Ten Simple Strategies to Prevent Chemotherapy Errors

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Safety experts currently recommend using technology to prevent medication errors. Computerized prescriber order entry, automated medication-dispensing machines, and bar coding are a few of the technologies being advocated to promote safety. Simple, easily implemented safety strategies to prevent chemotherapy errors should not be overlooked and include consistent use of a reliable method to verify patient identity, metric measurement, and workplace illumination and organization. Other strategies are elimination of abbreviations and acronyms, provision of up-to-date information at the point of care, and partnering with patients for safety. These strategies can be customized for use in a variety of practice settings. Oncology nurses are at the forefront of chemotherapy error-prevention initiatives and play a key role in implementing safety measures.

Chemotherapy error prevention has received considerable attention since 1995, when reports of patients' deaths from overdoses of chemotherapy were highly publicized in the media (Knox, 1995; Smaragdis, 1995). These lethal errors prompted many cancer centers to examine their policies, procedures, and practices. In many settings, heightened measures to prevent chemotherapy errors were implemented.

Following the anecdotal reports of patients' deaths, several journal articles about chemotherapy error prevention were published. Safety measures advocated by the authors of these articles included using preprinted chemotherapy order forms, systematically calculating and verifying doses, establishing dosage limits, eliminating the use of trailing zeros in doses (e.g., 2.0 mg), standardizing the prescribing vocabulary, requiring nurse certification in chemotherapy administration, and improving communication (Cohen et al., 1996; Fischer, Alfano, Knobf, Donovan, & Beaulieu, 1996; Kohler et al., 1998; Olsen, 1997; Schulmeister, 1997, 1999a).

In addition to the error-prevention strategies published in journals, guidelines and recommendations that address chemotherapy administration have been published by various organizations, such as the Oncology Nursing Society (Brown et al., 2001), Infusion Nurses Society (2000), and American Society of Health-System Pharmacists (ASHP, 2002). These guidelines often serve as the basis for an institution's policies and procedures and can be adapted to meet the needs of each particular institution.

More recently published literature on error prevention emphasizes the use of technology to reduce the potential for error. Examples include computerized prescriber order entry (CPOE), chemotherapy-specific software programs, computerized nursing documentation systems with links to pharmacology references, automated medication-dispensing machines, electronic medical records, linked networks of patient databases, computerized clinical decision support systems, personal data assistants, use of robots in pharmacies, and bar coding (ASHP, 2002; Bates & Gawande, 2003; Chung, Choi, & Moon, 2003; Gray & Felkey, 2004; Hagland, 2004; Kaushal, Shojania, & Bates, 2003; Larrabee & Brown, 2003; Oren, Shaffer, & Guglielmo, 2003).

The U.S. Food and Drug Administration (FDA) asserted that bar codes on medications would help to prevent medication errors when used with a bar code scanning system and computerized database. On February 25, 2004, the FDA published a rule titled "Bar Code Label Requirements for Human Drug Products and Biological Products" that requires linear bar codes on prescription medications and over-the-counter medications commonly used in hospitals and dispensed by medication orders. Manufacturers of new medications had 60 days from the February 25, 2004, implementation date to include bar codes on their products. Medications previously approved by the FDA, blood, and blood products must have bar codes within two years of the implementation date. A bar code must contain, at a minimum, the medication's national drug code number, which uniquely identifies the medication. Pharmacy use of bar codes and scanners helps to ensure that the right drug and correct dose are dispensed. Use of bar code technology in patient care areas reduces the risk that a patient will receive the wrong medication or wrong dose or that the wrong patient will receive a medication (FDA, 2004a). The FDA estimated that the bar code rule will result in more than 500,000 fewer medication-associated adverse events through 2024 and a 50% reduction in medication errors that otherwise would occur when medications are dispensed or administered (FDA, 2004b).

Chemotherapy error-prevention strategies have evolved from simple practice

Submitted September 2004. Accepted for publication December 27, 2004.

Digital Object Identifier: 10.1188/05.CJON.201-205

changes, such as consistent use of generic drug names in chemotherapy orders, to sophisticated solutions involving automation and computerization. Technology may effectively reduce errors; however, the current literature is largely descriptive or reflects one institution's experience in implementing new technology (e.g., staff satisfaction, documentation efficiency, billing accuracy). Few well-designed, patient-focused outcome studies have been conducted.

Data suggest that CPOE reduces medication errors and adverse drug events in general medicine practice (Bates et al., 1998, 1999; Raschke et al., 1998). However, in a 2002 survey of 626 randomly selected hospitals in the United States, only 9.6% of the hospitals reportedly had CPOE (Ash, Gorman, Seshadri, & Hersh, 2004). Also, cautionary articles have been published, such as "Computer Physician Order Entry and the Real World: We're Only Humans" (Scanlon, 2004), that acknowledge that automated and computerized systems do not eliminate the potential for error; they only are able to possibly reduce the potential for error. Ultimately, these systems are operated by people and therefore are vulnerable to human error, which can occur from a number of causes, including stress, fatigue, complacency, distraction, and memory lapses (Perry, 2004; Reason, 2000).

Equipment-related errors historically have been attributed to the equipment user and are called "user errors." However, many of these errors now are known to be caused partly by poor device design that fails to adequately account for the needs of the user. This new philosophy is the basis for human factors engineering, the science of designing systems that are safe, effective, and usable by taking into account human capabilities, limitations, characteristics, and needs (Ward & Clarkson, 2004).

Even the most advanced safety features are not infallible if systems can be manipulated. For instance, many systems can be overridden manually, increasing the potential for error. In a multicenter study of 3,481 computerized order entry alerts, physicians overrode 91.2% of drug allergy and 89.4% of high-severity drug interaction alerts (Weingart et al., 2003). Little is known about how often or under what circumstances chemotherapy orders are overridden manually. One published case report described how, despite the use of an automated prescribing system, a patient received a cisplatin dose of 760 mg instead of 190 mg. The dose error caused severe pancytopenia and renal failure that required hemodialysis (Pourrat et al., 2004).

Before jumping on the "high-tech bandwagon," healthcare providers need to carefully examine the pros and cons of automated and computerized systems. They need to separate information in marketing and promotional materials from study data and make informed decisions when they are considering adopting these systems. End users of this technology should be involved in the evaluation and selection process.

Several questions should be addressed. What is needed to obtain this system or item? Often, indirect costs exist (e.g., workplace renovations, need for additional staff), as well as the direct cost of purchasing the item. What is needed to implement this new technology? Equipment training, maintenance, and a contingency plan for times when equipment is not available or is being repaired may be needed. Lastly, discussion about who will use the system and how the system will be used is needed. Will all users have the authority to override the system? To what degree will manual manipulation or reconfiguration be allowed?

Evaluation of new devices and systems needs to be planned and should include a timeline. How will it be determined if the new system is being used and used properly? How and when will user feedback be obtained? How will the effectiveness of the technology be measured, both in terms of system considerations (e.g., cost, efficiency) and patient outcomes?

Back to Basics

Although the current focus of error prevention is use of technology, simple and easily implemented strategies to reduce chemotherapy errors should not be overlooked. Adaptations can be made in a variety of practice settings to help reduce the potential for error. The need for the following 10 recommendations is based on the author's research findings on chemotherapy errors, review of medical malpractice cases involving chemotherapy errors, and practice consulting experiences where common clinical practices that could be enhanced for safety were observed.

1. Consistently use a reliable method to verify patient identify prior to chemotherapy administration. Chemotherapy has been administered to the wrong patient when patients were addressed only by their surnames (e.g., "Mrs. Jackson"), language barriers existed between nurses and patients, or patients were in close proximity (e.g., same room) (Schulmeister, 1999a). A Joint Commission on Accreditation of Healthcare Organizations (JCAHO) National Patient Safety Goal is to improve the accuracy of patient identification by using at least two patient identifiers other than the patient's room number whenever blood samples are drawn or medication or blood products are administered (JCAHO, 2004b). Armbands can serve as one form of identification, and nurses should instruct patients to show their armbands routinely (rather than wait for nurses or laboratory technicians to request to see them) prior to receiving medications or undergoing blood sampling.

In some oncology settings, such as small clinics, office practices, and patients' homes, armbands are not worn routinely and patients must be identified by other means, such as by birth date, social security number, or complete address. Nurses also can request that patients show their drivers' license prior to receiving chemotherapy. Relying on photographs placed on or in patients' medical records to identify patients is not advised because many patients lose their hair, gain or lose weight, and may change in appearance over time. Instant photographs, which are used in some outpatient settings, tend to fade and often blur or distort; therefore, they are not a reliable method to accurately identify patients over time. Parisi (2003) recommended that healthcare providers develop a standard patient identification policy for use in their institutions and consistently adhere to it.

2. Measure height and weight in centimeters and kilograms. The current practice in many settings is to measure (or sometimes ask) a patient's height in feet and inches and weight in pounds. The first calculation required to compute a patient's body surface area is to convert height from feet and inches to inches. Errors can occur at this point that ultimately affect a patient's chemotherapy dose. For example, a height of 6'3" inadvertently was written as 63" on a patient's medical record, and the patient's body surface area was computed using this number. As a result, the patient received an underdose of chemotherapy. Calculation errors can occur as the number of feet is multiplied by 12 and inches are added. Most healthcare providers do not use a calculator when converting height to inches and do not recheck their math. One staff educator observed nurses' conversion errors and added a question to her hospital's orientation examination to assess new employees' ability to convert feet and inches to inches. In settings where converting to a metric system of measurement is not feasible, an online body surface area calculator that allows entry of height in feet and inches can be used to reduce the potential for conversion errors, such as the one available at www.fda.gov/cder/cancer/animalframe.htm.

3. Have good lighting, employ magnification, and use high-visibility tools such

as calculators with large-number buttons and a large lighted data display area. The aging process decreases the amount of light entering the eye, which decreases visual acuity and the ability to discern light or dark contrast and color intensity. The nurse's role in chemotherapy administration is visually demanding, and good lighting is needed to review orders, read vial or drug labels, prepare medications, and enter information into a computer. Full-spectrum fluorescent lighting, which is similar to natural daylight, enhances visual acuity and perception (Veitch & McColl, 2001). This type of lighting may be helpful in oncology settings. Minimally, nurses should examine their workspaces and ascertain whether additional lighting, such as under cabinets, is needed. To enhance visual acuity, computer screens can be adjusted easily to increase the size of the type, change the style of the type, or increase contrast if needed (Takeshita, 2004). Magnifying lenses make reading small type or print easier, and they are particularly helpful when reading product package inserts. To maximize efficiency and accuracy of use, calculators should have large buttons and large display screens. Chemotherapy errors may occur when the incorrect number button is pressed inadvertently and the calculation is not rechecked.

4. Organize the work and workspace for safety and efficiency. Chemotherapy errors sometimes occur simply because a workspace is cluttered and disorganized. Inefficient workplaces, with chemotherapy bags stacked in piles, multiple medication vials on a countertop, and several opened charts, increase the risk that an error will occur. Items used frequently should be easily accessible between waist and eye level. Eliminate repetitive nonproductive movements (e.g., efficiency is enhanced when upper cabinet doors are removed, especially if frequently used items are stored in this area). Arrange items logically and securely; for example, organize syringes in bins labeled by size. Streamline inventory to avoid stocking different brands of similar items. Remove unnecessary items (e.g., newspapers, personal items) from the workspace. Create additional counter space by relocating items that commonly are stored there. Pens, tape, books, and so on can be placed in drawers or on nearby shelves. Enlist staff support to keep a clean workspace, and at least annually, thoroughly clean and reorganize the space. This also is an ideal time to check the expiration dates of stock medications and fluids.

Workforce issues need to be considered in addition to workplace-related issues. The Institute of Medicine (IOM) called attention to this area in its recent report *Keeping Patients Safe: Transforming the Work Environment of Nurses.* In the report, the IOM outlined a blueprint of safety promotion actions that included designing the workplace with both nurses and patients in mind, using competent and capable nurses to provide patient care, and creating and sustaining an organizational culture of safety. Transformational leadership is necessary to implement these proposed actions (Page, 2004). These broad concepts can be operationalized in various oncology settings by examining the workload and work flow to make patient scheduling or nurse staffing adjustments, using strategies or resources to maximize time efficiency (e.g., group chemotherapy education classes for patients, instructional videotapes or computerized programs), providing comprehensive new staff orientation and training, and fostering an atmosphere where safety is the number-one goal.

5. If chemotherapy orders are transmitted via fax machine, use an original order sheet printed with a font larger than 12 points. In many settings, such as smaller clinics and offices (and especially those with satellite facilities), chemotherapy orders commonly are transmitted by fax. Often, copies of copies are faxed, which results in poor document quality. The quality of the fax machine on the receiving end is also a factor; some machines produce faint, difficult-to-read orders. Faxing original chemotherapy order sheets printed with a font larger than 12 points improves legibility, as does using a high-quality fax machine to receive orders. As an alternative to faxing, chemotherapy orders can be mailed electronically or entered directly into a computerized system.

6. Eliminate the use of abbreviations and acronyms in *all* clinical documentation. Treatment protocol acronyms and abbreviations for drug names, scheduling information, and administration instructions should not be used. Confusion or misinterpretation of acronyms and abbreviations can result in chemotherapy errors. JCAHO National Patient Safety Goal 2b is to standardize abbreviations, acronyms, and symbols used throughout an organization and develop a list of abbreviations, acronyms, and symbols not to be used (JCAHO, 2004b). JCAHO (2004a) listed implementation tips for this goal on its Web site that include providing pocket-sized cards to staff members, sending monthly reminders to staff, creating educational displays, and even creating a song incorporating the do-not-use list. To make documentation much easier and less confusing for staff members, simply implement a policy to eliminate the use of abbreviations and acronyms in *all* clinical documentation. Items that historically have been abbreviated or written as acronyms, such as chemotherapy treatment protocols, can be placed on paper or electronic flow sheets that are stored electronically and printed as needed.

7. Provide and use up-to-date, easily accessible information at the point of care. Information that is outdated is of limited value, and resources that require effort to locate them, such as manufacturers' Web sites or reference texts that are housed in an office, are not likely to be used. Up-to-date information needs to be available at the point of care. Providing this information may require, for instance, that two or more copies of certain reference texts are purchased so that all points of care, such as the pharmacy and infusion center, have this information readily available. Outdated information must be discarded. As new medication and treatment protocol information becomes available, a plan should be in place for its dissemination and retention at the appropriate points of care.

8. Follow the 80/20 rule. Although the 80/20 rule has its origins in economics, it can be applied in healthcare settings. The 80/20 rule is the principle that 20% of something is responsible for 80% of the results. Using this principle in product or device evaluations, for instance, a small number of defects (e.g., 20%) will cause the majority (e.g., 80%) of problems (Reh, 2002). In health care, this rule can be applied to medications: Only a small percentage of medications are deemed high alert, yet they are responsible for the greatest number of patient injuries. Education and safety measures therefore should be focused on these high-alert medications (Cohen & Mandrack, 2002).

Parenteral chemotherapy tops the list of high-alert medications. Other medications frequently administered to patients with cancer, such as insulin, potassium chloride, and anticoagulants, also are considered high alert (Institute for Safe Medication Practices, 2003). Providing information about high-alert medications and assessing (and reassessing) competency in administering these agents should be a priority in staff education.

9. Reduce the potential for human error. Human error, caused by stress, fatigue, and distraction, for example, can never be eliminated entirely, but it can be reduced. Some facilities have designated staff "quiet zones" where processes requiring concentration, such as checking chemotherapy orders, can be accomplished with minimal distraction and interruption. Contributors to sensory overload or distraction in workplaces where

chemotherapy is prepared and administered, such as music or notes posted all over the walls, should be removed.

In a study of chemotherapy errors, 114 nurses were asked to identify factors that they believed contributed to the occurrence of errors. The number-one factor cited by the nurses was stress (57%) (Schulmeister, 1999a). Stress-reduction measures can be implemented when the source of the stress is identified; however, few institutions focus on this area and instead view stress as something with which staff need to cope. In addition, many nurses involved in chemotherapy errors felt that personal stress (e.g., going through a divorce) and fatigue contributed to the errors. Nurses should speak up about how they feel and be supported when they do. Colleagues then have the opportunity to help or reassign them to less stressful activities. As one nurse noted,

> I knew she was frazzled as soon as she came in to work, so it wasn't surprising that she made a serious chemotherapy error that day. I wish now that I had done something. I feel partly responsible that the error occurred. Nurses—especially oncology nurses—need to look out for each other more (Schulmeister, 1999b).

10. Include the stakeholder with the most to lose—the patient—in chemotherapy error-prevention efforts. Partnering with patients to prevent chemotherapy errors is a concept that oncology nurses embrace, yet the degree that patients are involved in this process and how they are involved vary from institution to institution. To optimize patient partnership, nurses can involve patients in verifying chemotherapy (e.g., jointly reviewing drug names that are on the labels of the syringes or infusion bags, matching drug names on syringes or bags with a personalized drug card that is issued at the beginning of treatment), use an established template for writing instructions and reminders to reiterate chemotherapy teaching, and create a process to ensure that all patients are given information about their chemotherapy treatments (Boyle, Schulmeister, Lajeunesse, & Anderson, 2002).

Detailed information about chemotherapy protocols routinely is provided prior to initiating chemotherapy. Ongoing reinforcement of information may be haphazard. Information can be reviewed prior to chemotherapy treatment by providing drug cards or sheets to patients that outline major teaching points. One drug can be placed on each card or sheet of paper, or the drugs comprising commonly administered treatment protocols can be listed together. Patients can read and review the cards prior to treatment. Placing the cards in plastic protective sheets or laminating the cards allows for easy cleaning and reuse by other patients. A brief instructional video may be appropriate for patients with lower levels of literacy or those who are auditory learners. If individual video players are not available, wireless headphones can be used in settings where several patients are being treated simultaneously to enable patients to hear the information while reducing the overall noise level and nurse distraction.

Near-miss chemotherapy errors have been caught by patients when they happened to observe something out of the ordinary, such as a larger-than-usual infusion bag or a chemotherapy drug of a different color than those previously received (Schulmeister, 1999a). Patients need to be encouraged to speak up if anything appears unusual or unexpected, and nurses need to promptly investigate patients' concerns. In addition, nurses should provide intensive initial patient education about chemotherapy and reinforce information during subsequent treatment cycles. Well-informed patients have much to contribute to chemotherapy error prevention.

Summary

Automation and computerization currently play a major role in efforts to reduce and hopefully eliminate medication errors. However, several simple strategies can be implemented by nurses to potentially reduce chemotherapy errors. Errors may be reduced by verifying patient identity prior to chemotherapy administration, using accurate measurements for computation of a patient's body surface area, increasing visibility in the workspace, obtaining clearly transmitted chemotherapy orders, eliminating the use of abbreviations and acronyms, providing information at the point of care, reducing human error, and including the patient in the chemotherapy administration process. Oncology nurses play a major role in promoting safe patient care and are in an ideal position to adopt and customize chemotherapy error-prevention strategies for use in their workplaces.

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Rapid Recap

Ten Simple Strategies to Prevent Chemotherapy Errors

- The U.S. Food and Drug Administration bar code label requirements rule, published February 25, 2004, requires linear bar codes on prescription and nonprescription medications commonly used in hospitals and dispensed by a medication order.
- Chemotherapy error-prevention strategies have evolved from simple practice changes, such as the use of chemotherapy order sheets, to technologic solutions.
- Automated and computerized systems do not eliminate the potential for error; they only are able to possibly reduce the potential for error because these systems are operated by people and therefore are vulnerable to human error.
- Human factors engineering is the science of designing systems that are safe, effective, and usable by taking into account human capabilities, limitations, characteristics, and needs.