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How physicians can prevent medication errors: practical strategies

KEY POINTS:

In published studies, the most common type of medication error was wrong dose; the most common cause of an error was lack of readily available information about the drug or the patient.

Physicians can help reduce medication errors by writing legibly, avoiding verbal orders, and not using abbreviations.

Reporting deficiencies in packaging, labeling, and presentation of drug products to manufacturers and the FDA may help prevent future errors.

Physicians should support nonpunitive efforts to collect reports of medication errors.

ABSTRACT: To eliminate and reduce medication errors, health care organizations must develop a consistent approach that allows examination of errors in a supportive atmosphere with a bias toward preventing future errors rather than punishing past ones. Until improved systems are in place, physicians can help prevent many of the most serious medication errors by observing some basic safety practices, such as writing orders whenever possible and limiting verbal orders to urgent or emergency situations, writing clearly and neatly, and avoiding abbreviations.

Medication errors are common and potentially serious, although just how common they are is a matter of debate. The wide variation in estimated frequency—from 1% to 20% of doses given[1]—reflects the difficulty of collecting accurate data; many errors are probably never reported or even detected.

Part of the problem is the complexity of drug distribution and administration systems. From physician to patient, the order and the medication may pass through the hands of six or seven persons, any of whom can err. Each handoff, each transcription, and each dose given is an opportunity for error. On the other hand, a system in which only one person selects, prepares, and gives medications (such as a floor stock system) provides little opportunity for either preventing or detecting errors. Errors are not confined to hospitals, but data are more difficult to gather in other settings.

Surely nothing less than perfection is acceptable when people's lives are at stake. Yet, to err is human—although physicians, nurses, indeed all health care professionals, expect perfection of themselves. If we are to solve the problem of medication errors, we must move

TABLE 1

POSSIBLE TYPES OF MEDICATION ERRORS

Wrong drug
Wrong dose
Wrong time of administration
Dose omission
Wrong patient
Extra dose
Wrong route of administration

beyond viewing errors as personal failure. Blaming the person who erred and exhorting everyone to be more careful is ineffective; we need to determine how and why errors occur and change the system so that mistakes are harder to make.[2]

In this paper, we discuss recent study findings, suggest ways physicians can prevent errors, and encourage reporting of these events in an atmosphere of inquiry and study.

Nurses intercepted 42% of the physicians' errors

RECENT STUDIES OF MEDICATION ERRORS

Three recent studies used different methods to shed some light on the problem of medication errors:

The United States Pharmacopeial Convention (USP)[3] maintains a hotline to which anyone can report medication errors. Between August 1991 and April 1993, the USP logged 568 incidents, including 43 fatalities.

Lesar and colleagues[4] reviewed medication errors detected and averted by pharmacists in a hospital in Albany, New York. These investigators found an error rate of 3.99 per 1000 medication orders.

The Adverse Drug Event (ADE) Prevention Study Group[5,6] sent nurse-investigators to the floors of two hospitals in Boston to interview personnel and scrutinize charts to identify errors; they found a rate of 7.3 errors per 100 admissions.

WHAT ERRORS OCCURRED?

The types of medication errors are shown in TABLE 1. Some of the errors were alarming: 10-fold overdoses, intravenous potassium chloride given instead of furosemide, orders written in wrong charts, drugs prescribed to which the patient was documented to be allergic. However, in all three studies, the most common type of error was wrong dose (FIGURE).

WHERE DID ERRORS OCCUR?

The Albany study focused entirely on physician errors. In the USP study, nurses were involved in 31% of the incidents, pharmacists in 24%, and physicians in 13%. In the Boston study, physicians made 39% of the errors and nurses made 38% (FIGURE).

These analyses may be unfair to the nurses and too kind to the physicians and pharmacists. Physicians have pharmacists and nurses to check their work; in fact, nurses intercepted 42% of the physicians' errors in the Boston study and pharmacists intercepted another 6%. Nurses, however, have no one to catch their mistakes. Further, the purpose of these studies was not to assign blame, but to determine how and why errors occur.

HOW AND WHY DID ERRORS OCCUR?

All three studies identified lack of information about the drug or the patient as the leading cause of errors (FIGURE). This problem may be amenable to change: improved computer systems in hospitals could make drug information and the patient's age, weight, diagnosis, and allergy history more readily available to physicians, pharmacists, and nurses. A computerized ordering system could also alert physicians to potential mistakes before they made them, and it might eliminate some problems of communication, such as illegible handwriting. Such improvements would involve an institutional investment in computing equipment and information systems automation.

The USP investigators calculated that confusing labeling or packaging of drug products contributed to more than half of the incidents. Packaging problems can be such things

as label color, unreadable print, type style or size, label graphics, or other features. For example, many injectable products come in vials that look essentially identical, with similar cap colors and graphics and hard-to-read labels. Some medication incidents have been attributed to inappropriate strengths of capsules or tablets that required the nurse to give three, four, or more units to obtain the correct dose.

A few years ago, a system was developed in which a powdered antibiotic or other drug was contained in a small vial attached to an intravenous infusion bag. Twisting or pressing the vial broke a seal, allowing the infusion fluid to flow into the vial and dissolve the powder. Some hospitals gave these bags to the nursing staff without dissolving the drug so that the nurse could prepare the drug at the bedside and minimize waste. After these appeared, there were several reports of infusions being given without having been "activated"—the patient received no active drug.

Certain drugs caused more than their share of problems in each of the studies. In the USP study, 11 drugs were involved in more than 1 fatality each: lidocaine, doxorubicin, potassium chloride, chloral hydrate, furosemide, carboplatin, cisplatin, colchicine, digoxin, heparin, and insulin (TABLE 2). In the same study, parenteral medications were involved in almost 70% of the errors. In two of the fatalities, oral or topical medications were given intravenously. Wrong-strength errors, such as giving concentrated sodium chloride rather than a dilute solution, were involved in 11.8% of errors. Intravenous pumps were involved in more than 9% of errors, with "free-flow" (fluid flowing without pump control) episodes involved in 4.6% of reported incidents.

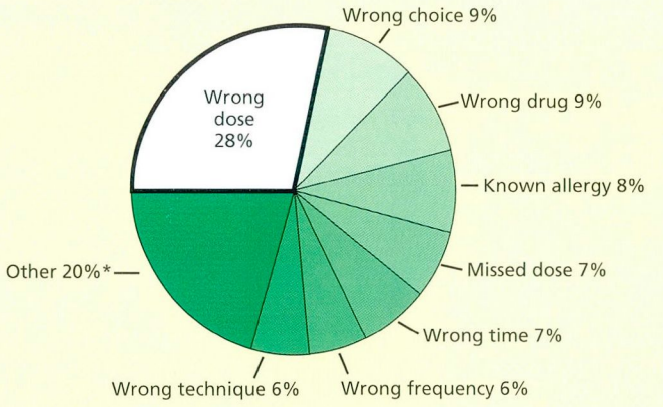
In the Boston study, on the other hand, the drugs most frequently involved in adverse drug events were narcotic analgesics (morphine, meperidine, oxycodone); antibiotics and sedatives came next. In the Albany study, the drug classes most frequently involved in prescribing errors were antimicrobials (39.7%), cardiovascular drugs (17.5%), gastrointestinal agents (7.3%), and nonnarcotic analgesics (6.6%).

Also cited as causes of error (but not quantified) by the Boston investigators were inappropriate staffing (ie, overworked or inexperienced personnel) and lack of feedback about adverse events.

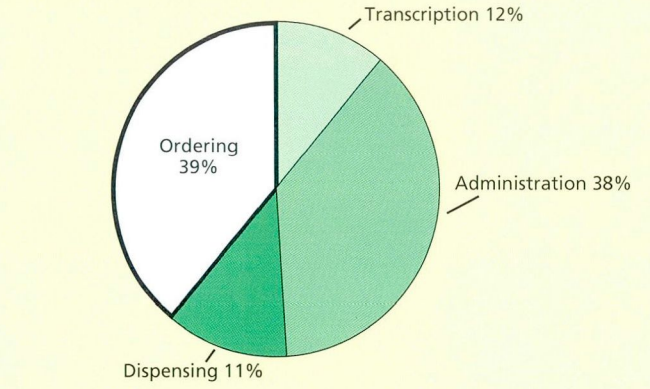
FIGURE

DIGGING DEEPER INTO MEDICATION ERRORS: A STUDY IN TWO HOSPITALS

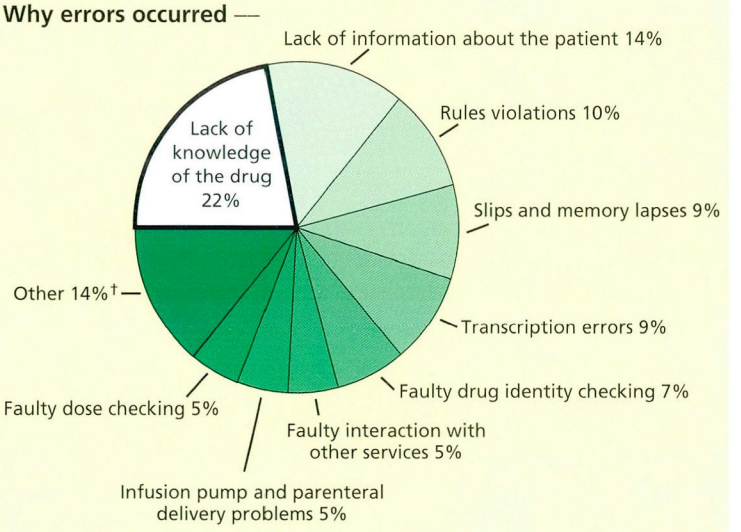
What errors occurred —



Where errors occurred —



Why errors occurred —



*Drug interaction 3%, wrong route 2%, extra dose 1%, failure to act on test 1%, equipment failure 1%, inadequate monitoring 1%, preparation error 1%, unclassified 11%
†Inadequate monitoring 4%, drug stocking and delivery problems 3%, preparation errors 3%, lack of standardization 2%, unclassified 2%
Data from Leape et al, reference 6; percentages may not add up to 100% due to rounding

TABLE 2

DRUGS INVOLVED IN THE 43 DEATHS REPORTED TO THE NATIONAL MEDICATION ERROR REPORT PROGRAM

Drug	No. of fatalities (%)
Lidocaine	7 (16%)
Doxorubicin	5 (12%)
Potassium chloride injection	5 (12%)
Chloral hydrate	4 (9%)
Furosemide	3 (7%)
Carboplatin	3 (7%)
Cisplatin	3 (7%)
Colchicine	2 (5%)
Digoxin	2 (5%)
Heparin	2 (5%)
Insulin	2 (5%)

Only drugs reported in more than one fatality are listed; therefore, percentages do not add to 100
Data from Edgar et al, reference 3

Medication errors as system failures

The Boston investigators borrowed the systems analysis concept from engineering to analyze why errors occur. Viewing medication distribution from a systems point of view focuses on the goal (appropriate medication use) rather than on blaming individuals, and allows everyone involved to become part of the solution.

Any solutions must take into account theories of human cognition, and not require persons to rely too heavily on short-term memory.[2]

There is no safe abbreviation for "daily" or every day

■ HOW PHYSICIANS CAN HELP PREVENT MEDICATION ERRORS

Until improved systems are in place, physicians can help prevent many of the most serious medication errors by observing some basic safety practices in drug prescribing.

- Write orders whenever possible. Limit verbal orders to urgent or emergency situations.
- Write clearly and neatly.
- Avoid abbreviations.

Dangerous abbreviations

Medical abbreviations are easily misunderstood, leading pharmacists, nurses, and others to err (TABLE 3).

O.D., for example, can mean "every day" or "right eye". One might think there would be little confusion about the physician's intention, but there are documented incidents of oral medication (eg, multivitamin syrup) being administered into a patient's right eye, with serious injury resulting. There is no safe abbreviation for daily or every day.

Q.D. is no better. The period after the "Q" has been misread as an "i" resulting in four-times-daily dosing rather than once daily. It is best to write out the word "daily" or "once daily". This should leave no room for misunderstanding.

Common abbreviations can mean different things in different contexts. For example:

M.S. can mean morphine sulfate, multiple sclerosis, mitral stenosis, medical student, muscle strength, mental status, and a host of other things.

AZT became popular a few years ago as an abbreviation for azidothymidine (zidovudine), an antiviral drug for patients with human immunodeficiency virus infection. It is easy to see how this abbreviation came to be mistaken for azathioprine, an immunosuppressant—with serious consequences.

Avoid using the abbreviation "U" for units. The word "units" should be written out. The "U" after a number may be seen as a zero and result in a tenfold overdose of a potent drug such as insulin or heparin.

Avoid using the trailing zero and decimal point. Colchicine 1.0 mg may be read as 10 mg if the decimal point is not clear. This type of error has resulted in the death of more than one patient. Here too, the result is a tenfold overdose of a potent drug. If the order was written as "1 mg" there would be little possibility that it could be misread.

Use the leading zero, as in "0.2 mg," to make the decimal point more noticeable, thus preventing a tenfold dosing error. In some institutions, drug doses must be written in whole numbers. A dose of 0.2 mg therefore must be written as 200 µg. This avoids the decimal point altogether but introduces the possibility of confusing micrograms and milligrams.

Use caution when prescribing or handling potent drugs that have been implicated in patient fatalities. Recent well-publicized incidents involving the administration of concentrated potassium chloride instead of 0.9% sodium chloride flush solutions should cause everyone to re-evaluate the practice of having nurses prepare their own line flush solutions. It should also cause us to question the practice of stocking concentrated potassium chloride on nursing units. Potassium chloride concentrate has also been mistaken for furosemide and given as an IV bolus, resulting in at least one fatality.[7]

Personnel who prescribe, dispense, and administer cancer chemotherapy drugs must have training and familiarity with these medications. The consequences of errors with these drugs are often serious or fatal.[8] The March 1997 issue of the *FDA Medical Bulletin* cites several reports of instances in which cisplatin was given when carboplatin was the intended drug. Careful attention to detail in the prescribing, preparation and administration of cancer chemotherapy drugs is the only acceptable standard of care.

TABLE 3

ABBREVIATIONS THAT CAN LEAD TO MEDICATION ERRORS

Abbreviation	Problem caused	Solution
O.D.	Can mean "every day" or "right eye"	Write out "every day"
Q.D.	Can be mistaken for "QID", with consequent overdose	Write out "every day"
AZT	Can be mistaken to mean azathioprine instead of azidothymidine (zidovudine)	Write out "zidovudine"
U	Can be mistaken for a zero, resulting in a 10-fold increase	Write out "units"
1.0 mg	Can be mistaken for 10 mg instead of 1 mg, with disastrous results	Omit the trailing zero
.2 mg	Can be mistaken for 2 mg	Write out 0.2 mg

HOW TO REPORT ERRORS

Many health professionals are reluctant to report errors, especially their own, fearing potential liability, loss of employment, and loss of confidence by colleagues. Health care organizations must develop a consistent approach that allows examination of errors in a supportive atmosphere with a bias toward preventing future errors rather than punishing past ones.[3]

The FDA MedWatch program accepts confidential reports of medication errors at 1-800-FDA-1088. Report forms are included in the *Physicians' Desk Reference* and can be faxed to 1-800-FDA-0178.

The USP Medication Errors Reporting Program cited in this article can be reached at 1-800-23-ERROR.

The purpose of both programs is to provide feedback to the medical community. We hope that the information gathered can be used to design prevention strategies.

Report errors to MedWatch at 1-800-FDA-1088, or the USP at 1-800-23-ERROR

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