

GUIDE TO THE PREVENTION OF CHEMOTHERAPY MEDICATION ERRORS

2nd Edition



Sponsored by



Please see the approved indication and Important Safety Information (including boxed WARNING) on page 45.

Please see the enclosed prescribing information (including boxed WARNING).

Disclaimer

This pocket guide is designed to be a summary of information. While it is detailed, it is not an exhaustive pharmaceutical review. McMahon Publishing, Abraxis BioScience, and the author neither affirm nor deny the accuracy of the information contained herein. No liability will be assumed for the use of this pocket guide, and the absence of typographical errors is not guaranteed.

Readers are strongly urged to consult any relevant primary literature and the complete prescribing information available in the package insert of each drug and appropriate clinical protocols. Copyright © 2010, McMahon Publishing, 545 West 45th Street, New York, NY 10036. Printed in the USA. All rights reserved, including the right of reproduction, in whole or in part, in any form.

GUIDE TO THE PREVENTION OF CHEMOTHERAPY MEDICATION ERRORS

2nd Edition 2010

DWIGHT D. KLOTH, PHARM.D, FCCP, BCOP

*Director of Pharmacy
Fox Chase Cancer Center
Philadelphia, Pennsylvania*



Table of Contents

Introduction	6
Causes of Chemotherapy Errors	8
Look-alike/Sound-alike Drug Names	10
Handwritten Prescription Drug Orders	13
Clarifying Terms	13
Deadly Drug Administration Errors	15
Strategies To Prevent Cancer Chemotherapy Errors	16
Chemotherapy Order Forms	19
Drug Information and Dosing Guidelines	22
Punitive Versus Nonpunitive Environments	30
The Patient's Role	31
Technology: Computerized Prescriber Order Entry	32
Customizing a CPOE System	32
Caveats to CPOE Systems	34
Technology: Bar Coding	35
Institutional Self-Assessment	36
Conclusion	38
References	40

Index of Tables and Figures

Table 1	8
Table 2	12
Table 3	14
Table 4	17
Table 5	20
Table 6	24
Table 7	37
Table 8	39

Introduction

Medication error prevention is a critical goal for pharmacists, nurses, and physicians in all treatment settings—especially in oncology. Antineoplastic agents have a lower therapeutic index and safety margin than do other drug classes. Additionally, in cancer chemotherapy, the dose, dosing interval, and even the route of administration may vary as a function of the tumor type and the stage of disease. Chemotherapy-related medication errors, such as the administration of a 10-fold higher dose as a result of a transcription error, or the intrathecal administration of drugs that only should be administered by IV infusion, are potentially fatal.¹⁻⁴

In 2006, the Institute of Medicine (IOM) released the landmark report *Preventing Medication Errors*,⁵ which stated that “medication errors harm at least 1.5 million patients every year in hospitals, long-term facilities, and outpatient clinics, resulting in billions of dollars in additional medical costs.” To help prevent medication errors, the committee recommended that all organizations implement an electronic prescribing and dispensing system by 2010. Additionally, the report contained several other important recommendations pertinent to facilities that treat patients with cancer:

- monitor medication safety literature;
- develop and implement a structured error-avoidance plan;
- establish a routine procedure for double-checking filled prescriptions;
- designate a practice-wide medication safety officer with widespread authority and responsibility to improve care;
- create a safer work environment by looking at lighting and noise levels, minimizing distractions, and improving drug storage areas by separating look-alike and sound-alike medications;
- continuously evaluate technology and automation to reduce medication errors;
- be assertive in requesting resources to promote accurate medication prescribing, processing, dispensing, and administration; and
- involve patients in an aggressive education and reconciliation program.

More recently, a group led by Donald Berwick, MD, president of the Institute for Healthcare Improvement and recently nominated to become the administrator of Centers for Medicare & Medicaid Services (CMS), published a timely editorial addressing the need for health care to adopt more of the performance measurements and improvement tools used in other complex fields in an effort to increase efficiency as well as safety.⁶ Although many of these tools are important, it is important to consider that tools such as electronic health record (EHR) systems are merely tools, not the ultimate safety goal, and must be used correctly in order to have value.⁷

Since the first edition of this publication, several additional articles involving chemotherapy safety, errors, or error rates have been published. Some have involved IV chemotherapy errors and some have involved oral regimens, an increasingly common route due to the advent of a number of oral agents. Walsh and colleagues reviewed records from 1,262 adult cancer patient visits and 117 pediatric visits, and reported that 7% of adult and 19% of pediatric visits were associated with an error.⁸ Errors most commonly occurred during the administration phase of the medication management process. The authors recommended that the following strategies would prevent errors: computerized prescriber order entry (CPOE), electronic medication administration records, enhanced patient/parent medication education, and “smart” infusion pumps with programmed limits for chemotherapy.⁸

This pocket guide is intended to help clinicians develop practical strategies to prevent chemotherapy medication errors. It includes information on selected publicized chemotherapy errors and their outcomes; examples of potential causes of errors, such as look-alike/sound-alike drug names and the use of handwritten orders; examples of optimal requirements and prohibitions for chemotherapy orders; and how to assess the risk for medication errors at one’s own institution or practice site. Because nearly all authorities recommend implementation of an electronic order entry system, this guide discusses the use of technology and computerization (eg, CPOE and bar coding)

Table 1. Selected Publicized Chemotherapy Medication Errors and Outcomes^a *(continued)*

Drug	Error and Outcome
Amphotericin B and liposomal amphotericin ¹²	Conventional amphotericin B administered at liposomal amphotericin doses: multiple patient deaths
Carboplatin ¹³	Overdose administered to 2 children: possible deafness in 1 child
Carboplatin and cisplatin ¹⁴	Confusion of proper dose ranges; cisplatin administered at dose intensity appropriate for carboplatin: consistently fatal outcome (numerous examples prior to labeling changes in 1996)
Docetaxel and conventional paclitaxel ¹⁵	An incorrect dose of 260 mg docetaxel (Taxotere, Sanofi-Aventis) was administered instead of 260 mg conventional paclitaxel (Taxol, Bristol-Myers Squibb): patient died 5 days later, although the error may not have caused the death
Doxorubicin hydrochloride and liposomal doxorubicin ^{16,17}	Liposomal doxorubicin administered instead of doxorubicin hydrochloride: increased morbidity and possible cause of patient death

in medication error prevention, including the advantages of and caveats to the use of these technologies.

Causes of Chemotherapy Errors

The consequences of antineoplastic drug errors can be devastating because these agents have one of the lowest therapeutic indices and safety margins of any drug class. Combination chemotherapy regimens are very complex and intensive. Doses can vary tremendously for different diseases. For example, a “normal” dose of methotrexate can range from 10 to 20,000 mg, and appropriate total doses and infusion durations of regimens for 5-fluorouracil for colorectal cancer can vary widely, even for the

Table 1. Selected Publicized Chemotherapy Medication Errors and Outcomes^a *(continued)*

Drug	Error and Outcome
Idarubicin ¹⁸	An incorrect dose of 60 mg oral idarubicin was administered daily for 4 days instead of a single dose over 4 days; patient death
Lomustine ^{16,19}	Serious errors have occurred when this oral agent was administered daily rather than every 6 weeks: patient harm, prolonged hospitalization, and death
Methotrexate ²⁰⁻²²	Multiple cases of accidental daily administration of oral methotrexate when weekly dosing was intended: at least 25 fatalities and an equal number of incidents of serious patient harm
Vincristine ²³⁻²⁹	Accidental intrathecal administration: multiple patient deaths over many years (universally fatal when this error occurs): patient harm
Vincristine and vinblastine ³⁰	Accidentally given at dose appropriate for vinblastine; patient death

^a Not all-inclusive; selected examples are given here to illustrate the nature of the error. Some examples have occurred numerous times in the literature.

same tumor type and stage of disease. Similarly, targeted agents such as bevacizumab (Avastin, Genentech) now include FDA-approved labeling at substantially different dose intensities, even within the colorectal cancer arena—that is, 5 mg/kg every 14 days if given with FOLFIRI (a chemotherapy regimen for colon cancer comprising irinotecan [Camptosar, Pfizer Oncology], 5-fluorouracil, and leucovorin)^{9,10} and 10 mg/kg every 14 days if given in conjunction with FOLFOX (a chemotherapy regimen for colon cancer combining oxaliplatin [Eloxatin, Sanofi-Aventis], 5-fluorouracil, and leucovorin).¹¹ This 100% dose variation is yet another potential opportunity for errors, although the clinical risks for such errors are not as clearly defined as

with conventional cytotoxic anticancer therapies.

Several publicized accounts of chemotherapy medication errors have appeared in the scientific and lay press within the past decade¹²⁻³⁰ (Table 1), reflecting the small to nonexistent margin of error that health professionals have when ordering, dispensing, and administering cytotoxic agents. Medication safety was recently evaluated in the ambulatory chemotherapy setting, where most antineoplastic drug doses are administered. Gandhi and colleagues²⁸ reviewed 10,112 medication orders in 1,606 patients (15% pediatric) and found an error rate of 3%, including 2% of orders with the potential to cause harm. Pharmacists and nurses intercepted 45% of potential adverse drug events before they reached the patient.

Errors occur not only at private practice oncology offices and smaller, nonspecialty hospitals but also at renowned teaching and research centers. Although some errors involve only one practitioner, in clinical experience most errors occur when several staff members are involved. These incidents often are the result of a lack of critical information or the presence of inaccurate data.²⁹ Significant potential causes of chemotherapy errors are highlighted in Table 2.³¹

LOOK-ALIKE/SOUND-ALIKE DRUG NAMES

One of the most common causes of medication errors is the similar-sounding names of drugs used in oncology practice.³² For example, fatal errors have occurred when the dose for one drug was mistaken for the dose of another (eg, when vincristine was administered instead of vinblastine, when docetaxel [Taxotere, Sanofi-Aventis] was administered instead of paclitaxel, and when cisplatin was administered instead of carboplatin).^{14,15,30} A theoretical risk is the potential for confusion between conventional paclitaxel (eg, Taxol, Bristol-Myers Squibb) and the new albumin-bound paclitaxel, Abraxane (Abraxis BioScience), as the doses for these 2 versions of paclitaxel are *not* identical. One could argue that the risk for confusion between the albumin-bound paclitaxel and conventional paclitaxel is even greater than the risk for confusing cisplatin with carboplatin or vincristine with vinblastine. Additionally, concerns have

been raised because the official generic name for Abraxane, paclitaxel protein-bound particles for injectable suspension (albumin bound), is neither intuitive or manageable for paper-based systems or feasible for computer database entries. Thus, this medication, like liposomal doxorubicin (Doxil, Tibotec Therapeutics), is an example of an instance where the trade name may be the most practical and feasible drug name to use to maximize safety in everyday practice. Oncology treatment centers (hospitals and practices) recognize that doxorubicin dosing and liposomal doxorubicin dosing are not the same and should not be substituted for each other. The same concern exists for conventional paclitaxel and albumin-bound paclitaxel and the same level of precautions should be taken. In fact, the package insert for Abraxane carries the following warning³³:

Note: An albumin form of paclitaxel may substantially affect a drug's functional properties relative to those of drug solution. DO NOT SUBSTITUTE FOR OR WITH OTHER PACLITAXEL FORMULATIONS.

One method practitioners can use to differentiate chemotherapeutic drugs with similar-sounding names is to use *TALL MAN* lettering on labels and electronic records: CISplatin versus CARBOplatin; vinBLASTine versus vinCRISTine or vinORElbine; DOXOrubicin versus LIPOSOMAL DOXOrubicin; DOCEtaxel versus PACLItaxel; and mitoMYCIN versus mitoXANTRONE. However, as stated above, in some cases the trade name actually may be the best choice available.

At Fox Chase Cancer Center (FCCC), in Philadelphia, the pharmacy computer system allows use of both *TALL MAN* lettering and scalable fonts for chemotherapy IV bag or syringe labels, enabling further differentiation of drug names. Additionally, use of supplemental labels or stickers in different bright colors highlight and distinguish between various agents of a particular drug class (eg, a neon green DOCETAXEL sticker sharply distinguishes a docetaxel dose from a paclitaxel dose with a neon purple PACLITAXEL sticker)—an important distinction when these drugs sound alike, are used for the same tumor types, and may be given

Table 2. Examples of Potential Causes of Chemotherapy Medication Errors

Miscommunicated verbal orders
Total course (or cycle) dose given every day
Lack of pertinent patient health care information (eg, lab data and patient demographics such as age, height, and weight)
Use of incorrect patient information/lab data or the information/lab data for a different patient
Excessive interruptions during order processing or dose preparation
Substantial distance between the pharmacy and the patient treatment area, which inhibits communication between pharmacy, nursing, and medical staff
Poor packaging and labeling by manufacturers
Use of abbreviations of drug names
Similar-sounding drug names within the therapeutic class
Lack of a proper copy of the physician order or use of a fax copy, which might be illegible
Use of trade names, which may vary even for generically available agents, rather than generic names
Lack of procedures (eg, using larger volumes for vincristine doses) and warning stickers/labels to prevent inadvertent intrathecal administration of drugs such as vincristine, doxorubicin, and daunorubicin
Failure to round drug doses to the nearest whole integer, potentially leading to a 10-fold overdose if the decimal point is not seen
Widely differing dosing regimens for the same drug even for the same tumor type and stage (eg, various regimens of 5-fluorouracil and bevacizumab in colorectal cancer)
Use of outdated lab data (eg, outdated serum creatinine or liver function tests)

Adapted from references 9, 11, and 31.

to patients seated next to each other in a busy infusion center, but have significantly different dosing regimens and toxicity profiles.

HANDWRITTEN PRESCRIPTION DRUG ORDERS

Some consider a CPOE system to be the best prevention for medication errors; however, most oncologists still hand-write orders, often because commercially available software simply is not available; when it is available it often is poorly written, incompatible with other existing computer systems, or otherwise unreliable. As a result, other safety steps remain vital.

In one such example, FCCC banned chemotherapy drug name abbreviations (eg, CPT-11, which might indicate irinotecan or cisplatin) from all chemotherapy order forms in 1995. Trade names are still permitted and in some cases encouraged (eg, Doxil to indicate liposomal doxorubicin) in response to such recommendations by the Institute for Safe Medication Practices (ISMP; www.ismp.org). The ISMP has a comprehensive list of error-prone abbreviations, symbols, and dose designations that can be used as a benchmark to improve patient safety (Table 3).³⁴ In the absence of a CPOE system, strict enforceable rules for medication orders should be in place (eg, write “daily” instead of “qd” and “units” instead of “U”). *“If in doubt, write it out”* is a mantra adopted by many leading health systems. The Joint Commission also recognizes the risks associated with various error-prone abbreviations and mandates that hospitals and health systems create and periodically review and update a list of error-prone abbreviations that are not permitted in any component of the medical record.³⁵

CLARIFYING TERMS

Another problem is a “disconnect” in the communication system, in which prescribers think of antineoplastic drug therapy as a “course” or a “cycle,” which is usually several doses, whereas pharmacists and nurses evaluate, prepare, and administer a single dose. Additionally, a decimal point can be missed if the prescriber fails to round doses of more than 5 or 10 mg to the nearest whole number, which can

Table 3. Error-Prone Medical Transcription

AVOID... (Error-Prone Transcription)	USE... (Strongly Recommended Transcription)
qd or QD	daily
qn, qhs, hs, BT (bedtime)	at bedtime
q 6pm	6 p.m. nightly
qod or QOD	every other
×3d	× 3 days
tiw or TIW	3 times weekly
µg or Ug	mcg (for micrograms)
U, IU, u	units
cc	mL
SS	sliding scale
per os (misread as “left eye”)	PO, by mouth, or orally
SC, subQ, SQ	subcutaneous
od	right eye
os	left eye
AU	both ears
terminal zeros for doses expressed in whole numbers (eg, AVOID 1.0 mg ...)	instead USE 1 mg
failure to use a zero before a decimal point when the dose is less than a whole unit (eg, AVOID .1 mg ...)	instead USE 0.1 mg
lack of a space between the drug name, dose, and unit of measure (eg, AVOID vinblastine 10mg ...)	instead USE vinblastine 10 mg

Adapted from reference 34. A comprehensive list is available at <http://www/ismmp.org/Tools/error.proneabbreviations.pdf>.

potentially cause a 10-fold overdose.³⁴ Similarly, the unwise use of a “trailing zero” or “leading decimal” also has the potential to cause a 10-fold dosage error.³⁴

DEADLY DRUG ADMINISTRATION ERRORS

The inadvertent intrathecal administration of drugs such as vincristine, doxorubicin, and daunorubicin continues to occur and almost always is fatal. From an order-entry standpoint, these errors could be avoided if all pharmacy computer systems had an automatic “dead stop” whenever a pharmacist tried to enter one of these drugs to be administered intrathecally. All manufacturers of vincristine include auxiliary warning labels that state: “Fatal if given intrathecally, for IV use only. Do not remove covering until moment of injection.”³⁶ Tragic deaths ensue because some practitioners choose not to use this United States Pharmacopeia-required label; and in some cases, the labels have been used by the pharmacy department but with no protective effect at the patient bedside.^{25,37,38} For example, in 2003, a patient at a university hospital in New Jersey died after mistakenly being injected intrathecally with vincristine—by a board-certified radiologist—despite the warning label that the drug is fatal if administered this way.²⁵

Because pharmacists are not routinely at the bedside when lumbar puncture procedures are performed, pharmacy CPOE warnings and/or syringe labeling cannot ensure the prevention of this error. Some researchers have suggested routinely diluting all vincristine doses in 50-mL IV piggyback (IVPB) bags to prevent recurrences of this type of error.^{39,40} Before employing this approach, one is encouraged to consider the possible morbidities associated with increased extravasation risk. This presents a struggle for balance between the prevention of fatal errors versus the prevention of more frequent non-life-threatening, albeit severe, adverse events (eg, vesicant drug extravasation when a drug is administered from an IVPB minibag into a peripheral IV line). In cases when a 50-mL IVPB vincristine, vinblastine, or vinorelbine dose might present excessive risk for extravasation, some centers use 20- or 30-mL fixed-volume syringes for all vinca alkaloid medication doses, with warning stickers

and label text, to achieve the same purpose—namely, making the drug volume too large to be accidentally administered intrathecally. Prevention of vincristine administration errors was reviewed in a 2005 Sentinel Event Alert issued by the Joint Commission.⁴¹ The Alert was distributed to all health care organizations in the United States. More recently, the ISMP has recommended revised wording for supplemental stickers applied to vinca medication doses. Specifically, the ISMP no longer recommends “NOT for Intrathecal Use” based on the concern that the presence of the word “intrathecal” may contribute to confusion if the sticker is not read completely or becomes damaged.⁴² The ISMP now recommends supplemental warning stickers that include the following text: “For IV Use Only: Fatal if given by other routes.”⁴²

Recommendations for preparing, dispensing, and administering IV vincristine and other vinca alkaloids (in addition to diluting vincristine and affixing the required warning labels) include conducting a “time out” with at least 2 licensed, qualified health care professionals to independently review the drug, dose, and route at the time of pharmacy preparation, as well as separating the dispensing of vincristine from other antineoplastics that may be given by the intrathecal route to a patient as part of the treatment regimen. In Australia, pharmacists are lobbying the national governmental organization to abolish the syringe as a vehicle to administer vincristine.⁴³

As this discussion illustrates, significant differences of opinion remain regarding the best (and safest) manner to avoid fatal accidental intrathecal administration of vincristine and other vinca alkaloids in light of the significant risk for severe local tissue injury if an IVPB dose of a vinca extravasates during a peripheral line administration.⁴³

Strategies To Prevent Cancer Chemotherapy Errors

The helpful rules illustrated in Table 4 have been in existence at FCCC for more than 10 years, and the strategies listed in Table 5 are important steps toward improving patient safety drawn from both the literature and clinical experience.^{31,44-55}

Table 4. Helpful DOs and DO NOTs for Writing Chemotherapy/Medication Orders

DOs	
DO	always double-check the dose against the actual drug regimen or protocol.
DO	always use the full name (generic preferred over the trade name) of the drug.
DO	prescribe all drug doses clearly in terms of dose (eg, micrograms, mg, grams, etc).
DO	use a leading zero when the dose is less than 1 unit/mg/gram, etc (ie, an order of .1 mg may be read as 1 mg; write 0.1 mg).
DO	avoid excessive attempts at precision and round chemotherapy doses greater than 5 mg to the nearest integer or nearest reasonable amount (ie, for fluorouracil, write 525 mg, NOT 521.6 mg; for carboplatin, write 925 mg, NOT 919.57 mg; for cisplatin, write 125 mg, NOT 126.4 mg). ^a
DO	date all orders with month, day, and year. For inpatient orders, also include time of day.
DO	use body surface area (BSA)-based dosing (ie, mg/m ² or g/m ² , or when applicable, mcg/kg), giving the daily dose and the specific number of days it is to be given. DO NOT write the course dose—unless the daily dose is written as well. For example, in a patient with a BSA of 1.5 m ² , cisplatin 20 mg/m ² per day for 5 days = 30 mg per day for 5 days = 100 mg/m ² per course = 150 mg per course.
DO	list a route of administration and an infusion duration for intravenous solutions.
DO	include patient's current height, weight, and BSA with the chemotherapy order.
DO	print critical information such as drug names, doses, etc.
DO	<i>double-check all drug names and doses before signing and verify that they are what you intend the patient to receive.</i>

(continued)

Table 4. Helpful DOs and DO NOTs for Writing Chemotherapy/Medication Orders *(continued)*

DO	make sure that the medication order sheet has <i>the correct patient's name</i> on it, either handwritten or stamped by addressograph plate. DO NOT leave orders on a blank order sheet for subsequent stamping by an addressograph plate.
DO NOTs	
DO NOT	designate drug by brand names, nicknames, company names, or abbreviations. For example, does Paraplatin refer to cisplatin or carboplatin? Does CPT-11 refer to cisplatin or irinotecan? Similarly, "Aredia" (pamidronate), when written, could be misunderstood to be "Adria" ^b (doxorubicin), or vice versa. Ideally, always use generic rather than trade names.
DO NOT	use a trailing zero when writing an order (eg, an order of 10.0 mg may be read as 100 mg; simply write 10 mg).
DO NOT	use a leading decimal. DO write 0.1 mg—not .1 mg, which may be misread as 1 mg and cause a 10-fold overdose.
DO NOT	use dangerous abbreviations. Using "U" for units may be read as "O" and the patient could receive a 10-fold overdose (eg, "5U of insulin" could be read as "50 of insulin").
DO NOT	refer to drugs by common name of drug class. For example, does "platinum" mean cisplatin or carboplatin?
DO NOT	use a soft felt-tip pen. When orders are written on multilayer carbonless paper, copies of the drug order may be illegible or invisible.

Table 4. Helpful DOs and DO NOTs for Writing Chemotherapy/Medication Orders *(continued)*

DO NOT	sign a blank copy of a medication order for an allied health professional (eg, RN, RPh, or RT) to fill in later. Medication orders should reflect information directly intended and checked by the licensed prescriber.
DO NOT	give verbal orders for chemotherapy.
DO NOT	abbreviate “daily” as “qd,” which has been mistaken for “qid.” Similarly, DO NOT abbreviate “every other day” as “qod.”
DO NOT	write drug orders in terms of number of ampules or vials. Drugs may come in more than 1 vial or ampule size, leading to administration of doses not intended by the prescriber. For example, both carboplatin and cisplatin come in 3 different vial sizes over a 10-fold size range.
DO NOT	use outdated laboratory information when writing orders. Current lab data might indicate a change in renal or hepatic function and a required dose modification might be missed, leading to an incorrect dose.

^a Rationale: Federal requirements mandate that commercial drug concentrations be between 95% and 105% of labeled strength; in addition, expiration dating procedures are based on ≤10% degradation over time, so for an ordered dose of 127.4 mg, even when Nursing and Pharmacy perform their functions flawlessly, the **dose actually received** by the patient is somewhere in the range of 114 to 134 mg!

^b Shortened form of Adriamycin.

Adapted from references 31 and 34.

CHEMOTHERAPY ORDER FORMS

In the absence of a functional CPOE system, the use of a standardized preprinted order form is a highly effective tool. Such a form should be used for both parenteral *and* oral anticancer drugs, and must be approved by the institution’s pharmacy and therapeutics committee. It should include the protocol number and treatment arm if

Table 5. Strategies To Prevent Cancer Chemotherapy Errors

Mandate the use of preprinted order forms that standardize practice and “force functions.”

Implement prescribing guidelines.

- Use full drug names and ban drug name abbreviations.
- Require that multiday regimens be in a format that specifies the dose per meter squared (m^2) per day, dose per day, and number of days of therapy.

Ban verbal orders for the initiation of chemotherapy.

- Verbal orders to immediately stop a chemotherapy infusion may in some cases be the only appropriate step in the event of an acute adverse drug reaction where it is imperative to immediately stop the administration of the chemotherapy and initiate appropriate therapy for the ADR.

Work diligently to develop a CPOE system.

- CPOE systems should interface directly with all pharmacy systems and meet the institution's specific needs.
- Pharmacists must be integral members of all implementation teams for automated prescribing and administration systems.

Make drug information available electronically, and train all members of the team to use electronic drug information.

- Develop unique drug guidelines that address the institution's dose information, infusion, hydration, antiemetic, and supportive care parameters, and update this information as often as necessary.

Ensure that critically important laboratory results are available before drug dispensing and administration with real-time interfaces.

Assess the clarity of a manufacturer's vial, syringe, and other labels with the goal of avoiding confusion.

- Formulary decisions of multisource products should consider labeling. When adding drugs to the formulary, publicize the name similarity to those of preexisting agents and any differences between the drugs.

Table 5. Strategies To Prevent Cancer Chemotherapy Errors *(continued)*

Realize that errors can and will happen at your institution, and then create a culture of safety.

- Discuss all errors in a formal multidisciplinary environment in a nonpunitive manner.
- Develop a medication process improvement committee or a patient safety committee that is regularly attended by leadership in medicine, pharmacy, nursing, administration, and quality improvement.
- Develop a mechanism to ensure that dangerous drugs, particularly the vinca alkaloids and doxorubicin, cannot be given intrathecally.

Be supportive of pharmacists, nurses, and physicians who make errors.

- Sincerely ask them for solutions to avoid a recurrence of the error. Recognize that, in general, most medication errors are fostered by system deficiencies; ask staff members for suggestions that could make the system stronger and less prone to allowing a similar error in the future.

Whenever possible, cultivate a teamwork relationship with the chief or president of the medical staff. That way, you have an ally should a confrontation arise when patient safety is threatened and the physician in question is refractory to following safe practices.

Ensure that Pharmacy is well represented on the institutional review board and all other applicable committees that govern clinical research at your institution.

Distribute the ISMP *Medication Safety Alert!* to medical, nursing, pharmacy, and quality improvement staff, and conduct an educational program on medication error prevention regularly.

- Review actual errors that have occurred at your practice site; the patient's name and all health care worker identifiers should be redacted if politically necessary. (If the handwriting of the prescriber would reveal the prescriber's identity, rewrite the order to preserve anonymity.)

(continued)

**Table 5. Strategies To Prevent Cancer
Chemotherapy Errors** *(continued)*

Conduct educational programs such as a Grand Rounds type of presentation on medication error prevention for the full medical staff annually, or more often as necessary.

Monitor and publicize errors that are described in Joint Commission Sentinel Event Alerts.

Develop tools to assess the competency of new staff and annually ensure (and document) the competency of existing staff.

If chemotherapy orders are written by fellows or other physicians in training, require that they be cosigned by an attending faculty member before being considered valid.

Consider possible ways to involve patients in the medication safety program.

Incorporate medication error prevention education, appropriately targeted, into new staff orientation for all clinical staff, including ward secretaries as well as nurses, pharmacists, and physicians.

ADR, adverse drug reaction; **CPOE**, computerized prescriber order entry; **ISMP**, Institute for Safe Medication Practices

Adapted from reference 31.

applicable; cycle number; patient age, weight, height, and body surface area; pertinent laboratory data; hydration fluids; antiemetics and other premedications; and supportive medications. Multiday regimens should be written in a format that specifies the dose per meter squared, per dose, and/or per day. Consistent with best practices and Joint Commission requirements, dangerous abbreviations such as “U” and “qd” should never be used.

DRUG INFORMATION AND DOSING GUIDELINES

Informational guidelines about conventional and investigational chemotherapy must be readily available. For example, electronic guidelines for each drug should list information such as the drug’s common indication and

clinical use, pharmacologic category, principal adverse effects, reconstitution directions, storage/stability, preparation/administration guidelines, incompatibilities, usual doses, clinical considerations (including standardized antiemetic, hydration, and supportive medications), and dose adjustment guidelines for renal or hepatic dysfunction.

Maximum single- and total-course doses should be established at each institution and entered into the pharmacy computer system.⁵⁵ The limits should be communicated during employee orientation programs and at regularly scheduled in-service education programs and should be available in all clinical areas either in written or electronic versions, or both. Pharmacists should take a leadership role in organizing and presenting such educational sessions for prescribers and nurses who administer drugs. Illustrating actual medication errors that have happened at their practice site is an effective tool for describing the consequences of nonstandard prescribing methods. One very effective tool is dissemination of the ISMP *Medication Safety Alert!* to clinical staff, with an accompanying summary highlighting the most compelling and/or most relevant articles in that particular issue.

Additionally, prescribers' vocabulary should be standardized, and the dose-verification process should have as many checking steps as possible. The prescriber who writes the order, the pharmacist who prepares it, and the nurse who administers the drug should calculate all doses independently.

An important but often underappreciated issue is the evaluation of errors when oral chemotherapy is administered. Many practice sites do not have the typical redundant verification checks seen when a parenteral antineoplastic drug is administered because the responsibility of the proper medication administration belongs to the patient or caregiver rather than to a health care professional.⁵⁶ Table 6 provides a list of antineoplastic order terms and their routes of administration. Prescribing and administration medication errors occurred in nearly 10% of oral chemotherapeutic drugs administered on an outpatient basis to 69 children with acute lymphoblastic leukemia.²⁶ Finally,

Table 6. Antineoplastic Ordering Terms and Routes of Administration

Ideal Generic Drug Names	Not Ideal Brand²/Generic Drug Names and Abbreviations	Most Common Administration Route(s)
Albumin-bound paclitaxel	Abraxane	Intravenous
Aldesleukin	Proleukin, interleukin-2 (IL-2)	Intravenous, subcutaneous
Alemtuzumab	Campath, monoclonal antilymphocyte antibody	Intravenous
Altretamine	Hexalen, hexamethylmelamine (HMM)	Oral
Amifostine	Ethyol, Ethiofos, Gammaphos, WR2721	Intravenous
Aminoglutethimide	Cytadren, Elipten	Oral
Anastrozole	Arimidex	Oral
Arsenic trioxide	Trisenox	intravenous
Asparaginase	Elspar, Colaspase, ASN-ase	Intramuscular, intravenous
Azacitidine	Vidaza	Intravenous, subcutaneous
Azathioprine	Imuran	Intravenous, oral
Bendamustine	Treanda	Intravenous
Bevacizumab	Avastin	Intravenous
Bexarotene	Targretin	Oral
Bicalutamide	Casodex	Oral
Bleomycin	Blenoxane, Bleo	Intravenous, intramuscular, subcutaneous

Table 6. Antineoplastic Ordering Terms and Routes of Administration *(continued)*

Ideal Generic Drug Names	Not Ideal Brand^a/Generic Drug Names and Abbreviations	Most Common Administration Route(s)
Bortezomib	Velcade	Intravenous
Busulfan	Myleran, Busulfex	Oral
Capecitabine	Xeloda, Ro 09-1978	Oral
Carboplatin	Paraplatin, CBDCA	Intravenous
Carmustine	BiCNU, bischloro-nitrosourea (BiCNU)	Intravenous
Cetuximab	Erbitux	Intravenous
Chlorambucil	Leukeran	Oral
Cisplatin	Platinol, cis-diamin-edichloro-platinum (CDDP)	Intravenous, intraperitoneal
Cladribine	Leustatin, 2-chlorodeoxyadenosine (2-CdA), CDA	Intravenous, subcutaneous
Clofarabine	Clolar	Intravenous
Cyclophosphamide	Cytoxan, Neosar, CTX, CPM, CYT	Intravenous, oral
Cytarabine	Cytosar-U, Tarabine, aytosine, cytosine arabinoside (Ara-C)	Intravenous, intrathecal
Dacarbazine	DTIC-Dome, DIC, imidazole carboxamide	Intravenous
Dactinomycin	Cosmegen, Actinomycin-D (ACT-D)	Intravenous
Dasatinib	Sprycel	Oral
Daunorubicin	Cerubidine, Daunomycin, Rubidomycin, DNR	Intravenous

(continued)

Table 6. Antineoplastic Ordering Terms and Routes of Administration *(continued)*

Ideal Generic Drug Names	Not Ideal Brand^a/Generic Drug Names and Abbreviations	Most Common Administration Route(s)
Decitabine	Dacogen	Intravenous
Denileukin diftitox	Ontak, LY-335348	Intravenous
Dexrazoxane	Zinecard, ICRF-187, ADR-529	Intravenous
Docetaxel	Taxotere, RP-56976	Intravenous
Doxorubicin	Adriamycin, Rubex, Adria	Intravenous, intraperitoneal
Doxorubicin liposome	Doxil	Intravenous
Epirubicin	Ellence, 4'-epidoxo-rubicin (EPI)	Intravenous
Erlotinib	Tarceva	Oral
Estramustine	Emcyt	Oral
Etoposide	Etopophos, VePesid, VP-16, EPEG	Intravenous, oral, intrapleural
Everolimus	Afinitor	Oral
Exemestane	Aromasin, Nikidess	Oral
Floxuridine	Fluorodeoxyuridine (FUDR)	Intravenous
Fludarabine	Fludara, FAMP	Intravenous
Fluorouracil	Adrucil, Efudex, 5-FU	Intravenous, topical
Flutamide	Eulexin, Niftolid	Oral
Gemcitabine	Gemzar, LY-18801	Intravenous
Goserelin	Zoladex, ICI-118630	Subcutaneous

Table 6. Antineoplastic Ordering Terms and Routes of Administration *(continued)*

Ideal Generic Drug Names	Not Ideal Brand^a/Generic Drug Names and Abbreviations	Most Common Administration Route(s)
Hydroxyurea	Hydrea, Droxia, Mylocel, hydroxycarbamide	Oral
Idarubicin	Idamycin, 4-demethoxydaunorubicin, IDR, IDA	Intravenous
Ifosfamide	Ifex, IFX	Intravenous
Imatinib	Gleevec, STI-571	Oral
Interferon alfa	Roferon-A, Intron A, IFN	Intramuscular, subcutaneous
Irinotecan	Camptosar, CPT-11	Intravenous
Isotretinoin	Accutane, 13- <i>cis</i> -retinoic acid (13-CRA)	Oral
Ixabepilone	Ixempra	Intravenous
Lapatinib	Tykerb	Oral
Lenalidomide	Revlimid	Oral
Letrozole	Femara	Oral
Leucovorin	Wellcovorin, citrovorum factor, folinic acid (FA), LV	Intravenous, oral
Leuprolide	Lupron, Lupron Depot, leuporelin	Intramuscular, subcutaneous
Levamisole	Ergamisol, I-tetramisole, ICI-59623	Oral
LEVO-leucovorin,	Fusilev, leucovorin, L-leucovorin	Intravenous
Lomustine	CeeNU, CCNU, bis-chloro-nitrosourea	Oral

(continued)

Table 6. Antineoplastic Ordering Terms and Routes of Administration *(continued)*

Ideal Generic Drug Names	Not Ideal Brand²/Generic Drug Names and Abbreviations	Most Common Administration Route(s)
Mechlorethamine	Mustargen, Chlorethazine, HN ₂ , nitrogen mustard	Intravenous, topical
Medroxyprogesterone	Provera, Depo-Provera	Oral, intramuscular
Megestrol	Megace	Oral
Melphalan	Alkeran, phenylalanine mustard, L-PAM	Oral, intravenous
Mercaptopurine	Purinethol, 6-MP	Oral
Mesna	Mesnex, sodium 2-mercaptoethane sulfonate	Intravenous, oral
Methotrexate	Amethopterin, MTX, Folex	Intravenous, oral, intrathecal
Mitomycin	Mutamycin, mitomycin-c	Intravenous
Mitotane	Lysodren, o,p'-DDD	Oral
Mitoxantrone	Novantrone, DHAD, DHAQ	Intravenous, intraperitoneal
Nelarabine	Arranon	Intravenous
Nilotinib	Tasigna	Oral
Octreotide	Sandostatin, 1-cysteinamide, SMS	Subcutaneous
Ofatumumab	Arzerra	Intravenous
Oprelvekin	Neumega, interleukin-11 (IL-11), rIL-11	Subcutaneous

Table 6. Antineoplastic Ordering Terms and Routes of Administration *(continued)*

Ideal Generic Drug Names	Not Ideal Brand^a/Generic Drug Names and Abbreviations	Most Common Administration Route(s)
Oxaliplatin	Eloxatin, diamino-cyclohexane platinum	Intravenous
Paclitaxel	Taxol, TX, PCL, PCT, TX	Intravenous
Pegaspargase	Oncaspar, polyethylene glycol L-asparaginase	Intramuscular
Pemetrexed	Alimta	Intravenous
Pentostatin	Nipent, co-vidarabine, 2-deoxycoformycin (DCF)	Intravenous
Plicamycin	Mithramycin, Mithracin, aureolic acid	Intravenous
Pralatrexate	Folotylin	Intravenous
Prednisone	Deltasone	Oral
Procarbazine	Matulane, Natulana, N-methylhydrazine	Oral
Rituximab	Rituxan, IDEC-C2B8	Intravenous
Sorafenib	Nexavar	Oral
Streptozocin	Zanosar	Intravenous
Sunitib	Sutent	Oral
Tamoxifen	Nolvadex	Oral
Temozolomide	Temodar	Oral
Temsirolimus	Torisel	Intravenous
Thalidomide	Thalomid	Oral

(continued)

Table 6. Antineoplastic Ordering Terms and Routes of Administration *(continued)*

Ideal Generic Drug Names	Not Ideal Brand^a/Generic Drug Names and Abbreviations	Most Common Administration Route(s)
Thioguanine	Tabloid , 6-thioguanine (6-TG), TG, WR-1141	Oral
Thiotepa	TESPA , Thioplex, WR-45312	Intravenous, intravesical
Topotecan	Hycamtin , SKF-104864	Intravenous
Toremifene	Fareston , EC-11570	Oral
Trastuzumab	Herceptin , anti- <i>HER2</i> antibody	Intravenous
Tretinoin	Vesanoid , all <i>trans</i> -retinoic acid (ATRA)	Oral
Trimetrexate	NeuTrexin , TMQ, TMTX	Intravenous
Vinblastine	Velban	Intravenous
Vincristine	Oncovin , Vincasar	Intravenous
Vinorelbine	Navelbine	Intravenous
Vorinostat	Zolinza	Oral

This information is based on the prescribing information for each drug.

^a Brand names are listed in bold.

verbal orders for the initiation of chemotherapy should not be permitted under any circumstance.

PUNITIVE VERSUS NONPUNITIVE ENVIRONMENTS

An important consideration that recently has been appreciated is the issue of punitive versus nonpunitive

cultures. Medication errors are predominantly system dependent rather than the result of negligence by a specific individual. A punitive focus on individuals involved in a medical error is dangerous. It inhibits open discussion about errors, creates a defensive and reactive environment, and hinders careful and unbiased consideration of the system-based root causes of errors.^{57,58} A “no-blame” or “blame-free” culture fails to discipline individuals who repeatedly make unsafe behavioral choices or go against established policies and procedures.^{59,60} The safety culture in health care has been like a pendulum during the past decade. It has gone from a “name, shame, and blame” philosophy (punitive) to an “amnesty for all” policy (non-punitive). Health care now is gradually settling at a reasonable middle ground—a “just culture”—that is fair to health care professionals and effective in reducing safety risks.⁶¹ All workers need to know that safety is valued in their organization and that they should have ongoing discussions about risks and ways to avoid them. Managers are continuously looking for systems, technology, and policies that give workers the opportunity for better outcomes.⁶¹

A paradigm shift is required for successful cancer chemotherapy error prevention. To avoid recurrence of errors, it is essential to conduct open interdisciplinary discussions of errors and near-misses that have occurred. Anonymous error reporting using an intranet site may be effective at increasing such reporting and institutional evaluation. Individuals who make errors should be sincerely thanked for reporting them, rather than being punished. A structured interdisciplinary team should review all actual and potential medication errors, to resolve the miscommunication that often is a leading cause of problems and to look for practice trends.

THE PATIENT’S ROLE

Because patients often are the last line of defense against an error, they should be well educated about the names of their drugs, the route of administration, the planned treatment schedule, and the color of the infusion. Patients should be encouraged to remind caregivers to verify their identity (eg, check their wristband or home address) and ask

questions about their chemotherapy. Health care professionals must listen carefully to what patients tell them.

Technology: Computerized Prescriber Order Entry

Essential features of a safe medication system include electronic prescribing, automated dispensing machines, the addition of clinical indications to prescriptions, smart IV pumps, point-of-care systems, appointment of an institutional medication safety officer, and reporting and analysis of medication errors in a national database.⁶² The potential benefits of using a CPOE system include creating standardized order sets, automating clinical decision support, reducing errors by decreasing time to refill orders, checking doses against online clinical information, eliminating lost and illegible orders, improving coding for research protocol and outcomes analysis, evaluating clinical interventions, and resolving billing issues.⁶³

CUSTOMIZING A CPOE SYSTEM

To maximize the safety benefits for an individual practice site, CPOE systems initially must be robust and well designed yet highly customizable according to the needs of the institution; therefore, before implementing a CPOE system, the specific needs of the practice site should be assessed. Unfortunately, very few institutions have the internal resources to build a suitable CPOE system and must purchase a system “off the shelf” or enter into a development agreement with a commercial vendor. This is problematic because many commercial computer software vendors believe that their product is the best on the market, that no additional features or modifications are necessary for their product, and that all end-users have the same needs and should use the same software.⁶³ An additional complication is that some enterprise-wide or CPOE software vendors “strongly encourage” their customers to migrate in entirety to their corporate product line of software, even if the hospital may already use a superior product (eg, a pharmacy computer system) from a different vendor.⁶³ When working with such software

vendors, reaching an agreement on the necessary aspects of CPOE can be very difficult and/or associated with extensive delays. Even when a vendor agrees in principle to a certain feature or modification, their interpretation of what that means may differ from those of institutional customer clinicians in medicine, pharmacy, and nursing. Important questions that should be considered before purchasing a CPOE system can be found in the patient safety section of the American Society of Health-System Pharmacist (ASHP) Web site (www.ashp.org).⁴⁴ As new therapies (agents or combination regimens) are developed and new data become available, it is possible that previously designed custom order sets will either require some level of modification or even become completely outmoded. Examples of such developments may include the incorporation of new cytotoxic agents into existing regimens, incorporation of extensions of regimens for metastatic disease into the adjuvant or neoadjuvant setting, and changes in supportive care medications such as anti-emetics, growth factors, or both.

At FCCC, chemotherapy order forms (presently a combination of paper-based and online/interactive, printable PDF templates) are reviewed periodically and revised as dictated by developments in therapies. Readers are encouraged to consider annual or other periodic reviews of any CPOE order templates, in order to ensure that the CPOE system in use remains accurate and up to date, using concepts such as those listed below:

1. Terminology specific to chemotherapy, such as “cycle,” “parameter,” “protocol,” and “regimen,” must be clearly defined.
2. A multidisciplinary team, including physician service chiefs within medical oncology, should establish and approve a wide variety of standardized chemotherapy regimens from actual institutional experience and evidence-based guidelines. The National Comprehensive Cancer Network compendia of clinical practice guidelines (available at www.nccn.org) are an excellent resource because the guidelines are differentiated by tumor type and stage of disease. Ideally, order sets

should be available for all CPOE users on a multiple-column grid that lists each drug of the specified regimen and accompanying supportive care medications. The grid should contain patient-specific parameters, such as height, weight, and body surface area; the treatment cycle number and regimen start date; and hydration fluids, antiemetics, colony-stimulating factors, and other associated medications to be given both before and after chemotherapy administration.

3. The system should be able to apply policies and procedures designed to minimize medication errors (eg, a policy and procedure for rounding parenteral chemotherapy doses between 101 and 500 mg to the nearest 10 mg when appropriate).
4. A CPOE system should be programmed to notify prescribers when a patient has received a specified cumulative lifetime dose of a specific chemotherapy agent, such as doxorubicin or bleomycin, and these data should include any doses administered at other locations prior to the transfer of the patient to the current institution.
5. The system should be programmed to prevent prescribers from entering contraindicated routes of administration (eg, intrathecal administration of vincristine or doxorubicin and intramuscular administration of most antineoplastics).
6. A catalogue of all “physician’s order sets,” including complete drug names, dosages, diluent fluid volumes, administration rates, and duration of administration for chemotherapy and supportive care agents, must be maintained and available to all prescribers. Institutions have described a successful multidisciplinary approach to reducing chemotherapy errors with order sets.⁶⁴

CAVEATS TO CPOE SYSTEMS

CPOE systems are designed to decrease the risk for chemotherapy-related medication errors. However, they are not designed to replace physicians, pharmacists, or nurses, and staff reduction should not be a goal of CPOE system implementation. CPOE systems are neither a panacea nor the sole solution for preventing medication errors. Studies have

illustrated that total reliance on a CPOE system not only has failed to improve safety, but has presented new risks for serious errors, as well as life-threatening results for patients.^{65,66} In 2005, a systematic study using explicit, standard criteria on a random sample of all admissions during a 20-week period found persistently significant rates of adverse drug events at a highly computerized, 110-bed tertiary care Veterans Administration hospital.⁶⁷ Medication errors contributed to 27% of those adverse drug events. Of those medication errors, 61% occurred at the ordering stage, 25% at monitoring, 13% on administration, 1% at dispensing, and none at transcription. In addition to these types of data, the IOM Committee on Identifying and Preventing Medication Errors received testimony from Bruce Bagley, MD, medical director for Quality Improvement for the American Academy of Family Physicians, in which he stated, “Just putting a system in or buying the right software is not the answer. Getting your whole culture to change the way they do their work, supported by the new opportunities that are available through electronic health records, is really the key.”⁶⁸

Although CPOE offers significant, additional protection against medication errors, its implementation can be an arduous task with a long adaptation period. Additionally, a CPOE system clearly requires a substantial investment in resources. For treatment settings that have not converted to electronic formats (or cannot convert because of a lack of resources), the use of a standardized, preprinted order form is an effective tool to reduce the occurrence of chemotherapy errors.³¹ Like electronic order forms, paper forms must include pertinent patient information, required laboratory monitoring, supportive care and other special medication orders, and proper delineation of the chemotherapeutic regimen to be administered (full drug name, dose, total daily dose or total cumulative dose per cycle, route of administration, and frequency and duration of administration).

Technology: Bar Coding

In addition to CPOE, bar coding has been promoted as an important step in medication error reduction by enhancing medication administration.⁶⁹⁻⁷³ Many issues in

the successful implementation of bar coding are similar to those in the development of CPOE—for example, multidisciplinary involvement, vendor selection and support, product capabilities, and protocols for use. Bar-coding systems must be properly designed and implemented. In an era of seemingly daily drug shortages, on a practical level, it is quite possible that bar coding may be too brand- or vendor-specific. Bar-code scanners do not recognize medications the same way that humans can recognize that a different brand or vial description of a particular generic medication is still the correct medication and dose. There must be a functional interface between systems for drug prescribing, dispensing, and administration.

Institutional Self-Assessment

The resolve by oncology caregivers to prevent patient harm must be absolute. It is important for all institutions to assess their own error prevention strategies, both as a baseline at one time point as well as continuously, especially if an error or a near-miss should occur. It also is important for organizations to consider errors that occurred elsewhere to be a potential risk at their site.

The ISMP newsletter *Medication Safety Alert!* is an exceptional resource that provides excellent examples of reported errors and near-miss events. Most settings find the alerts to be extremely helpful. The alerts can be accessed at ISMP's Web site (www.ismp.org) or via published tabulations of the ISMP's surveys on medication safety processes.⁷⁴

Table 7 contains suggested questions to ask when assessing your institution's chemotherapy error prevention program. It is hoped that these questions will provoke considerable discussion and spark critical evaluation of chemotherapy practice. For additional information on safe medication practices, patient safety, and cancer chemotherapy, the Web sites listed in Table 8 are useful resources in which updated, comprehensive information can be found.

Recently, the American Society of Clinical Oncology (ASCO), in conjunction with the Oncology Nursing Society (ONS), jointly published a document outlining safety recommendations derived from their joint task force, which convened

Table 7. Questions for Institutional Self-Assessment of a Chemotherapy Error Prevention Program

- ☐ Do health care providers at your institution constantly monitor the external medication and medical error literature (eg, the ISMP Medication Safety Newsletter, etc) in order to be aware of potential risks to your patients based on events elsewhere? If so, do ongoing risk assessment discussions occur at your institution so that risk reduction strategies, as necessary, can be implemented?
- ☐ Does your institution/practice site prohibit abbreviations of chemotherapy drug names (generic or trade) on chemotherapy order sheets?
- ☐ Did your institution organize multidisciplinary reviews or task forces/committees to analyze medication control systems in the wake of recently publicized tragic chemotherapy errors?
- ☐ Does your institution have maximum dose guidelines/ceilings for chemotherapy?
- ☐ In your opinion, does your pharmacy computer system aid rather than hinder pharmacy department-driven medication safety programs at your institution?
- ☐ Does your institutional computer system help rather than hinder medical and medication error prevention by allowing prescribers and other staff to conveniently and accurately access necessary patient data?
- ☐ When/if your institution were to have a severe medication error, would the administrative response, in your opinion, be analytical (root-cause analysis) rather than punitive?
- ☐ Have you made any significant revisions to your chemotherapy medication order forms?
- ☐ For multiday chemotherapy orders, do your institutional or site guidelines require nomenclature of “drug X ____ mg per m² per day = ____ mg for ____ days” and prohibit expressing the dosage as “the cycle drug dose over ____ days”?
- ☐ Has your institution taken steps, above and beyond using supplemental warning stickers and extra zip lock bag containers, to prevent inadvertent intrathecal administration of vinca alkaloids, including vinCRISTine?

(continued)

Table 7. Questions for Institutional Self-Assessment of a Chemotherapy Error Prevention Program *(continued)*

- ☐ Are your medical and nursing staff educated about the need to keep vinca alkaloid doses away from any patient scheduled for a lumbar puncture?
- ☐ Does your institution have a documented final 2-person check procedure (eg, nurse and pharmacist or 2 nurses) where the prepared drug dose is compared one final time to the source document (ie, physician order, either written or electronic)?

Based on references 4, 31, 56, 59, and 64.

in 2008 to develop standards for safe chemotherapy administration to adult cancer patients in the outpatient setting.⁷⁵ The defined scope of the project was limited to patient safety and included both parenteral and oral chemotherapy regimens. Thirty-one unique standards are highlighted in 7 distinct domains: review of clinical information and selection of treatment regimens; treatment planning and informed consent; ordering of treatment; drug preparation; assessment of treatment compliance; drug administration and monitoring; and assessment of response and toxicity monitoring.⁷⁵ The scope of the ASCO/ONS document and the space limitations of this publication preclude a more thorough review, but readers are highly encouraged to review the ASCO/ONS recommendations carefully and assess their own practices against those standards.

Conclusion

Cancer care is exceedingly complex and continues to change. Oncology caregivers face the challenges of increasing workloads, staff vacancies resulting from nurse and pharmacist shortages, institutional financial pressures attributable to managed care, reimbursement cutbacks and other economic challenges, increased regulatory burdens such as HIPAA and compliance regulations, and an expanding armamentarium of cytotoxics and targeted biologic

Table 8. Selected Web Sites for Safe Medication Practices

www.qualityindicators.ahrq.gov – Agency for Healthcare Research & Quality

www.safemedication.com – American Society of Health-System Pharmacists medication safety site

www.ihl.org – Institute for Healthcare Improvement

www.ismp.org – Institute for Safe Medication Practices

www.consumermedsafety.org – Consumer Medication Safety

www.fda.gov/cder/drug/medErrors/ – FDA Medication Errors

therapies. Without question, oncology patients are among the most complex to care for and receive the most medications at the majority of hospitals. Despite these enormous pressures, health care's resolve to prevent patient harm should be absolute and a team effort between the medicine, pharmacy, nursing, and laboratory staffs.

It is clear that the appropriate use of technology is vital to increasing patient safety, but it is important that such tools be carefully thought out and constructed to reflect the needs and characteristics of the specific organization where they are to be used. A “one-size-fits-all” approach by a computer software vendor may hamper safety efforts and create rather than reduce risk.

Prevention of chemotherapy errors is a matter of remaining vigilant, having systems in place to expose mistakes and talk openly about ways to avoid them, and fostering a culture among co-workers who recognize that there is a mandate from the top levels of an organization that error prevention is an absolute priority. No one wants to wait for a tragedy to occur—each system must prioritize safety as a core value through its leadership and must commit resources for a cultural change that invites open discussion of errors.

Robert Wachter, MD, a prominent patient safety authority published a paper assigning a report card grade to 9 components of patient safety domains including health

information technology, research, and provider leadership.⁷⁶ Dr. Wachter assigned individual category scores from A- to C+ with an overall grade of B-. Although significant strides have been made in standardizing our systems and practices, we still have considerable room for improving the chemotherapy experience for our patients.

A recent tragedy illustrates that the movement toward a just culture and/or blame-free culture is not complete. In August 2009, there was widespread publicity surrounding a chemotherapy error that involved the tragic death of a 2-year-old child who received chemotherapy on a weekend complicated by a lengthy period of computer downtime in the hospital pharmacy, short staffing in the hospital pharmacy, and other challenges for the pharmacy staff on duty during that tragic day.⁷⁷ An experienced hospital pharmacist failed to recognize that a technician who he was supervising used 23.4% sodium chloride instead of 0.9% sodium chloride to prepare the base solution for an etoposide dose.⁷⁷

The pharmacist was convicted to a 6-month jail sentence, followed by 6-month house arrest, and his license was permanently revoked. There were many confounding variables complicating this tragic event, but the highly publicized actions taken by the local district attorney and the state pharmacy board may reduce dramatically the open reporting of errors and near-misses.⁷⁷ Health care provider reluctance to admit a mistake due to fear of such severe punishment as this pharmacist faced could prevent rigorous root-cause analyses and the enhancements in safety that can result from such analyses. The outcomes could make the death of that patient even more tragic and place other patients at increased risk in the future.

References

1. Beckwith MC, Tyler LS. Preventing medication errors with antineoplastic agents, part 1. *Hosp Pharm*. 2000;35(5):511-524.
2. Womer RB, Tracy E, Soo-Hoo W, Bicket B, Bitaranto S, Barnsteiner JH. Multidisciplinary systems approach to chemotherapy safety: rebuilding processes and holding the gains. *J Clin Oncol*. 2002;20(24):4705-4712.
3. Müller T. Typical medication errors in oncology: analysis and prevention strategies. *Onkologie*. 2003;26(6):539-544.

4. Schulmeister L. Preventing chemotherapy errors. *Oncologist*. 2006; 11(5):463-468.
5. Aspden P, Wolcott J, Bootman JL, Cronenwett LR, eds, for the Committee on Identifying and Preventing Medication Errors. *Preventing Medication Errors: Quality Chasm Series*. Washington, DC: National Academy Press; 2006.
6. Swenson SJ, Meyer GS, Nelson EC, et al. Cottage industry to postindustrial care—the revolution in health care delivery. *N Engl J Med*. 2010;362(6):e12. Epub 2010 Jan 20.
7. Chang SW. Health information technology as a tool, not an end. *Ann Intern Med*. 2009;169(16):1474-1475.
8. Walsh KE, Dodd KS, Seetharaman K, et al. Medication errors among adults and children with cancer in the outpatient setting. *J Clin Oncol*. 2009;27(6):891-896.
9. Hurwitz H, Fehrenbacher L, Novotny W, et al. Bevacizumab plus irinotecan, fluorouracil, and leucovorin for metastatic colorectal cancer. *N Engl J Med*. 2004;350(23):2335-2342.
10. Avastin [prescribing information] South San Francisco, CA: Genetech; 2008.
11. Giantonio BJ, Catalano PJ, Meropol NJ, et al. Bevacizumab in combination with fluorouracil, and leucovorin (FOLFOX4) for previously treated metastatic colorectal cancer: results from the Eastern Cooperative Oncology Group study E3200. *J Clin Oncol*. 2007;25(12):1539-1544.
12. Institute for Safe Medication Practices. Urgent Drug Safety Message. Medication errors with certain lipid-based products. <http://www.ismp.org/msaarticles/ampho-alert.html>. Accessed April 30, 2010.
13. Chemotherapy overdoses for 2 Children at Johns Hopkins. *The New York Times*. August 2, 2002. <http://www.nytimes.com/2002/08/02/us/national-briefing-health-and-science-chemotherapy-overdoses-for-2-children.html?n=Top/Reference/Times%20Topics/Organizations/J/Johns%20Hopkins%20University>. Accessed April 30, 2010.
14. Fritsch J. Syracuse hospital admits causing death of patient. *The New York Times*. May 13, 1992. <http://www.nytimes.com/1992/05/13/nyregion/syracuse-hospital-admits-causing-death-of-patient.html>. Accessed April 30, 2010.
15. ISMP Medication Safety Alert 2/7/01. FDA Advise-ERR: Medication errors associated with taxotere and taxol. <http://www.ismp.org/newsletters/acute-care/articles/20010207.asp>. Accessed April 30, 2010.
16. ISMP Medication Safety Alert 10/21/04. <http://www.ismp.org/MSAarticles/A4Q04Action.htm>. Accessed April 30, 2010.
17. Hazard Medication Alert. 8/18/98. MSA Acute Care Edition Newsletter. <http://www.ismp.org/hazardalerts/lipid.asp>. Accessed April 30, 2010.
18. Bristol woman killed by cancer drug overdose. *This Is Bristol*. <http://www.thisisbristol.co.uk/news/Bristol-woman-killed-cancer-drug-overdose/article-1358082-detail/article.html>. Accessed April 30, 2010.
19. Institute for Safe Medication Practice. Medication Safety Alert 7/15/04. Low-dose on lomustine: we'd hate CEENU make this mistake. <http://www.ismp.org/Newsletters/acute-care/articles/20040715.asp>. Accessed April 30, 2010.
20. Moore TJ, Walsh CS, Cohen MR. Reported medication errors associated with methotrexate. *Am J Health Syst Pharm*. 2004;61(13):1380-1384.

21. National Patient Safety Agency. Reducing the harm caused by oral methotrexate. June 2004.
22. Institute for Safe Medication Practice. Medication Safety Alert 4/3/02. <http://www.ismp.org/Newsletters/acutecare/articles/20020403.asp>. Accessed April 30, 2010.
23. Institute for Safe Medication Practice. Medication Safety Alert 4/5/00. Pain, paralysis, and knowledge of impending death marks intrathecal vincristine. <http://www.ismp.org/newsletters/acutecare/articles/20000405.asp>. Accessed April 30, 2010.
24. Berwick D. Not again! Preventing errors lies in redesign—not exhortation. *BMJ*. 2001;322(7281):247-248.
25. Narayanan A. Family tells tragedy following fatal injection. *The Home News Tribune*. April 17, 2003. <http://www.njatty.com/whatsnew/Fultoncase.pdf>. Accessed April 30, 2010.
26. Bennett C. Is jail the answer for fatal negligence? *Guardian* (UK). September 25, 2003. <http://www.guardian.co.uk/uk/2003/sep25/ukcrime.comment>. Accessed April 30, 2010.
27. Cohen MR. Vincristine therapy: days “4-11” misunderstood as days 4 through 11. *Hosp Pharm*. 2006;41(9):811-815.
28. Ghandi TK, Bartel SB, Shulman LN, et al. Medication safety in the ambulatory chemotherapy setting. *Cancer*. 2005;104(11):2477-2483.
29. Alcaraz A, Rey C, Concha A, Medina A. Intrathecal vincristine: fatal myeloencephalopathy despite cerebrospinal fluid perfusion. *J Toxicol Clin Toxicol*. 2002;40(5):557-561.
30. Twedt S. Deadly hospital mistakes are doomed to be repeated. *Post-Gazette*. October 24, 1993;section A,1.
31. Kloth DD. Prevention of chemotherapy medication errors. *J Pharm Pract*. 2002;15(1):17-31.
32. Joint Commission. Look-alike, sound-alike names. 2001. http://www.joint-commission.org/SentinelEvents/SentinelEventAlert/sea_19.htm. Accessed April 30, 2010.
33. Abraxane [prescribing information]. Bridgewater, NJ: Abraxis BioScience; 2009.
34. Institute for Safe Medication Practices. ISMP’s List of Error-Prone Abbreviations, Symbols, and Dose Designations. <http://www.ismp.org/Tools/errorproneabbreviations.pdf>. Accessed April 30, 2010.
35. The Joint Commission. Official “Do Not Use” list. http://www.jointcommission.org/NR/rdonlyres/2329F8F5-6EC5-4E21-B932-54B2B7D53F00/O/dnu_list.pdf. Accessed April 30, 2010.
36. Vincristine [prescribing information]. Lake Forest, IL: Hospira, Inc.; 2007.
37. Dyer C. Junior doctor charged with manslaughter after medical error [news item]. *BMJ*. 2002;325(7365):616.
38. Dyer C. Doctor sentenced for manslaughter of leukaemia patient [news item]. *BMJ*. 2003;327(7417):697.
39. Davis NM. The preparation of vincristine in minibags will prevent deadly medication errors. *Hosp Pharm*. 2001;36(7):707.
40. Trissel LA, Zhang Y, Cohen MR. The stability of diluted vincristine sulfate used as a deterrent to inadvertent intrathecal injection. *Hosp Pharm*. 2001;36(7):740-745.

41. JCAHO. Sentinel event alert: preventing vincristine administration errors. http://www.jointcommission.org/sentinelEvents/SentinelEventAlert/sea_34.htm. Accessed April 30, 2010.
42. Institute for Safe Medication Practices. Medication Safety Alert Nurse Advise-ERR. 2008;6(10).
43. Gilbar PJ, Carrington CV. The incidence of extravasation of vinca alkaloids supplied in syringes or mini-bags. *J Oncol Pharm Pract*. 2006;12(2):113-118.
44. ASHP Council on Professional Affairs. ASHP guidelines on preventing medication errors with antineoplastic agents. *Am J Health Syst Pharm*. 2002;59(17):1648-1668.
45. Cohen MR, Anderson RW, Attilio RM, Green L, Muller RJ, Pruemer JM. Preventing medication errors in cancer chemotherapy. *Am J Health Syst Pharm*. 1996;53(7):737-746.
46. Sano HS, Waddell JA, Solimando DA, Doulaveris P, Myhand R. Study of the effect of standardized chemotherapy order forms on prescribing errors and anti-emetic cost. *J Oncol Pharm Pract*. 2005;11(1):21-30.
47. Kozakiewicz JM, Benis LJ, Fisher SM, Marseglia JB. Safe chemotherapy administration: using failure mode and effects analysis in computerized prescriber order entry. *Am J Health Sys Pharm*. 2005;62(17):1813-1816.
48. Sheridan-Leos N, Schulmeister L, Hartranft S. Failure mode and effect analysis: a technique to prevent chemotherapy errors. *Clin J Oncol Nurs*. 2006;10(3):393-398.
49. Attilio RM. Caring enough to understand: the road to oncology medication error prevention. *Hosp Pharm*. 1996;31:17-26.
50. Cohen MR. Medication error: clarify laboratory test results given by telephone. *Nursing*. 1981;11(11):63.
51. Cohen MR, Senders J, Davis NM. Failure mode and effects analysis: a novel approach to avoiding dangerous medication errors and accidents. *Hosp Pharm*. 1994;29(4):319-330.
52. Cohen MR. Medication-error reporting: banish a system that blames. *Nursing*. 1996;26(1):15.
53. Cohen MR. Why error reporting systems should be voluntary [editorial]. *BMJ*. 2000;320(7237):728-729.
54. McCarthy ID, Cohen MR, Kateiva J, McAllister JC 3rd, Ploetz PA. What should a pharmacy manager do when a serious medication error occurs? A panel discussion. *Am J Hosp Pharm*. 1992;49(6):1405-1412.
55. DuBeshter B, Griggs J, Angel C, Loughner J. Chemotherapy dose limits set by users of a computer order entry system. *Hosp Pharm*. 2006;41:136-142.
56. Birner A. Safe administration of oral chemotherapy. *Clin J Oncol Nurs*. 2003;7(2):158-162.
57. Stump LS. Re-engineering the medication error-reporting process: removing the blame and improving the system. *Am J Health Syst Pharm*. 2000; 57(suppl 4):S10-S17.
58. Accelerating Change Today. Reducing medical errors and improving patient safety: success stories from the front lines of medicine. National Coalition of Health Care and Institute for Healthcare Improvement. February 2000. http://www.qualityhealthcare.org/ihl/uploads/medical_errorsACT.pdf. Accessed April 30, 2010.
59. Institute for Safe Medication Practices. Our long journey towards a safety-minded just culture part I: where we've been. <http://www.ismp.org/Newsletters/acute/articles/20060907.asp>. Accessed April 30, 2010.

60. Global Aviation Information Network (GAIN). Roadmap to a just culture: enhancing the safety environment. September 2004. http://www.flightsafety.org/files/just_culture.pdf. Accessed April 30, 2010.
61. Institute for Safe Medication Practices. Our long journey towards a safe-ty-minded just culture part II: where we're going. <http://www.ismp.org/Newsletters/acutecare/articles/20060921.asp>. Accessed April 30, 2010.
62. Kelly WN, Rucker TD. Compelling features of a safe medication-use system. *Am J Health Syst Pharm*. 2006;63(15):1461-1468.
63. Gray MD, Felkey BG. Computerized prescriber order-entry systems: evaluation, selection, and implementation. *Am J Health Syst Pharm*. 2004;61(2):190-197.
64. Dinning C, Branowicki P, O'Neill JB, Marino BL, Billett A. Chemotherapy error reduction: a multidisciplinary approach to create templated order sets. *J Pediatr Oncol Nurs*. 2005;22(1):20-30.
65. Koppel R, Metlay JP, Cohen A, et al. Role of computerized physician order entry systems in facilitating medication errors. *JAMA*. 2005;293(10):1197-1203.
66. McNutt RA, Abrams R, Arons DC; Patient Safety Committee. Patient safety efforts should focus on medical errors. *JAMA*. 2002;287(15):1997-2001.
67. Nebeker JR, Hoffman JM, Weir CR, Bennett CL, Hurdle JF. High rates of adverse drug events in a highly computerized hospital. *Arch Intern Med*. 2005;165(10):1111-1116.
68. Young D. IOM panel reviews lessons for medication safety. *Am J Health Syst Pharm*. 2005;62(13):1340-1342.
69. Kester M. Bar coding at the bedside: New England hospital implements an automated point-of-care medication administration system to reduce medication errors and their associated complications. *Health Manag Technol*. 2004;25(5):42-44.
70. Neuenschwander M, Cohen MR, Vaida AJ, Patchett JA, Kelly J, Trohimovich B. Practical guide to bar coding for patient medication safety. *Am J Health Syst Pharm*. 2003;60(8):768-779.
71. Greenly M, Gugerty B. How bar coding reduces medication errors. *Nursing*. 2002;3(5):2-70.
72. Scalise D. Medication safety. Bar coding: the forgotten technology. *Hosp Health Netw*. 2002;76(4):16.
73. Tribble DA. Bar coding a must for patient safety. *Am J Health Syst Pharm*. 2002;59(7):667, discussion 667-668.
74. Smetzer JL, Vaida AJ, Cohen MR, Trantum D, Pittman MA, Armstrong CW. Findings from the ISMP Medication Safety Self-Assessment for hospitals. *Jt Comm J Qual Saf*. 2003;29(11):586-597.
75. Jacobson JO, Polovich M, McNiff KK, et al. American Society of Clinical Oncology/Oncology Nursing Society chemotherapy administration safety standards. *J Clin Oncol*. 2009;27(32):5469-5475.
76. Wachter RM. Patient safety at ten: unmistakable progress, troubling gaps. *Health Affairs*. 2010;29(1):1-9.
77. Cohen MR. An injustice has been done: jail time given to pharmacist who made an error. 2009. <http://www.ismp.org/pressroom/injustice-jail%20time-for-pharmacist.asp>. Accessed April 30, 2010.

Indication

ABRAXANE for Injectable Suspension (paclitaxel protein-bound particles for injectable suspension) (albumin bound) is indicated for the treatment of breast cancer after failure of combination chemotherapy for metastatic disease or relapse within 6 months of adjuvant chemotherapy. Prior therapy should have included an anthracycline unless clinically contraindicated.

Boxed Warning

WARNING: ABRAXANE for Injectable Suspension (paclitaxel protein-bound particles for injectable suspension) (albumin-bound) should be administered under the supervision of a physician experienced in the use of cancer chemotherapeutic agents. Appropriate management of complications is possible only when adequate diagnostic and treatment facilities are readily available.

ABRAXANE therapy should not be administered to patients with metastatic breast cancer who have baseline neutrophil counts of less than $1,500 \text{ cells/mm}^3$. In order to monitor the occurrence of bone marrow suppression, primarily neutropenia, which may be severe and result in infection, it is recommended that frequent peripheral blood cell counts be performed on all patients receiving ABRAXANE.

Note: An albumin form of paclitaxel may substantially affect a drug's functional properties relative to those of drug in solution. **DO NOT SUBSTITUTE FOR OR WITH OTHER PACLITAXEL FORMULATIONS.**

Important Safety Information

The use of ABRAXANE has not been studied in patients with renal dysfunction.

Dose adjustment is recommended for patients with moderate to severe hepatic impairment. Further dose adjustments in subsequent courses should be based on individual tolerance.

ABRAXANE can cause fetal harm when administered to a

pregnant woman. Women of childbearing potential should be advised to avoid becoming pregnant while receiving treatment.

Men should be advised to not father a child while receiving ABRAXANE.

It is recommended that nursing be discontinued when receiving ABRAXANE therapy.

ABRAXANE contains albumin, a derivative of human blood.

Caution should be exercised when administering ABRAXANE concomitantly with known substrates or inhibitors of CYP2C8 and CYP3A4.

ABRAXANE therapy should not be administered to patients with metastatic breast cancer who have baseline neutrophil counts of less than 1,500 cells/mm³. It is recommended that frequent peripheral blood cell counts be performed on all patients receiving ABRAXANE. Patients should not be retreated with ABRAXANE until neutrophils recover to a level >1,500 cells/mm³ and platelets recover to >100,000 cells/mm³.

In the case of severe neutropenia (<500 cells/mm³ for 7 days or more), a dose reduction for subsequent courses is recommended.

Sensory neuropathy occurs frequently with ABRAXANE.

If grade 3 sensory neuropathy develops, treatment should be withheld until resolution to grade 1 or 2 followed by a dose reduction for all subsequent courses of ABRAXANE.

Severe cardiovascular events possibly related to single-agent ABRAXANE occurred in approximately 3% of patients in the randomized trial. These events included chest pain,

cardiac arrest, supraventricular tachycardia, edema, thrombosis, pulmonary thromboembolism, pulmonary embolism and hypertension. During postmarketing surveillance rare reports of congestive heart failure and left ventricular dysfunction were observed, primarily among individuals with underlying cardiac history or prior exposure to cardiotoxic drugs.

In the randomized metastatic breast cancer study, the most important adverse events included alopecia (90%), neutropenia (all cases 80%; severe 9%), sensory neuropathy (any symptoms 71%; severe 10%), asthenia (any 47%; severe 8%), myalgia/arthralgia (any 44%; severe 8%), anemia (all 33%; severe 1%), infections (24%), nausea (any 30%; severe 3%), vomiting (any 18%; severe 4%), diarrhea (any 27%; severe <1%) and mucositis (any 7%; severe <1%).

Other adverse reactions have included ocular/visual disturbances (any 13%; severe 1%), fluid retention (any 10%; severe 0%), hepatic dysfunction (elevations in bilirubin 7%, alkaline phosphatase 36%, AST [SGOT] 39%), renal dysfunction (any 11%; severe 1%), thrombocytopenia (any 2%; severe <1%), hypersensitivity reactions (any 4%; severe 0%), cardiovascular reactions (severe 3%) and injection site reactions (<1%). In clinical trials and during postmarketing surveillance, dehydration was common and pyrexia was very common. Rare occurrences of severe hypersensitivity reactions have also been reported during postmarketing surveillance.

Adverse events such as fatigue, lethargy and malaise may affect the ability to drive and use machines.

PG1012

Brought to you
by the publisher of



From the Publisher of

ClinicalOncology
news

PHARMACY PRACTICE NEWS

AB 1603 5/10