When a medication error is identified, it is important to immediately attend to the patient's needs and implement any necessary treatment. Then the error must be reported according to the policies and procedures of the healthcare organization. Documentation of medication errors should include the following:

1. *Immediate reporting to the physician responsible for the patient*—Oral communication may be used but must be followed with written documentation in the patient's medical record within the time frame defined by the organization's policy. Timely reporting to the physician is essential to ensure prompt assessment of the patient's status and implementation of any necessary supportive treatment.
2. *Entries in patient's medical record*—Omitted doses and medications administered in error should be promptly noted. However, the information should be recorded in the manner required by the risk management department of the organization. Entries should not refer to "wrong doses" or "errors" and should not indicate that a medication error report was filed.
3. *Written reports*—Written reports of medication errors should be prepared within 24 hours. Most hospitals use special forms for this purpose (e.g., incident report, variance report, or medication error report forms). These reports are confidential to the institution and should not become part of the patient's medical record. They are used to evaluate errors and reduce the potential for future errors.
4. *Reporting to the USP*—Healthcare facilities may report actual or potential medication errors to the USP Medication Errors Reporting Program, a cooperative effort between USP and ISMP. The program is voluntary and facilities may request that their identity not be released. Reports are forwarded to the manufacturers and the FDA. The USP and ISMP evaluate the information provided in the reports and make recommendations for reducing future occurrences (e.g., changes in packaging and labeling; safe dispensing and administration procedures).
5. *Reporting to The Joint Commission*—The Joint Commission has established a sentinel event policy to encourage healthcare organizations to report serious adverse events (including those involving medications), to investigate the underlying causes of these events, and to take actions to reduce the risk of future occurrences. Joint Commission's definition of a *sentinel event* is "an unexpected occurrence involving death or serious physical or psychological injury, or the risk thereof. Serious injury specifically includes loss of limb or function. The phrase or the *risk thereof*, includes any process variation for which a recurrence would carry a significant chance of serious adverse outcome."[16]

The Joint Commission does not require healthcare organizations to report sentinel events. However, it does require identification and appropriate response to all sentinel events, which includes conducting a root cause analysis of these events (see the following section for a discussion of root cause analysis). A more complete discussion of sentinel events can be found in the Joint Commission's *Sentinel Events: Evaluating Cause and Planning Improvement*.[17]

6. *Reporting to other organizations*—Reporting medication errors to other organizations may be required. Regulations in some states, for example, require reporting of certain types of errors (e.g., errors resulting in permanent harm or death).

Assessment and Analysis of Medication Errors

Once identified and reported, medication errors should be assessed and analyzed to determine not only the cause, but also how to prevent future occurrences. This evaluation should be a

multidisciplinary process. In addition to quality and safety/risk management, groups such as pharmacy, nursing, and medicine should be included because they can act to minimize errors.

The assessment and analysis of medication errors should be consistent and systematic with a focus on individual processes within the medication-use system. There are several methods for evaluating medication errors that use process improvement techniques. Three of these include the following:

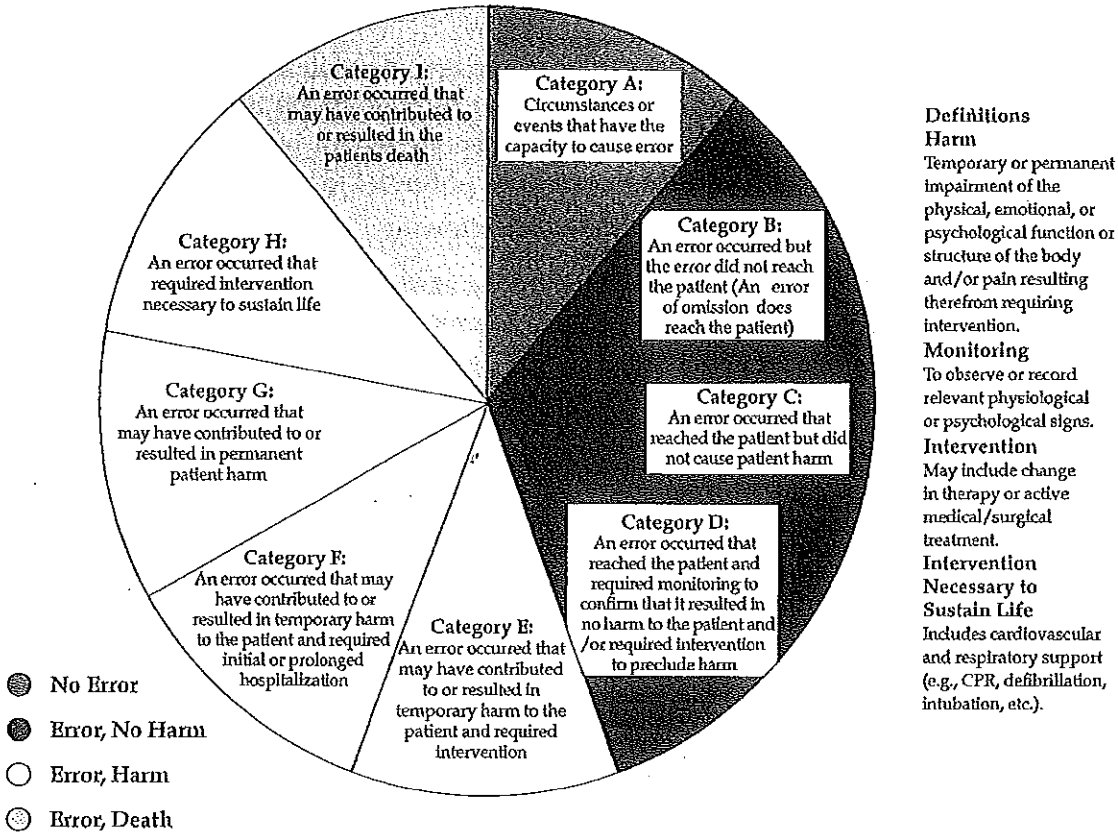
1. *Root cause analysis*—This method identifies the underlying ("root") causes of the error. Ways to improve system processes to reduce the potential for recurrence of the error are then identified, implemented, and evaluated.
2. *Failure mode and effects analysis*—This method has been used extensively in the aerospace and automobile industries. It involves the systematic analysis of processes to identify where and how errors may occur and their potential effects. Remedies are then identified and implemented to eliminate or minimize the reoccurrence of the error.
3. *Plan, Do, Check, Act (PDCA) process improvement cycle*—This approach is a continuous process composed of the following four components:
   - *Plan*—understanding the process and developing an action plan to improve the process
   - *Do*—testing the action plan on a small scale
   - *Check*—analyzing the effect of the action
   - *Act*—fully implementing the action (or reassessing the action taken and choosing another action)

Many variations of this method have been used in hospitals. A popular variant of this method is the Rapid Cycle Improvement (RCI) approach. This involves the implementation of rapid, sequential PDCA cycles to improve systems and processes in a short period of time.

Tools that can aid in evaluating medication errors include the following:

1. A standard definition of a medication error (e.g., the NCC MERP definition)
2. A standard system for categorizing errors by type (e.g., the ASHP medication error types)
3. Forms for gathering and tabulating medication error data. Data useful for tracking and trending errors include
   - type of error
   - cause of error
   - type of medication
   - type of patient (e.g., age group and gender)
   - area or patient care unit where error occurred
   - shift
   - medical service
   - categories of personnel involved
   - action taken
   - supportive treatment given to the patient
4. Standard indexes for categorizing errors. NCC MERP has developed an index for categorizing and reporting medication errors (see Figure 34-1). An algorithm that aids in categorizing errors can be obtained from their website at www.nccmerp.org.

FIGURE 34-1. NCC MERP Index for Categorizing Medication Errors



Source: Reprinted with permission from Reference 11. Adopted by NCC MERP on July 16, 1996, revised Feb. 20, 2001 from: Hartwig SC, Denger SD, Schneider PJ. Severity-indexed, incident report-based medication error-reporting program. *Am J Hosp Pharm.* 1991;48:2611–6.

5. Medication error rate calculations. There are several methods for calculating medication error rates. Two common methods include determining the number of errors per doses administered or calculating the number of errors per patients admitted or patient days. There are no "standard" or "national" error rates because so many factors can vary between healthcare organizations. These factors include number of beds, patient mix, types of medications used, definition of medication error, and the effectiveness of detection and reporting processes. Each organization should establish a benchmark rate by analyzing error rates over a period of time. The benchmark rate can be used as a threshold for assessing medication errors. When the threshold is exceeded, the medication-use process should be evaluated. However, for certain critical, high-risk medications, all occurrences should be evaluated to detect any problems in the medication-use process.

There are two national programs that collect information about medication errors, USP's Medication Errors Reporting Program (MERP) and the MedWatch program operated by the FDA. The information gathered by these agencies is shared with healthcare organizations and manufacturers so problems can be identified and improvements made. Recently, the USP implemented the MedMARx program, a national, anonymous, confidential database of medication errors. This subscription program enables participating healthcare facilities to report and analyze medication errors using standardized reporting elements. It also provides comparisons with other facilities of similar demographics so that benchmarks can be established.

Prevention and Reduction of Medication Errors

To reduce potential medication errors and maintain system improvements, a medication safety program must be comprehensive and emphasize improvement within the whole system. As emphasized previously in this chapter, most medication errors result from multiple weaknesses in the medication-use system. Focusing on one incident or component of the system does not produce lasting solutions. A team-based approach is needed for building and sustaining a medication safety program that effectively reduces the potential for errors.

Key elements of an effective program include the following:

1. Involvement of all disciplines
2. Provision of needed resources and support
3. A "just" culture of safety that emphasizes learning and a shared accountability for good system design and good behavioral choices of staff
4. Identification of high-risk steps in the medication-use system
5. An organized plan to systematically implement improvements in the medication-use system
6. Education and competence assessment of staff and patients (in addition to educating and assessing staff, it is important to educate and assess the competence of patients to manage their medication therapy)
7. Communication of current, accurate patient and drug information, in a timely manner, to all who need it
8. Appropriate use of technology

Medication System Improvement

Medication safety improves when potential sources of error are eliminated from the medication-use system with improvements such as the following:

1. Standardized and simplified systems
2. Work environments that minimize distractions, stress, and fatigue (e.g., minimal interruptions, sufficient lighting, uncluttered workspace, and adequate staff)
3. Centralized error-prone procedures that are performed by well-trained, competent staff
4. Double checks and safeguards in processes
5. Less reliance on memory in medication-use activities

Examples of improvements in medication-use processes that can eliminate or reduce sources of medication errors are outlined below.

Selecting, Procuring, and Storing

- Remove unneeded medications from the formulary. When adding new medications to the formulary, evaluate the potential for similar names and packaging.
- Ensure that medication storage areas are organized and uncluttered. Do not store more than one product in a single bin.
- Do not store medications with similar names or packaging together in medication storage areas and automated distribution cabinets.
- Use product labels on shelves and bins that differentiate between similar names using bold type, color, and/or Tall-Man lettering (e.g., DOPAmine, DOBUTamine).
- Place name alert warnings on areas where look-alike, sound-alike medications are stored.

- Use unit-dose packaging as much as possible.
- Minimize floor stock and night stock.
- Store high-risk and hazardous products in isolated or locked areas.
- Separate adult and pediatric strengths of medications.
- Ensure the use of an effective recall procedure.
- Do not store lethal concentrations of medications in patient care areas (e.g., concentrated potassium chloride injection).
- Do not store chemicals, reagents, and other hazardous nondrug items with medications.
- Ensure all medication storage areas are inspected regularly. Outdated, contaminated, and unusable medications should be removed.
- Use premixed products and standardized concentrations of medications to minimize compounding and calculations.

Ordering and Transcribing

- Avoid verbal orders except in emergencies.
- Read back verbal orders. Spell out medication names and pronounce each digit of a number (e.g., "one five" instead of "fifteen") to confirm accuracy.
- Write complete orders (i.e., medication name, dosage form, dose, strength, route, frequency, and the rate, method, and site of administration). Include both the brand and generic names for medications with look-alike, sound-alike names.
- Write or print orders legibly or use a computerized order entry system.
- Include the patient's age and, if appropriate, weight on the order to enable a double check of the appropriate dose.
- Use only standard abbreviations approved by the facility. Avoid dangerous abbreviations and symbols. Do not use abbreviations for medication names (e.g., HCTZ, AZT). Table 34-4 lists examples of abbreviations that are commonly misinterpreted and should not be used.
- Use standard names for medications. Terms such as "GI cocktail" are nonspecific and strengths and ingredients may vary between facilities.
- Use the metric system to express quantities (except for products that use standard units such as insulin, vitamins, and some immunologics). Avoid the use of the apothecary and avoirdupois systems that use easily misinterpreted symbols and abbreviations.
- Use Arabic numerals to express numbers. Avoid the use of Roman numerals which are easily misread.
- Include proper spacing between medication names and doses and between doses and dosage units (e.g., metoprolol40mg" can be mistaken for "metoprolol 140 mg).
- Do not use unnecessary decimal points or terminal zeros after a decimal point (e.g., write 25 mg rather than 25.0 mg). Decimal points may be hidden by lines on the order sheet or may not reproduce on a copy.
- Place a zero in front of a leading decimal point (e.g., write 0.5 mg instead of .5 mg).
- Avoid the use of decimals when possible (e.g., write 500 mg instead of 0.5 g).
- Express dosages in strengths (e.g., milligrams) rather than dosage form units (e.g., 2 tablets, 1 vial). An exception would be some oral combination products.

TABLE 34-4. Dangerous Abbreviations

ABBREVIATION	INTENDED MEANING	COMMON ERROR	RECOMMENDATION
U[a]	Units	Mistaken as a zero or a four (4) or six (6) resulting in overdose Also mistaken for *cc* (cubic centimeters) when poorly written	Write out *units*
IU[a]	International Units	Mistaken as *IV* (intravenous) or *10* (ten)	Write out *International Units*
µg	Micrograms	Mistaken for *mg* (milligrams) resulting in a 10-fold overdose	Use *mcg* or write out *micrograms*
Q.D.,[a] QD,[a] q.d.,[a] qd[a]	Latin abbreviation for every day	The period after the *q* has sometimes been mistaken for an *i*, and the drug has been given *qid* (four times daily) rather than daily Also, can be misinterpreted to mean *OD* (right eye)	Write out *daily*
Q.O.D.,[a] QOD,[a] q.o.d.,[a] qod[a]	Latin abbreviation for every other day	Misinterpreted as *qd* (daily) or *qid* (four times daily) If the *o* is poorly written, it looks like a period or *i*	Use *q other day* or write out *every other day*
SC, SQ, sub q	Subcutaneous	SC mistaken as *SL* (sublingual); SQ mistaken as *5 every;* the *q* in *sub q* mistaken as *every* (e.g., *sub q 2 hr before surgery*)	Write *subcut* or *subcutaneously*
TIW	Three times a week	Misinterpreted as *three times a day* or *twice a week*	Write out *three times a week*
D/C	Discharge; also discontinue	Patient's medications have been prematurely discontinued when D/C (intended to mean *discharge*) was misinterpreted as *discontinue,* because it was followed by a list of drugs	Write out *discontinue* and *discharge*

TABLE 34-4. Dangerous Abbreviations (Continued)

ABBREVIATION	INTENDED MEANING	COMMON ERROR	RECOMMENDATION
HS	Half strength	Misinterpreted as the Latin abbreviation *HS* (hour of sleep)	Write out the strength of the medication; writing out *at bedtime* is preferred over using *HS*
cc	Cubic centimeters	Mistaken as *U* (units) when poorly written Also, can be read as two zeros	Use *mL* or write out *milliliters*
AU, AS, AD	Latin abbreviation for both ears; left ear; right ear	Misinterpreted as the Latin abbreviation *OU* (both eyes); *OS* (left eye); *OD* (right eye)	Write out full intended meaning (e.g., both eyes, both ears)
×4d	For 4 days	Misinterpreted as *for 4 doses*	Write out intended meaning (e.g., *for 4 days* and *for 4 doses*)
MS,[a] MSO4[a]	Morphine sulfate	Mistaken as *magnesium sulfate*	Write *morphine sulfate*
MgSO4[a]	Magnesium sulfate	Mistaken as *morphine sulfate*	Write *magnesium sulfate*

[a]Item included on the do-not-use abbreviation list of The Joint Commission's National Patient Safety Goal 2B.

Source: Adapted with permission from Reference 12.

- Do not express dosages in volume alone. Volume may be used along with a strength or concentration (e.g., 5 mL of a 10 mg/mL solution). Volume may also be used for combination products and certain external products (e.g., lotions, creams, eye drops).
- Do not use vague directions for use (e.g., take as directed, use as needed).
- Include the indication for the medication on "prn" orders (e.g., q 4 hr prn pain).
- Do not use "blanket" orders (e.g., "continue home meds," "resume pre-op meds").
- Indicate the reason for ordering the medication (e.g., for cough, for nausea) unless inappropriate. This extra safety measure ensures that the appropriate medication is dispensed, especially for look-alike, sound-alike medications.
- Minimize the need to transcribe orders. Use standardized, preprinted orders and computer order entry as much as possible.
- Differentiate look-alike, sound-alike medication names on computer order screens using safeguards such as bold type, color, and Tall-Man letters. Configure screens to prevent potentially confused medications from appearing consecutively.

- Install computer alerts to warn of potential problems such as doses exceeding dose limits and look-alike, sound-alike medications.

Dispensing and Preparation

- A pharmacist reviews all orders before medication dispensing and administration except in emergency situations.
- Clarify orders that are incomplete, illegible, or ambiguous.
- Clarify unusual doses and number of dosage units. When clarifying an order, rewrite the entire order.
- Maintain patient profiles that contain current, accurate information.
- Ensure that a pharmacist reviews the patient information before dispensing (e.g., medication profile, allergies, age, height, weight, diagnoses, pregnancy/lactation status).
- Double-check transcription of orders into manual or computerized patient profiles.
- Reconcile pharmacy patient medication profiles with MARs daily.
- Perform an independent double check of all calculations.
- Label medications clearly and accurately. Avoid handwritten labels.
- Dispense oral liquid medications in oral syringes or unit-dose cups. Do not use syringes intended for parenteral products to dispense nonparenteral products.
- Prepare all IV admixtures in the pharmacy to the greatest extent possible.
- Place cautionary labels on dangerous medications (e.g., chemotherapy) and unusual concentrations of medications (e.g., concentrated lidocaine).
- Ensure that labels do not obscure important information or markings on the medication container (e.g., name of base solution, measurement markings on syringes).
- Read labels on medication containers three times (i.e., when removing medication from storage, when preparing or packaging medication, and when returning medication to storage).
- Ensure that a pharmacist checks all work done by technicians.
- Use independent double checks in the dispensing process. One person should enter the order in the computer, another checks the label against the order and the product before dispensing.
- Use a unit-dose medication distribution system to the fullest extent possible.

Administering

- Ensure that personnel who administer medications are knowledgeable and competent about medication use, including use of administration devices.
- Identify patient before administering medications by confirming two patient-specific identifiers.
- Review patient information (e.g., medication profile, allergies, age, height, weight, diagnoses, pregnancy/lactation status) before administering medications.
- Differentiate look-alike, sound-alike medication names on automated distribution cabinet screens using safeguards such as bold type, color, Tall-Man letters and similar name alerts.
- Double-check transcription of orders to MARs.
- Minimize measuring and calculations.

- Perform an independent double check of dosage calculations.
- Establish safe intravenous administration guidelines for all nursing areas. The guidelines should include limits, precautions, special monitoring parameters, and maximum infusion rates/doses. Review guidelines prior to administration of medications.
- Use standardized dosage and infusion rate charts to ensure accurate administration of critical care and dangerous drugs (e.g., dopamine and heparin).
- Use written protocols whenever possible.
- Perform independent double check of settings on infusion devices. Use devices that prevent free-flow of medications. Use "smart pump" technology.
- Verify medication orders before administration.
- Clarify orders that are illegible, incomplete, or unusual (e.g., large volumes or number of dosage units). When clarifying an order, rewrite the entire order.
- Do not remove medications from unit-dose packaging until immediately before administration.
- Read labels on medication containers three times (i.e., when selecting or preparing medications, prior to administration, and when disposing of medication container or returning to storage).
- Before administering medications, verify the following: The right patient, the right medication, the right dose, the right route, and the right time.
- Record administration of medications promptly after administration.
- Use automated systems (i.e., direct-order entry, computerized MARs, bar coding) that are interfaced to reduce transcription errors, enable review of patient information, and facilitate accurate administration.
- Provide accurate, up-to-date information about medications that is accessible to personnel who administer medications.
- Provide counseling to patients and/or caregivers at the time of administration (i.e., name of medication, reason for use, and effects). This serves as an additional safety check.

Monitoring

- Provide ongoing monitoring of patients to determine if desired therapeutic effects of medications are achieved as well as monitoring for undesirable or unexpected effects.
- Monitor patients for toxic doses, adverse drug reactions, interactions, and contraindications.
- Use appropriate monitoring methods such as laboratory tests (e.g., drug serum concentrations, serum creatinine), measurements of body functions (e.g., blood pressure), and direct observation of the patient for signs and symptoms of change in status. Ensure timely reporting of critical test results.

Barriers to Improving Medication Safety

There are many barriers, such as financial, legal/regulatory, technological, corporate culture/management, and human resources, that can prevent improved medication safety.[1] Table 34-5 lists examples of each type of barrier. These barriers must be identified and managed by each healthcare organization to ensure that the most effective medication safety program is in place and that it produces long-term improvements.

TABLE 34-5. Barriers to Improving Medication Safety

TYPE OF BARRIER	EXAMPLES
Financial	Reduction in available financial resources resulting from reduced reimbursements from third-party payers and increased cost of products and labor Cost of system redesign and new technologies Cost of personnel needed to implement and maintain new systems and technologies Reluctance of drug manufacturers to name, label, and package medications in a manner that minimizes errors
Legal/regulatory	State regulations restricting use of technical personnel in medication distribution activities
Technological	Lack of bar-coded products Lack of interfaces between technologies Design weaknesses in technologies
Corporate culture/management	Fear of discipline, intimidation, and embarrassment Fear of litigation Lack of incentives and rewards for reporting medication errors Reluctance to replace immediate, convenient systems with safer systems that may be more time consuming Lack of cooperation between disciplines Lack of support from leadership Primary focus on passing Joint Commission surveys Lack of emotional support for personnel involved in medication errors Focus on individuals rather than system weaknesses as the cause of medication errors Reluctance to standardize and eliminate sources of error
Human resources	Shortage of pharmacists, pharmacy technical personnel, and nursing personnel Understaffing and staff turnover Lack of essential skills and knowledge about medications, computers, etc. Lack of staff time to participate in surveillance and reporting