Using Patient Safety Science to Explore Strategies for Improving Safety in Intravenous Medication Administration

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Abstract

Harm is more likely to result from errors in intravenous (IV) administration than through any other routes of administration. Infusion therapies are delivered in a variety of settings every day, including hospitals, home care settings, long-term care facilities, occupational health facilities, outpatient clinics, and physician offices. Understanding the basic principles of patient safety and developing strategies to reduce risk and severity are critical to improving the safety of IV medication administration. Consistent implementation of accepted strategies to prevent error is long overdue in the practice of IV medication administration. This article challenges the reader to develop a better understanding of patient-safety science, thoroughly investigate the causes of IV medication administration errors, and develop processes to mitigate the recurrence of similar errors.

In 1999, the Institute of Medicine (IOM) published their landmark report, *To Err is Human*, stating that every year as many as 98,000 people in the United States die from preventable medical errors.[1] This exceeds the number of deaths attributed each year to AIDS, breast cancer, and car accidents combined.[1] Although this report was certainly not the first to sound the alarm on patient safety, it may be the most well known, and it succeeded in focusing national attention on a system fraught with error. Unfortunately, nearly 7 years, later little progress has been made in improving patient safety both nationally and locally.

One area that has been particularly neglected is infusion therapy. Infusion therapies are being delivered in many health care settings, including hospitals, home care settings, long-term care facilities, occupational health facilities, outpatient units, and physician offices.[2] Approximately 750,000 pumps are used to administer more than 1 million intravenous (IV) doses of medication per day in U.S. hospitals alone.[3]

IV infusions are administered to the sickest patients, often with several medications being administered simultaneously and requiring frequent dose changes. Harm is more likely to result from an error related to an IV administration than through any other route because of the immediate absorption of the drug and the inability to "recall" it after it is given. Although there is well-substantiated evidence related to the types of infusion-related errors, the root cause of these errors has not been thoroughly investigated (see Table 1).

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Review of Literature

A review of the literature reveals a plethora of information related to medication errors; primarily, studies have been done with non-IV drugs, and the error rate with IV therapy is not well documented. Studies that have been published regarding infusion-related errors have identified types of errors that range from mishaps with infusion pumps to confusion about tubing connections. The literature contains very little on the causes of these types of errors. Consider the seminal medication-error study in which Bates et al found that 38% of the preventable medication errors occur at the point of administration, and only 2% of these are intercepted before reaching the patient.[4] IV medications represent 61% of the serious and life-threatening errors. Errors occurring later in the process are more difficult to intercept. In addition, compared with oral and non-IV parenteral medications, an IV infusion is typically not a single administration event but a series of programming events under circumstance where risk is the greatest.[3] Often, infusion-related errors can be difficult to identify and may not always be reported, making their true frequency difficult to ascertain.

Table 1. Examples of IV-related errors

Enteral formulas administered parenterally
Oral medications administered intravenously
IV medications administered intrathecally
IM preparation administered intravenously
Epidural and IV lines mixed up (also arterial lines)
Using IV syringes to measure doses of oral medications
Using IV medications orally

Note. IV, intravenous; IM, intramuscular.

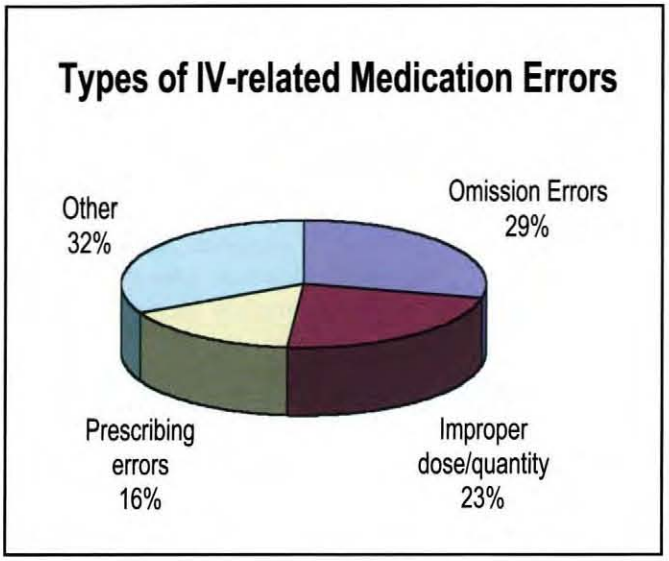

Figure 1. Type of errors associated with intravenous (IV)-related medication errors[5]

Table 2. Error-producing conditions[6]

- Handling technology
  - Lack of knowledge, routine, and experience
- Design technology
  - Design of drug vial, ambiguous manufacturer inserts
- Communication
  - Nurse/nurse, nurse/pharmacist, nurse/physician
- Workload
  - Several tasks at once, end of shift, lack of qualified staff
- Patient-related factors
  - Limited venous access, noncooperative patient
- Supervision
  - Lack of supervision of students/agency nurses
- Other factors

Error in Infusion Therapy

Those practicing IV therapy are well aware that IV medication administration errors, both detected and latent, are quite common. In a study reviewing IV-related medication administration errors reported to MEDMARX, a national medication error–reporting program, Hicks and Becker noted that IV-related errors accounted for 27,000 reports in 2004 and nearly double the number of overall errors leading to harm.[5] Figure 1 shows the three most common types of IV-related medication errors reported.

In addition, the three most common causes of IV-related errors, accounting for 89% of the errors reported, included "performance deficit" (ie, the provider had the requisite skills and knowledge to correctly discharge his or her duty but failed to do so in the situation), "procedure/protocol not followed," and "transcription inaccurate/omitted." Other less common causes involved lack of communication, data entry error, knowledge deficit, and poor documentation.[5]

Other types of errors identified have to do with erroneous calculations, particularly those involving decimal points that can result in a 10-fold or greater variation. Errors with weight-based dosing are prevalent because the process often requires the practitioner to perform a series of calculations with each calculation, representing an opportunity for error.[5]

Causes of IV medication errors have not been well studied. In their study conducted on 10 wards in two U.K. hospitals, Taxis and Barber observed 483 IV drug preparations and 447 IV drug administrations performed by 113 nurses. A total of 265 errors were identified during these observations (see Table 2).[6] Observations could be categorized as slips, lapses, mistakes, and violations. Slips and lapses were failures in the process of executing the task. Intended actions failed because of recognition, attentional, memory, or selection failures. Examples of slips or lapses include failure to notice the drug was not completely dissolved prior to administration or misreading the label of the additive during the add-mixture process. Mistakes were failures at the planning or problem-solving stages of the task. For example, when adding multivitamins to a large-volume IV, the nurse mistakenly added only one of the two vials, thinking the second vial was a concentrated version of the first. Violations were deliberate deviations from safe operating practices. Routine violations were observed particularly when bolus medications were given. Nearly two out of every three bolus doses exceeded the recommended administration time.[6]

Contributing to the causes of errors were also such factors as high workload and distractions when carrying out several tasks at the same time, lack of supervision of agency and student nurses, and lack of appropriate training. Nurses were observed to deliberately violate the speed of injection of a bolus because of a perceived lack of risk, poor role models, and lack of available technology.[6] Humans tend to think because nothing bad has ever happened before, risks become acceptable. It is often the case with error; it is not those who make the error who should be the focus, but the whole system of work and technology around them.[7] Attempts to reduce the harm caused by IV medication errors in the past have focused on restricting choice and removing the nurse from the task of preparation. Although label designs, similar-sounding drug names, and the complexity and design of infusion pumps have been investigated and recognized as risk factors, the application of concepts and techniques to reduce human error have not been fully implemented yet.

Understanding Patient-Safety Science

In addition to the above problems, changing the way people think about patient safety is not easy. An organization's culture is the major determinate in the behavior of its people. An organization's culture can be critical in determining how well patient safety efforts will "stick." IV drug errors are not only caused by the immediate individual act but a range of organizational and managerial issues, including training, organizational culture, choice of product, purchasing policy, and design of technology. Implementing a behavior-based safety process without a solid cultural foundation supporting it causes most patient safety efforts to fail.

Simply put, an organization's culture is "the way they do what they do when no one else is looking." The culture of an organization plays a key role in efforts to embed patient safety throughout an organization. To create a true culture of safety requires