

ASHP Guidelines on Preventing Medication Errors in Hospitals

The goal of drug therapy is the achievement of defined therapeutic outcomes that improve a patient's quality of life while minimizing patient risk.¹ There are inherent risks, both known and unknown, associated with the therapeutic use of drugs (prescription and nonprescription) and drug administration devices. The incidents or hazards that result from such risk have been defined as drug misadventuring, which includes both adverse drug reactions (ADRs) and medication errors.² This document addresses medication errors—episodes in drug misadventuring that should be preventable through effective systems controls involving pharmacists, physicians and other prescribers, nurses, risk management personnel, legal counsel, administrators, patients, and others in the organizational setting, as well as regulatory agencies and the pharmaceutical industry.

This document suggests medication error prevention approaches that should be considered in the development of organizational systems and discusses methods of managing medication errors once they have occurred. These guidelines are primarily intended to apply to the inpatient hospital setting because of the special collaborative processes established in the setting [e.g., formulary system, pharmacy and therapeutics (P&T) committee, and opportunity for increased interaction among health-care providers].

Recommendations for practice settings other than hospitals are beyond the scope of this document, although many of the ideas and principles may be applicable.

Medication errors compromise patient confidence in the health-care system and increase health-care costs. The problems and sources of medication errors are multidisciplinary and multifactorial. Errors occur from lack of knowledge, substandard performance and mental lapses, or defects or failures in systems.^{3,4} Medication errors may be committed by both experienced and inexperienced staff, including pharmacists, physicians, nurses, supportive personnel (e.g., pharmacy technicians), students, clerical staff (e.g., ward clerks), administrators, pharmaceutical manufacturers, patients and their caregivers, and others. The incidence of medication errors is indeterminate; valid comparisons of different studies on medication errors are extremely difficult because of differences in variables, measurements, populations, and methods.²

Many medication errors are probably undetected. The outcome(s) or clinical significance of many medication errors may be minimal, with few or no consequences that adversely affect a patient. Tragically, however, some medication errors result in serious patient morbidity or mortality.³ Thus, medication errors must not be taken lightly, and effective systems for ordering, dispensing, and administering medications should be established with safeguards to prevent the occurrence of errors. These systems should involve adequately trained and supervised personnel, adequate communications, reasonable workloads, effective drug handling systems, multiple procedural and final product checks by separate individuals, quality management, and adequate facilities, equipment, and supplies.

The pharmacist's mission is to help ensure that patients make the best use of medications.⁵ This applies to all drugs used by inpatients or ambulatory patients, including oral or

injectable products, radiopharmaceuticals, radiopaque contrast media, anesthetic gases, blood-fraction drugs, dialysis fluids, respiratory therapy agents, investigational drugs, drug samples, drugs brought into the hospital setting by patients, and other chemical or biological substances administered to patients to evoke a pharmacological response.⁶

Through a systems-oriented approach, the pharmacist should lead collaborative, multidisciplinary efforts to prevent, detect, and resolve drug-related problems that can result in patient harm.¹ An understanding of the risk factors associated with medication errors should enable improved monitoring of patients and medications associated with increased risk for serious errors and should enable the development of organizational systems designed to minimize risk.⁷ The pharmacist should participate in appropriate organizational committees and work with physicians, nurses, administrators, and others to examine and improve systems to ensure that medication processes are safe.

Types of Medication Errors

Medication errors include prescribing errors, dispensing errors, medication administration errors, and patient compliance errors. Specific types of medication errors are categorized in Table 1, based on a compilation of the literature.^{3,7-18}

A *potential error* is a mistake in prescribing, dispensing, or planned medication administration that is detected and corrected through intervention (by another health-care provider or patient) before actual medication administration. Potential errors should be reviewed and tabulated as separate events from errors of occurrence (errors that actually reach patients) to identify opportunities to correct problems in the medication use system even before they occur. Detection of potential errors should be a component of the hospital's routine quality improvement process. Documentation of instances in which an individual has prevented the occurrence of a medication error will help identify system weaknesses and will reinforce the importance of multiple checks in the medication use system.

Recommendations for Preventing Medication Errors

Organizational systems for ordering, dispensing, and administering medications should be designed to minimize error. Medication errors may involve process breakdowns in more than one aspect of a system. This section provides recommendations to the management staff (general and departmental) of hospitals, as well as to individual prescribers, pharmacists, nurses, patients, pharmaceutical manufacturers, and others.

Organizational and Departmental Recommendations.

Organizational policies and procedures should be established to prevent medication errors. Development of the policies and procedures should involve multiple departments, including pharmacy, medicine, nursing, risk management, legal counsel, and organizational administration. The following recommendations are offered for organizational management and clinical staff:^{3,8,11-14,16,19-29}

Table 1.
Types of Medication Errors^{3,7–18,a}

| Type | Definition |
|---|--|
| Prescribing error | Incorrect drug selection (based on indications, contraindications, known allergies, existing drug therapy, and other factors), dose, dosage form, quantity, route, concentration, rate of administration, or instructions for use of a drug product ordered or authorized by physician (or other legitimate prescriber); illegible prescriptions or medication orders that lead to errors that reach the patient |
| Omission error ^b | The failure to administer an ordered dose to a patient before the next scheduled dose, if any |
| Wrong time error | Administration of medication outside a predefined time interval from its scheduled administration time (this interval should be established by each individual health care facility) |
| Unauthorized drug error ^c | Administration to the patient of medication not authorized by a legitimate prescriber for the patient |
| Improper dose error ^d | Administration to the patient of a dose that is greater than or less than the amount ordered by the prescriber or administration of duplicate doses to the patient, i.e., one or more dosage units in addition to those that were ordered |
| Wrong dosage-form error ^e | Administration to the patient of a drug product in a different dosage form than ordered by the prescriber |
| Wrong drug-preparation error ^f | Drug product incorrectly formulated or manipulated before administration |
| Wrong administration-technique error ^g | Inappropriate procedure or improper technique in the administration of a drug |
| Deteriorated drug error ^h | Administration of a drug that has expired or for which the physical or chemical dosage-form integrity has been compromised |
| Monitoring error | Failure to review a prescribed regimen for appropriateness and detection of problems, or failure to use appropriate clinical or laboratory data for adequate assessment of patient response to prescribed therapy |
| Compliance error | Inappropriate patient behavior regarding adherence to a prescribed medication regimen |
| Other medication error | Any medication error that does not fall into one of above predefined categories |

^a The categories may not be mutually exclusive because of the multidisciplinary and multifactorial nature of medication errors.

^b Assumes no prescribing error. Excluded would be (1) a patient's refusal to take the medication or (2) a decision not to administer the dose because of recognized contraindications. If an explanation for the omission is apparent (e.g., patient was away from nursing unit for tests or medication was not available), that reason should be documented in the appropriate records.

^c This would include, for example, a wrong drug, a dose given to the wrong patient, unordered drugs, and doses given outside a stated set of clinical guidelines or protocols.

^d Excluded would be (1) allowable deviations based on preset ranges established by individual health care organizations in consideration of measuring devices routinely provided to those who administer drugs to patients (e.g., not administering a dose based on a patient's measured temperature or blood glucose level) or other factors such as conversion of doses expressed in the apothecary system to the metric system and (2) topical dosage forms for which medication orders are not expressed quantitatively.

^e Excluded would be accepted protocols (established by the pharmacy and therapeutics committee or its equivalent) that authorize pharmacists to dispense alternate dosage forms for patients with special needs (e.g., liquid formulations for patients with nasogastric tubes or those who have difficulty swallowing), as allowed by state regulations.

^f This would include, for example, incorrect dilution or reconstitution, mixing drugs that are physically or chemically incompatible, and inadequate product packaging.

^g This would include doses administered (1) via the wrong route (different from the route prescribed), (2) via the correct route but at the wrong site (e.g., left eye instead of right), and (3) at the wrong rate of administration.

^h This would include, for example, administration of expired drugs and improperly stored drugs.

- Using the principles of the formulary system, the P&T committee (or its equivalent)—composed of pharmacists, physicians, nurses, and other health professionals—should be responsible for formulating policies regarding the evaluation, selection, and therapeutic use of drugs in organized health-care settings.
- Care and consideration must be given in hiring and assigning personnel involved in medication ordering, preparation, dispensing, administration, and patient education. Policies and procedures should be developed that ensure adequate personnel selection, training, supervision, and evaluation. This would include the need to ensure proper interviewing, orientation, evaluation of competency, supervision, and opportunities for continuing professional and technical education.
- Sufficient personnel must be available to perform tasks adequately. Policies and procedures should ensure that reasonable workload levels and working hours are established and rarely exceeded.
- Suitable work environments should exist for the preparation of drug products. Potential error sources within the work environment, such as frequent interruptions, should be identified and minimized.
- Lines of authority and areas of responsibility within the hospital should be clearly defined for medication ordering, dispensing, and administration. The system should ensure adequate written and oral communications among personnel involved in the medication use process to optimize therapeutic appropriateness and to enable medications to be prescribed, dispensed, and administered in a timely fashion. All systems should provide for review and verification of the prescriber's original order (except in emergency situations) before a drug product is dispensed by a pharmacist. Any necessary clarifications or changes in a medication order must be resolved with the prescriber before a medication is administered to the patient. Written documentation of such consultations should be made in the patient's medical record or other appropriate record. Nursing staff should be informed of any changes made in the medication order. Changes required to correct incorrect orders should be regarded as potential errors, assuming the changes occurred in time to prevent the error from reaching the patient.
- There should be an ongoing, systematic program of quality improvement and peer review with respect to the safe use of medications. A formal drug use evaluation (DUE) program, developed and conducted through collaborative efforts among medicine, pharmacy, and nursing, should be integrated and coordinated with the overall hospital quality improvement program. To prevent medication errors, a portion of the DUE program should focus on monitoring

the appropriate use of any drugs associated with a high frequency of adverse events, including specific drug classes (such as antimicrobials, antineoplastic agents, and cardiovascular drugs) and injectable dosage forms (e.g., potassium products, narcotic substances, heparin, lidocaine, procainamide, magnesium sulfate, and insulin). The quality improvement program should include a system for monitoring, reviewing, and reporting medication errors to assist in identifying and eliminating causes of errors (system breakdowns) and preventing their recurrence. Table 2 lists common causes of medication errors, i.e., areas where there may be system breakdowns.

7. Pharmacists and others responsible for processing drug orders should have routine access to appropriate clinical information about patients (including medication, allergy, and hypersensitivity profiles; diagnoses; pregnancy status; and laboratory values) to help evaluate the appropriateness of medication orders.
8. Pharmacists should maintain medication profiles for all patients, both inpatients and ambulatory patients, who receive care at the hospital. This profile should include adequate information to allow monitoring of medication histories, allergies, diagnoses, potential drug interactions and ADRs, duplicate drug therapies, pertinent laboratory data, and other information.
9. The pharmacy department must be responsible for the procurement, distribution, and control of all drugs used within the organization. Adequate hours for the provision of pharmaceutical services must be maintained; 24-hour pharmaceutical service is strongly recommended in hospital settings. In the absence of 24-hour pharmaceutical service, access to a limited supply of medications should be available to authorized nonpharmacists for use in initiating urgent medication orders. The list of medications to be supplied and the policies and procedures to be used (including subsequent review of all activity by a pharmacist) should be developed by the P&T committee (or its equivalent). Items should be chosen with safety in mind, limiting wherever possible medications, quantities, dosage forms, and container sizes that might endanger patients. The use of well-designed night cabinets, after-hours drug carts, and other methods would preclude the need for non-pharmacists to enter the pharmacy. Access to the pharmacy by nonpharmacists (e.g., nurses) for removal of doses is strongly discouraged; this practice should be minimized and eliminated to the fullest extent

possible. When 24-hour pharmacy service is not feasible, a pharmacist must be available on an “on-call” basis.

10. The pharmacy manager (or designee), with the assistance of the P&T committee (or its equivalent) and the department of nursing, should develop comprehensive policies and procedures that provide for efficient and safe distribution of all medications and related supplies to patients. For safety, the recommended method of distribution within the organized health-care setting is the unit dose drug distribution and control system.
11. Except in emergency situations, all sterile and nonsterile drug products should be dispensed from the pharmacy department for individual patients. The storage of non-emergency floor stock medications on the nursing units or in patient-care areas should be minimized. Particular caution should be exercised with respect to drug products that have commonly been involved in serious medication errors or whose margin of safety is narrow, such as concentrated forms of drug products that are intended to be diluted into larger volumes (e.g., concentrated lidocaine and potassium chloride for injection concentrate). All drug storage areas should be routinely inspected by pharmacy personnel to ensure adequate product integrity and appropriate packaging, labeling, and storage. It is important that drug products and other products for external use be stored separately from drug products for internal use.
12. The pharmacy director and staff must ensure that all drug products used in the organizational setting are of high quality and integrity. This would include, for example, (1) selecting multisource products supported by adequate bioavailability data and adequate product packaging and labeling, (2) maintaining an unexpired product inventory, and (3) keeping abreast of compendial requirements.
13. The use of a patient’s own or “home” medications should be avoided to the fullest extent possible. Use of such medications should be allowed only if there is a need for the patient to receive the therapy, the drug product is not obtainable by the pharmacy, and no alternative therapy can be prescribed. If such medications are used, the prescribing physician must write an appropriate order in the patient’s medical record. Before use, a pharmacist should inspect and identify the medication. If there are any unresolved questions with respect to product identity or integrity, the medication must not be used.
14. All discontinued or unused drugs should be returned to the department of pharmacy immediately on discontinuation or at patient discharge. Discharged patients must not be given unlabeled drug products to take home, unless they are labeled for outpatient use by the pharmacy in accordance with state and federal regulations. Discharged patients should be counseled about use of any medications to be used after discharge.
15. It is recommended that there be computerized pharmacy systems in place that enable automated checking for doses, duplicate therapies, allergies, drug interactions, and other aspects of use. Where possible, the use of technological innovations such as bar coding is recommended to help identify patients, products, and care providers. Pharmacy-generated medication administra-

Table 2.

Common Causes of Medication Errors

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| Ambiguous strength designation on labels or in packaging |
| Drug product nomenclature (look-alike or sound-alike names, use of lettered or numbered prefixes and suffixes in drug names) |
| Equipment failure or malfunction |
| Illegible handwriting |
| Improper transcription |
| Inaccurate dosage calculation |
| Inadequately trained personnel |
| Inappropriate abbreviations used in prescribing |
| Labeling errors |
| Excessive workload |
| Lapses in individual performance |
| Medication unavailable |

- tion records or labels are recommended to assist nurses in interpreting and documenting medication activities.
16. Adequate drug information resources should be available for all health-care providers involved in the drug use process.
 17. Standard drug administration times should be established for the hospital by the P&T committee (or its equivalent), with input from the departments of nursing and pharmacy. Policies and procedures should allow for deviations from the standard times when necessary. Further, standard drug concentrations and dosage charts should be developed to minimize the need for dosage calculations by staff.
 18. The P&T committee (or its equivalent) should develop a list of standard abbreviations approved for use in medication ordering. There should be efforts to prohibit or discourage the use of other abbreviations in medication ordering.
 19. A review mechanism should be established through the P&T committee specifying those responsible for data collection and evaluation of medication error reports. The review group should investigate causes of errors and develop programs for decreasing their occurrence. The review group should be composed of representatives from pharmacy, nursing, medicine, quality assurance, staff education, risk management, and legal counsel.
 20. The pharmacy department, in conjunction with nursing, risk management, and the medical staff, should conduct ongoing educational programs to discuss medication errors, their causes, and methods to prevent their occurrence. Such programs might involve seminars, newsletters, or other methods of information dissemination.
- Recommendations for Prescribers.** Prescribing is an early point at which medication errors can arise. It has been estimated that 1% of hospitalized patients suffer adverse events as the result of medical mismanagement³⁰ and that drug-related complications are the most common type of adverse event.⁷ The following recommendations for preventing medication errors are suggested for physicians and other prescribers^{3,7,11–16,31}:
1. To determine appropriate drug therapy, prescribers should stay abreast of the current state of knowledge through literature review, consultation with pharmacists, consultation with other physicians, participation in continuing professional education programs, and other means. It is especially crucial to seek information when prescribing for conditions and diseases not typically experienced in the prescriber's practice.
 2. Prescribers should evaluate the patient's total status and review all existing drug therapy before prescribing new or additional medications to ascertain possible antagonistic or complementary drug interactions. To evaluate and optimize patient response to prescribed drug therapy, appropriate monitoring of clinical signs and symptoms and of relevant laboratory data is necessary.
 3. In hospitals, prescribers should be familiar with the medication ordering system (e.g., the formulary system, participation in DUE programs, allowable delegation of authority, procedures to alert nurses and others to new drug orders that need to be processed, standard medication administration times, and approved abbreviations).
 4. Drug orders should be complete. They should include patient name, generic drug name, trademarked name (if a specific product is required), route and site of administration, dosage form, dose, strength, quantity, frequency of administration, and prescriber's name. In some cases, a dilution, rate, and time of administration should be specified. The desired therapeutic outcome for each drug should be expressed when the drug is prescribed. Prescribers should review all drug orders for accuracy and legibility immediately after they have prescribed them.
 5. Care should be taken to ensure that the intent of medication orders is clear and unambiguous. Prescribers should
 - a. Write out instructions rather than using nonstandard or ambiguous abbreviations. For example, write "daily" rather than "q.d.," which could be misinterpreted as q.i.d. (causing a drug to be given four times a day instead of once) or as o.d. (for right eye).
 - b. Do not use vague instructions, such as "take as directed," because specific instructions can help differentiate among intended drugs.
 - c. Specify exact dosage strengths (such as milligrams) rather than dosage form units (such as one tablet or one vial). An exception would be combination drug products, for which the number of dosage form units should be specified.
 - d. Prescribe by standard nomenclature, using the drug's generic name (United States Adopted Name or USAN), official name, or trademarked name (if deemed medically necessary). Avoid the following: locally coined names (e.g., Dr. Doe's syrup); chemical names [e.g., 6-mercaptopurine (instead of mercaptopurine) could result in a six-fold overdose if misinterpreted]; unestablished abbreviated drug names (e.g., "AZT" could stand for zidovudine, azathioprine, or aztreonam); acronyms; and apothecary or chemical symbols.
 - e. Always use a leading zero before a decimal expression of less than one (e.g., 0.5 mL). Conversely, a terminal zero should never be used (e.g., 5.0 mL), since failure to see the decimal could result in a 10-fold overdose. When possible, avoid the use of decimals (e.g., prescribe 500 mg instead of 0.5 g).
 - f. Spell out the word "units" (e.g., 10 units regular insulin) rather than writing "u," which could be misinterpreted as a zero.
 - g. Use the metric system.
 6. Written drug or prescription orders (including signatures) should be legible. Prescribers with poor handwriting should print or type medication or prescription orders if direct order entry capabilities for computerized systems are unavailable. A handwritten order should be completely readable (not merely recognizable through familiarity). An illegible handwritten order should be regarded as a potential error. If it leads to an error of occurrence (that is, the error actually reaches the patient), it should be regarded as a prescribing error.

7. Verbal drug or prescription orders (that is, orders that are orally communicated) should be reserved only for those situations in which it is impossible or impractical for the prescriber to write the order or enter it in the computer. The prescriber should dictate verbal orders slowly, clearly, and articulately to avoid confusion. Special caution is urged in the prescribing of drug dosages in the teens (e.g., a 15-mEq dose of potassium chloride could be misheard as a 50-mEq dose). The order should be read back to the prescriber by the recipient (i.e., the nurse or pharmacist, according to institutional policies). When read back, the drug name should be spelled to the prescriber and, when directions are repeated, no abbreviations should be used (e.g., say “three times daily” rather than “t.i.d.”). A written copy of the verbal order should be placed in the patient’s medical record and later confirmed by the prescriber in accordance with applicable state regulations and hospital policies.
8. When possible, drugs should be prescribed for administration by the oral route rather than by injection.
9. When possible, the prescriber should talk with the patient or caregiver to explain the medication prescribed and any special precautions or observations that might be indicated, including any allergic or hypersensitivity reactions that might occur.
10. Prescribers should follow up and periodically evaluate the need for continued drug therapy for individual patients.
11. Instructions with respect to “hold” orders for medications should be clear.

Recommendations for Pharmacists. The pharmacist is expected to play a pivotal role in preventing medication misuse. The value of pharmacists’ interventions to prevent medication errors that would have resulted from inappropriate prescribing has been documented.^{7,32,33} Ideally, the pharmacist should collaborate with the prescriber in developing, implementing, and monitoring a therapeutic plan to produce defined therapeutic outcomes for the patient.¹ It is also vital that the pharmacist devote careful attention to dispensing processes to ensure that errors are not introduced at that point in the medication process. The following recommendations are suggested for pharmacists^{3,4,8–10,14,16,18–20,28,29}:

1. Pharmacists should participate in drug therapy monitoring (including the following, when indicated: the assessment of therapeutic appropriateness, medication administration appropriateness, and possible duplicate therapies; review for possible interactions; and evaluation of pertinent clinical and laboratory data) and DUE activities to help achieve safe, effective, and rational use of drugs.
2. To recommend and recognize appropriate drug therapy, pharmacists should stay abreast of the current state of knowledge through familiarity with literature, consultation with colleagues and other health-care providers, participation in continuing professional education programs, and other means.
3. Pharmacists should make themselves available to prescribers and nurses to offer information and advice about therapeutic drug regimens and the correct use of medications.
4. Pharmacists should be familiar with the medication ordering system and drug distribution policies and

procedures established for the organizational setting to provide for the safe distribution of all medications and related supplies to inpatients and ambulatory patients. In particular, pharmacists should be familiar with all elements that are designed into the system to prevent or detect errors. Actions by any staff that would (even unintentionally) defeat or compromise those elements should serve as “alerts” to the pharmacist that safety may be affected. Any necessary followup action (e.g., education or reeducation of staff) should ensue promptly. Policies and procedures to be followed for “hold” orders should be clear and understood by pharmacy, medical, and nursing staffs.

5. Pharmacists should never assume or guess the intent of confusing medication orders. If there are any questions, the prescriber should be contacted prior to dispensing.
6. When preparing drugs, pharmacists should maintain orderliness and cleanliness in the work area and perform one procedure at a time with as few interruptions as possible.
7. Before dispensing a medication in nonemergency situations, the pharmacist should review an original copy of the written medication order. The pharmacist should ensure that all work performed by supportive personnel or through the use of automated devices is checked by manual or technological means. All processes must conform with applicable state and federal laws and regulations. Pharmacists should participate in, at a minimum, a self-checking process in reading prescriptions, labeling (drug or ingredients and pharmacist-generated labeling), and dosage calculations. For high risk drug products, when possible, all work should be checked by a second individual (preferably, another pharmacist). Pharmacists must make certain that the following are accurate: drug, labeling, packaging, quantity, dose, and instructions.
8. Pharmacists should dispense medications in ready-to-administer dosage forms whenever possible. The unit dose system is strongly recommended as the preferred method of drug distribution. The need for nurses to manipulate drugs (e.g., measure, repackage, and calculate) prior to their administration should be minimized.
9. Pharmacists should review the use of auxiliary labels and use the labels prudently when it is clear that such use may prevent errors (e.g., “shake well,” “for external use only,” and “not for injection”).
10. Pharmacists should ensure that medications are delivered to the patient-care area in a timely fashion after receipt of orders, according to hospital policies and procedures. If medication doses are not delivered or if therapy is delayed for any reason pending resolution of a detected problem (e.g., allergy or contraindications), the pharmacist should notify the nursing staff of the delay and the reason.
11. Pharmacists should observe how medications are actually being used in patient-care areas to ensure that dispensing and storage procedures are followed and to assist nurses in optimizing patient safety.
12. Pharmacy staff should review medications that are returned to the department. Such review processes may reveal system breakdowns or problems that resulted in medication errors (e.g., omitted doses and unauthorized drugs).

13. When dispensing medications to ambulatory patients (e.g., at discharge), pharmacists should counsel patients or caregivers and verify that they understand why a medication was prescribed and dispensed, its intended use, any special precautions that might be observed, and other needed information. For inpatients, pharmacists should make their services available to counsel patients, families, or other caregivers when appropriate.
14. Pharmacists should preview and provide advice on the content and design of preprinted medication order forms or sheets if they are used.
15. Pharmacists should maintain records sufficient to enable identification of patients receiving an erroneous product.

Recommendations for Nurses. By virtue of their direct patient-care activities and administration of medications to patients, nurses—perhaps more than any other health-care providers—are in an excellent position to detect and report medication errors. Nurses often serve as the final point in the checks-and-balances triad (physicians and other prescribers, pharmacists, and nurses) for the medication use process; thus, they play an important role in risk reduction. The following recommendations for preventing medication administration errors are suggested^{3,14,16,17,34}:

1. Nurses who practice in organized health-care settings should be familiar with the medication ordering and use system (e.g., participation in DUE activities, order processing, and standard medication administration times).
2. Nurses should review patients' medications with respect to desired patient outcomes, therapeutic duplications, and possible drug interactions. Adequate drug information (including information on medication administration and product compatibilities) should be obtained from pharmacists, nurses, other health-care providers, the literature, and other means when there are questions. There should be appropriate followup communication with the prescriber when this is indicated.
3. All drug orders should be verified before medication administration. Nurses should carefully review original medication orders before administration of the first dose and compare them with medications dispensed. Transcriptions of orders should be avoided to the extent possible and should be recognized as prime opportunities for errors. Doses should not be administered unless the meaning of the original order is clear and unambiguous and there are no questions with respect to the correctness of the prescribed regimen. Nurses should check the identity and integrity (e.g., expiration date and general appearance) of the medications dispensed before administering them. When there are discrepancies, the nurse should contact the pharmacy department and determine the appropriate action.
4. Patient identity should be verified before the administration of each prescribed dose. When appropriate, the patient should be observed after administration of the drug product to ensure that the doses were administered as prescribed and have the intended effect.
5. All doses should be administered at scheduled times unless there are questions or problems to be resolved. Medication doses should not be removed from packaging or labeling until immediately before administra-

tion. The administration of medication should be documented as soon as it is completed.

6. When standard drug concentrations or dosage charts are not available, dosage calculations, flow rates, and other mathematical calculations should be checked by a second individual (e.g., another nurse or a pharmacist).
7. The drug distribution system should not be circumvented by "borrowing" medications from one patient (or another hospital area) to give to a different patient or by stockpiling unused medications. If there are apparent missing doses, it is important that the pharmacy be contacted for explanation or correction. There may be an important reason why the dose was not sent to the patient-care area (e.g., allergy, contraindication, and questionable dose), and resolution of the potential question or problem may be pending.
8. If there are questions when a large volume or number of dosage units (e.g., more than two tablets, capsules, vials, or ampuls) is needed for a single patient dose, the medication order should be verified. Consult with the pharmacist and prescriber as appropriate.
9. All personnel using medication administration devices (e.g., infusion pumps) should understand their operation and the opportunities for error that might occur with the use of such devices.
10. Nurses should talk with patients or caregivers to ascertain that they understand the use of their medications and any special precautions or observations that might be indicated. Any counseling needed should be provided before the first dose is administered, when possible.
11. When a patient objects to or questions whether a particular drug should be administered, the nurse should listen, answer questions, and (if appropriate) double check the medication order and product dispensed before administering it to ensure that no preventable error is made (e.g., wrong patient, wrong route, and dose already administered). If a patient refuses to take a prescribed medication, that decision should be documented in the appropriate patient records.

Recommendations for Patients and Personal Caregivers.

Patients (or their authorized caregivers or designees) have the right to know about all aspects of their care, including drug therapy. When patient status allows, health-care providers should encourage patients to take an active role in their drug use by questioning and learning about their treatment regimens. Generally, if patients are more knowledgeable, anxieties about the uncertainty of treatments can be alleviated and errors in treatment may be prevented. The following suggestions are offered to help patients whose health status allows, and their caregivers, make the best use of medications³:

1. Patients should inform appropriate direct health-care providers (e.g., physicians, nurses, and pharmacists) about all known symptoms, allergies, sensitivities, and current medication use. Patients should communicate their actual self-medication practices, even if they differ from the prescribed directions.
2. Patients should feel free to ask questions about any procedures and treatments received.
3. Patients should learn the names of the drug products that are prescribed and administered to them, as well as dosage strengths and schedules. It is suggested that

patients keep a personal list of all drug therapy, including prescribed drugs, nonprescription drugs, home remedies, and medical foods. Patients should also maintain lists of medications that they cannot take and the reasons why. This information should be shared with health-care providers. Patients should be assertive in communicating with health-care providers when anything seems incorrect or different from the norm.

4. After counseling from an authorized health-care provider about the appropriateness of the medication, patients should take all medications as directed.

Recommendations for Pharmaceutical Manufacturers and Approval Organizations. Poor designs with respect to drug product packaging and labeling, as well as selection of inappropriate or confusing nomenclature, have been identified as factors that contribute to serious medication errors by practitioners.^{4,35–37} Pharmaceutical manufacturers and approval agencies should be responsive to efforts of practitioners to minimize errors. The following guidelines are recommended for the pharmaceutical industry and regulatory authorities^{3,4,16,38}

1. Drug manufacturers and the Food and Drug Administration are urged to involve pharmacists, nurses, and physicians in decisions about drug names, labeling, and packaging.
2. Look-alike or sound-alike trademarked names and generic names should be avoided.
3. Similar proprietary appearances of packaging and labeling should be avoided, because look-alike products contribute to medication errors.
4. The use of lettered or numbered prefixes and suffixes in trademarked names is generally discouraged. Lettered prefixes or suffixes could be mistaken for instructions or strength. Commonly used medical abbreviations should never be used in trademarked names (e.g., “HS” could stand for half-strength or a bedtime dose). Numbers as part of trademarked names could be mistaken for quantities to be administered. Coined abbreviations that could be misinterpreted (e.g., MTX, U, and HCTZ) should not be used in trademarked names.
5. Special instructions should be highlighted on labeling, such as the need for dilution before administration.
6. The most prominent items on the product label should be information in the best interest of safety (e.g., product name and strength). Less prominence should be given to company names or logos.
7. Drug manufacturers are encouraged to make dosage forms available commercially in unit dose and unit-of-dispensing containers, as well as bulk packaging, to facilitate their appropriate use in all practice settings.
8. Drug manufacturers must communicate with health-care providers (i.e., pharmacists, physicians, and nurses) when changes are made in product formulations or dosage forms.

Monitoring and Managing Medication Errors

Monitoring Medication Errors. Ongoing quality improvement programs for monitoring medication errors are needed. The difficulty in detecting errors has long been recognized as one of the barriers to studying the problem effectively.³⁹ Medication errors should be identified and documented and

their causes studied in order to develop systems that minimize recurrence.^{3,4,7,10,11,14,16,22,40} Several error monitoring techniques exist (e.g., anonymous self-reports, incident reports, critical incident technique, and disguised observation technique) and may be applied as appropriate to determine the rates of errors.^{9,40,41} There are differences in the validity of data obtained by the various error monitoring techniques or combined techniques. Program managers should determine the best method for use in their organizations in consideration of utility, feasibility, and cost. Monitoring programs for medication errors should consider the following risk factors^{6,10,11,22,40,41}:

1. Work shift (higher error rates typically occur during the day shift).
2. Inexperienced and inadequately trained staff.
3. Medical service (e.g., special needs for certain patient populations, including geriatrics, pediatrics, and oncology).
4. Increased number or quantity of medications per patient.
5. Environmental factors (lighting, noise, and frequent interruptions).
6. Staff workload and fatigue.
7. Poor communication among health-care providers.
8. Dosage form (e.g., injectable drugs are associated with more serious errors).
9. Type of distribution system (unit dose distribution is preferred; floor stock should be minimized).
10. Improper drug storage.
11. Extent of measurements or calculations required.
12. Confusing drug product nomenclature, packaging, or labeling.
13. Drug category (e.g., antimicrobials).
14. Poor handwriting.
15. Verbal (orally communicated) orders.
16. Lack of effective policies and procedures.
17. Poorly functioning oversight committees.

Managing Medication Errors. Medication errors result from problematic processes, but the outcomes of medication errors could range from minimal (or no) patient risk to life-threatening risk. Classification of the potential seriousness and clinical significance of detected medication errors should be based on predefined criteria established by the P&T committee (or its equivalent). The error classification should be based on the original order, standard medication dispensing and administration procedures, dosage forms available, acceptable deviation ranges, potential for adverse consequences and patient harm, and other factors.^{6,32,41}

Classification of medication errors should allow for better management of followup activities upon medication error detection. A simple classification of medication errors is the following: (1) clinically significant (includes potentially fatal or severe, potentially serious, and potentially significant errors) or (2) minor.^{7,33} Hartwig, Denger, and Schneider defined seven medication error severity levels, as follows⁴¹:

Level 0—Nonmedication error occurred (potential errors would be classified here).

Level 1—An error occurred that did not result in patient harm.

Level 2—An error occurred that resulted in the need for increased patient monitoring but no change in vital signs and no patient harm.

Level 3—An error occurred that resulted in the need for increased patient monitoring with a change in vital signs but no ultimate patient harm, or any error that resulted in the need for increased laboratory monitoring.

Level 4—An error occurred that resulted in the need for treatment with another drug or an increased length of stay or that affected patient participation in an investigational drug study.^a

Level 5—An error occurred that resulted in permanent patient harm.

Level 6—An error occurred that resulted in patient death.

Medication error classifications could also be based on probability and severity scales analogous to those used in ADR reporting programs.^{42,43}

Determination of the causes of medication errors should be coupled with assessment of the severity of the error. While quality management processes should include programs to decrease the incidence of all medication errors, effort should be concentrated on eliminating the causes of errors associated with greater levels of severity. There should be established mechanisms for tracking drugs or drug classes that are involved in medication errors. Correlations between errors and the method of drug distribution should also be reviewed (e.g., unit dose, floor stock, or bulk medications; premixed or extemporaneously compounded products; and oral or injectable products). These processes will help identify system problems and stimulate changes to minimize the recurrence of errors.

Quality improvement programs should provide guidance for patient support, staff counseling and education, and risk management processes when a medication error is detected. Incident reporting policies and procedures and appropriate counseling, education, and intervention programs should be established in all hospitals. Risk management processes for medication errors should include pharmacists, physicians, and nurses, in addition to risk management specialists, legal counsel, and others as appropriate. The following actions are recommended upon error detection^{3,7,10,11,16,17,27,43}:

1. Any necessary corrective and supportive therapy should be provided to the patient.
2. The error should be documented and reported immediately after discovery, in accordance with written procedures. For clinically significant errors, an immediate oral notice should be provided to physicians, nurses, and pharmacy managers. A written medication error report should follow promptly.
3. For clinically significant errors, fact gathering and investigation should be initiated immediately. Facts that should be determined and documented include what happened, where the incident occurred, why the incident occurred, how the incident occurred, and who was involved. Appropriate product evidence (e.g., packaging and labeling) should be retrieved and retained for future reference until causative factors are eliminated or resolved.
4. Reports of clinically significant errors and the associated corrective activities should be reviewed by the supervisor and department head of the area(s) involved, the appropriate organizational administrator, the organizational safety committee (or its equivalent), and legal counsel (as appropriate).

5. When appropriate, the supervisor and the staff members who were involved in the error should confer on how the error occurred and how its recurrence can be prevented. Medication errors often result from problems in systems rather than exclusively from staff performance or environmental factors^{2,3,44}; thus, error reports should not be used for punitive purposes but to achieve correction or change.
6. Information gained from medication error reports and other means that demonstrates continued failure of individual professionals to avoid preventable medication errors should serve as an effective management and educational tool in staff development or, if necessary, modification of job functions or staff disciplinary action.
7. Supervisors, department managers, and appropriate committees should periodically review error reports and determine causes of errors and develop actions to prevent their recurrence (e.g., conduct organizational staff education, alter staff levels, revise policies and procedures, or change facilities, equipment, or supplies).
8. Medication errors should be reported to a national monitoring program so that the shared experiences of pharmacists, nurses, physicians, and patients can contribute to improved patient safety and to the development of valuable educational services for the prevention of future errors. Reports of medication errors can be made by telephone to the United States Pharmacopeial Convention, Inc. (USP) Medication Errors Reporting Program (1-800-23ERROR). Reports can be submitted to USP on a confidential basis if the reporter so chooses. Other reporting programs may also be in existence or under development. Reporting programs are intended to track trends and inform practitioners, regulators, and the pharmaceutical industry of potential product and system hazards that have a documented association with medication errors.

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^aThe mention of investigational drugs in the definition of level 4 errors (and nowhere else in the levels) may lead some to believe that any error involving an investigational drug should automatically be classified as a level 4 error. However, in discussing this issue at its September 1992 meeting, the ASHP Council on Professional Affairs noted that it is the effect on the patient (for a medication of any type) that really should determine what level of error is involved. Approved by the ASHP Board of Directors, June 23, 1993, reaffirming the version approved November 18, 1992. Developed by the ASHP Council on Professional Affairs.

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