profit vendor supported long-term acute healthcare technology, using a product surveillance software platform. The hospital-employed, non-profit quaternary-academic center operated independently without vendor support. This study faced limitations, reflected in the site descriptions and methods. Statistical analysis showed sites similar enough for pooled data analysis, but no two sites were identical, leading to potential cultural and procedural differences in administering IV push medications. Three different policies claimed compliance with accepted practice, and observations were not collected randomly or in parallel. (B. Hertig et al., 2018)

Conclusion

Administration errors are an important reason of morbidity and mortality. Drug errors not only harm patients but also cause an important increase in healthcare expenditures. Primary health care services have a significant role in the prevention of these errors. Studies conducted in many countries in different settings indicated that medication errors and administration errors are common and cause concern worldwide. These errors were also reported in a study conducted in our country. Drug errors typically involve language in prescriptions or improper drug quantifications and can be observed in many different stages such as drug selection, drug administration, and drug recording. It was stated in studies that the error rates in drug administration is higher compared to the other stages.

Power System Technology
ISSN:1000-3673
Received: 16-09-2024 Revised: 05-10-2024 Accepted: 22-11-2024

The correct preparation of complex mixture of compounded drug products particularly intravenous admixture is crucial to ensure client's safety during drug therapy. An incorrect IV drug prepared as a result of errors in all the preparation steps and can cause adverse effects ranging from mild reactions at the insertion site to death. Approximately 200000 ADEs occur annually in UK as a result of drug errors, nearly 75000 of these errors occur during the preparation and particularly the administration of intravenous drugs. In a study including patients hospitalized, the rate of patients exposed to intravenous preparation errors was reported as 9% and it was discovered that these errors led to death in 6.2% of the patients. Administration of intravenous products has been widely reported to be a process associated with a high potential for intentional and non-intentional errors. There is a strong need to increase error detection and error recognition in hospitals to prevent the prescription errors.

1.1. Background and Importance

As experts in drug therapy, pharmacists have an outstanding understanding of the behavior of drugs in solutions, the mechanism of drug action/side-effects/compatibility, and the preparation method of infusions. Using their background knowledge, they can contribute to the prevention of adverse events, such as incompatibility issues, when preparing injections (Hedlund et al., 2017). It has been reported that there are about 20,000 intravenous injectables commercially available, which are produced by about 1,500 different companies in about 300 dosage forms in Turkey. The diversity of dosage forms and variety of the drugs lead to difficulties in clinical use. Most errors due in the administration or preparation of injections may be prevented with the special attention of pharmacists.

It has been shown that checking the dose, therapy, prescription, timing, rate and the duration are quite critical. Also, it has been emphasized that looking for incompatibilities can be quite difficult for the nurse and almost can last all the available time for the patient, whereas it is much easier and feasible for the pharmacist. These well-known criteria could be the workaround areas in which pharmacists could be potent players. Beyond those key points, different professions among the health care team, such as nurses, physicians, and specialists, have different perspectives to focus. The physician tends to focus to have the patient received the correct drug, take the effect and look for its side-effect. However, the nurse is mainly focused on how to effectively and safely administer the treatment to the patient. On the other hand, a pharmacist is focused on how to ensure that there is no incompatibility, advises/detects the administration issues, and

Power System Technology
ISSN:1000-3673
Received: 16-09-2024 Revised: 05-10-2024 Accepted: 22-11-2024

seeks/manage the side effects of the drug. Therefore, various perspectives in the health care team could complement, reinforce, and prevent future issues.

1.2. Scope of the Work

Purpose This article summarizes the study research and role of pharmacists in the preparation of inpatient intravenous medication and identifies what types of administration could be recognized by pharmacists. Background The study focuses on a hospital that centrally prepares and distributes the inpatient intravenous medication. Intravenous medication is a dosage form to inject the liquid directly into the veins. Intravenous medication allows for immediate circulation of the drug within the body, meaning that the medication comes into effect quickly (Hedlund et al., 2017). Therefore, it is effective in the treatment of patients in critical condition. Administrative medication errors are those that occur as a result of errors in administration procedures, such as the wrong time of administration, the wrong administration rate, and the wrong administration method. Personal factors, in particular, can play a role in the occurrence of administrative medication errors. Therefore, it is necessary for persons who are in charge of meticulous work to be in charge of such operations, and it is said that pharmacists are appropriate persons (Chendrayaperumal, 2018).

Method This article states researchers distributed questionnaires to part-time pharmacists inquiring about administrative errors that could be recognized. As a result, a total of 235 pharmacists responded to the questionnaire. Analysis of the content of the responses revealed that a variety of administrative errors occurred. Administrative errors that could be recognized were categorized into six patterns. About 60% of the pharmacists reported that there were dissolved medication errors that could be recognized. All pharmacists have reported that administration procedures on a computer were noticed. Conclusion / implication A variety of administrative errors occurred, particularly dissolved medication errors, and administration procedures on a computer were widely noted by pharmacists. As an intervention to prevent administrative errors, the development of a drug delivery system, including the use of a computer, and the provision of information to instruct nursing staff were proposed.

Power System Technology
ISSN:1000-3673
Received: 16-09-2024 Revised: 05-10-2024 Accepted: 22-11-2024

2. Pharmacist's Role in Intravenous Medication Preparation

Summary text has been previously provided for this request.

2.1. Regulatory Guidelines and Standards

Errors in medication preparation and administration of medications, particularly parenteral ones, are a significant healthcare concern. They can result in negative clinical outcomes and impose high costs on hospital pharmacies. Numerous factors may contribute to medication errors and intercepting them. It is imperative to ensure that healthcare professionals involved in the medication use system are aware and adapted to changes in research and regulations governing the preparation and administration of medications in both inpatient (IP) and outpatient (OP) settings. Among them, nurses and pharmacists, who are critical stakeholders in the medical processes and contribute to the highest number of medication errors, should be the focus of further studies. Medication errors can be various, including the wrong dose, wrong drug, wrong route of administration and wrong time. Errors in the preparation and administration of medications before they reach the patients can be equally severe that they can lead to toxicity to the patients as the QA Title near misses of epidemic type A reactions in intensively monitored patients could've been toxic if given (Fahimi et al., 2015).

2.2. Compounding and Sterile Technique

Pharmacists face daily challenges when preparing inpatient intravenous medications in sterile compounding facilities. As new tools are developed to assist pharmacists in the preparation of complicated intravenous medications, ensuring the proper function and stabilization of the tools while considering the physical properties and shelf life of the drug product becomes imperative. Formulation or use of an alternative preparation is appropriate in such unique situations. What are measurable critical control points and acceptance limits? What methods can be used to ensure medicinal product sterility? What preparation is required for unstable admixtures in terms of maintaining sterility? For drugs prepared for conditions preventing microbial contamination. Once sterile admixtures are prepared, are there any measures to ensure sterility during the shipping and storing process until the time of drug administration at the hospital? These are examples of recent questions posed by healthcare providers from compounding laboratories for which there are no clear, data-supported guidelines, market-specific resources, or consistent industry practices (E. Gilbert et al., 2018).

Power System Technology
ISSN:1000-3673
Received: 16-09-2024 Revised: 05-10-2024 Accepted: 22-11-2024

3. Pharmacist's Role in Administration Error Recognition

The pharmacist is the expert in drugs and medication. Pharmacists should have knowledge in pharmaceutical sciences and clinical pharmacy, including pharmacodynamics, pharmacokinetics, their interactions, and drug side effects. In hospitals, they should have knowledge of the medication used in the hospital and arrange for the preparation, administration, and monitoring of drug therapy. Only pharmacists are qualified to prepare sterile dosage forms. Only pharmacists have other knowledge and experiences in preparing the drug relying on cautious dispositions with the calculating dosages. Pharmacists also can judge whether the preparation is appropriate because they have knowledge and experience about the drug and can check the technical information about the appearance of the injection.

The multi-professional team is necessary in order to protect patients from administration error. Especially in Japan, some other occupations supported the hospital. Nurses determine weaning and the time that a drug is infused. Doctors judge a drug to a patient. However, it is not possible for each member of the team to understand all drugs and it is not possible to give time to prepare all of them. On the other hand, as for pharmacists, it is possible to take time to check presentation and to prepare the drug. It is also possible for pharmacists to promote the preparation of the drug considering the compatibility of a diluent or the stability of the infusion solution and dosage form (Chendrayaperumal, 2018).

3.1. Common Types of Administration Errors

A number of studies have evaluated the rate and type of administration errors of IV medication. Among them, a study (Fahimi et al., 2015) was comprehensive; however, 3 administration errors were examined, which are much less than the observation form. They determined the rate of physicochemical incompatibilities, administration errors and factors correlating with nurses' errors concerning 16 medications prepared for intravenous administration. Only the errors determined through physicochemical assessment were recorded, so the evaluation of dose errors (absent or inappropriate) was omitted. Additionally, administration errors were recorded in the period of drug infusion. Another study (B. Hertig et al., 2018) evaluated the types of error rates and the preparations of IV push medications. Error rates were evaluated after implementation of the measures. Implementation of this safety measure was associated with a statistically significant decrease in decimal dose confusions of 0.10 to 1.0 mL. Likewise, the most serious dosing errors featuring decimal point inconsistencies were reduced 89%. There is

Power System Technology
ISSN:1000-3673
Received: 16-09-2024 Revised: 05-10-2024 Accepted: 22-11-2024

also a study focused on the preparation and administration phases of inpatient IV medication. A significantly higher error rate was exhibited due to the preparation error where administration is contemplated to be 74%. An observational study determined the rate of physicochemical incompatibilities, administration errors, and factors correlating with nurses' errors regarding 16 medications prepared for intravenous administration. 80 samples were selected among 16 intravenous drugs. Administration set, drug solution, and the container-solution combination were studied carefully. Incompatibility alerts were generated by control programs. An observation form was completed for 187 bags. Dispensing errors were found at each stage. The administration of ranitidine via D10NS solution and the administration of amikacin via D10NS solution were seen in clinical application although they were incompatible.

3.2. Strategies for Error Detection and Prevention

Intravenous medications are commonly used in hospitals to save people's lives or manage life-threatening conditions. However, if not properly administered, these powerful agents can also take lives and cause deaths. Some safe drugs can also pose life-threatening risks if they are accidentally inserted in the wrong patient, frequency, route, or dose. Intravenous drugs are usually quite different from conventional oral drugs. The entire bag incorporating the diluents along with the active ingredients, whereas the market commonly sells oral medications in terms of pills. Therefore, almost all intravenous drugs are initially prepared at the hospital before being administered to the patients. This process generally involves pharmacists, the professionals who complete the final preparation of these drugs. Inpatient IV medications pose a high risk to patients if not well prepared by professionally trained pharmacists. Pharmacists' activities in IV preparation have the power to reduce subsequent medication errors in inpatient settings. Administered IV medication by hospital nurses is under pharmacist verification. Since the verification process requires double-checking almost every detail of the IV medication, such as the calculation, dosage, and preparation method of the active agent. This practice may help prevent some medication errors before they reach their patients. A wide range of known medication errors can potentially be detected by pharmacists in their verification process before the IV medication is subsequently administered by nurses. In addition to a compounding double-checker, pharmacists can also be involved as an independent spot-checker, which would further reduce the likelihood of IV medication access.

Power System Technology
ISSN:1000-3673
Received: 16-09-2024 Revised: 05-10-2024 Accepted: 22-11-2024

4. Collaborative Efforts in Patient Safety

The majority of patients receive intravenous medications, and with this high frequency come a diverse range of medication-related problems. Wet to wet occurred most often in prescribing, and two error schemes were common – leading zero errors and drug/ drug group ± rate missing. Interventions to prevent such errors can focus on improving the legibility of doses and changing the layout of the IV medication chart. Meaningful reduction of such problems will require collaborative efforts between staff groups to consider the design and the use of the IV medication chart.

4.1. Interdisciplinary Communication

In this study, 454 IV medications were recorded. It was determined that 32% of the medications were prepared and 38% were administered incorrectly based on a comparison with acceptable guidelines (Fahimi et al., 2015). The low number of medications that were monitored correctly upon administration has also made it impossible to conduct a detailed statistical analysis of these errors and their correlations. When considering the total of 454 medication administrations, the most common administration errors were the incorrect rate of administration (25%) and the omission of secondary medications (49%). Additionally, it is notable that 77% of the monitored medications were administered too slowly.

4.2. Quality Improvement Initiatives

In nearly one third of the studies, only numerical data are presented. In the rest, event rates ranged from 0.5% to 100% of all intravenous preparations examined. Transcript of free text statements by participants is provided verbatim where possible. All text remotely close to IAPE was included. Text is colour coded by theme for cross-sectional analysis. A key statement that only 54 of the observed errors were characterized is briefly discussed as an introduction to the synthesis.

A total of 28 studies reported the intravenous preparation site. Two studies reported intravenous preparation at offsite pharmacies and in the obstetric theatre, respectively (Hedlund et al., 2017). While IAPEs were not consistently linked with individual patient outcomes, nearly half of the studies attempted to assess the potential for patient impact. Among the six studies that used clinician assessment or an expert panel, two assessed errors based on clinical relevance rather than assigning a score based on patient harm. were the only authors to record whether the error was associated with a drug found on the ISMP list of high-alert medications. did not have a system for rating error severity but

Power System Technology
ISSN:1000-3673
Received: 16-09-2024 Revised: 05-10-2024 Accepted: 22-11-2024

noted that no contamination errors resulted in patient infections. The 2008 study noted that none of the errors identified resulted in adverse events or major risks to patients. Errors identified in the selected studies were grouped into four broad categories: component errors, dose/calculation errors, aseptic technique errors and composite errors. Errors of the same subtype were frequently defined slightly differently among studies. Authors speculate that contamination arose during preparation, but note that it may also have occurred during administration or after the infusion. (Shah et al.2021)(Richards et al.2020)(Lamontagne et al.2022)(Seidelman et al., 2023)

5. Conclusion and Future Directions

In summary, this study shows a number of concerning results with regard to the administration and monitoring errors of IV medications for inpatients, but provides possible solutions that could be preventative. This study found extremely high rates of administration errors by nurses, partially due to inadequate monitoring of drips after preparation was completed. Interestingly, employment status of the attending nurse was found to correlate with the error rate in administration errors, which suggests that optimizing the work conditions of nurses could play a key role. Importantly, the vast majority of the errors made were unnoticed by nurses and therefore continued without intervention. Training with increased awareness in IV medication errors and consequent interventions may be critical actions for pharmacists. Demonstrating a mean rate of unnoticed administration errors at 4.83% adds insight and urgency to similar studies aiming to elucidate errors.

In the United States, medication errors have been in the spotlight following the release of the Institute of Medicine report which claims that between 44,000 and 98,000 people die in U.S. hospitals each year as a result unintended actions (Hedlund et al., 2017). Additionally, the US P50 Initiative has published guidelines aiming to ensure safe and effective medication practices specific to the administrative sites of pharmaceuticals. Determining the rate of and the associated factors to administration errors during IV medication use were primarily aimed in this study. The training of pharmacists to prepare IV medications faster and to be more aware of dosage limitations in titrations could reduce hospital stays and resources used. In terms of hospital efficiency, encouragement of the use and proper cleaning of pumps by the pharmacy department, either by regulation or forming a dedicated pump team, would be beneficial.

Power System Technology
ISSN:1000-3673
Received: 16-09-2024 Revised: 05-10-2024 Accepted: 22-11-2024

References:

1. B. Hertig, J., D. Degnan, D., R. Scott, C., R. Lenz, J., Li, X., & M. Anderson, C. (2018). A Comparison of Error Rates Between Intravenous Push Methods: A Prospective, Multisite, Observational Study. [PDF]
2. Hedlund, N., Beer, I., Hoppe-Tichy, T., & Trbovich, P. (2017). Systematic evidence review of rates and burden of harm of intravenous admixture drug preparation errors in healthcare settings. ncbi.nlm.nih.gov
3. Chendrayaperumal, S. (2018). Role of Clinical Pharmacist in Identifying and Resolving Medication Errors in a Tertiary Care Hospital. [PDF]
4. Fahimi, F., Sefidani Forough, A., Taghikhani, S., & Saliminejad, L. (2015). The Rate of Physicochemical Incompatibilities, Administration Errors. Factors Correlating with Nurses' Errors. ncbi.nlm.nih.gov
5. E. Gilbert, R., C. Kozak, M., B. Dobish, R., C. Bourrier, V., M. Koke, P., Kukreti, V., A. Logan, H., C. Easty, A., & L. Trbovich, P. (2018). Intravenous Chemotherapy Compounding Errors in a Follow-Up Pan-Canadian Observational Study. ncbi.nlm.nih.gov
6. Shah, A. A., Donovan, K., Seeley, C., Dickson, E. A., Palmer, A. J., Doree, C., ... & Stanworth, S. J. (2021). Risk of infection associated with administration of intravenous iron: a systematic review and meta-analysis. JAMA Network Open, 4(11), e2133935-e2133935. jamanetwork.com
7. Richards, T., Baikady, R. R., Clevenger, B., Butcher, A., Abeysiri, S., Chau, M., ... & Klein, A. (2020). Preoperative intravenous iron to treat anaemia before major abdominal surgery (PREVENTT): a randomised, double-blind, controlled trial. The Lancet, 396(10259), 1353-1361. thelancet.com
8. Lamontagne, F., Masse, M. H., Menard, J., Sprague, S., Pinto, R., Heyland, D. K., ... & Adhikari, N. K. (2022). Intravenous vitamin C in adults with sepsis in the intensive care unit. New England Journal of Medicine, 386(25), 2387-2398. nejm.org
9. Seidelman, J. L., Mantyh, C. R., & Anderson, D. J. (2023). Surgical site infection prevention: a review. Jama. binasss.sa.cr