

This appendix includes summaries of several articles that identify different types of medication errors, a table illustrating varied medication error rates among studies, and a list of references cited in the appendix.

### **I. Types of Medication Errors Administering the Wrong Dose**

Folli et al. examined errant chart orders in two large pediatric hospitals (Ref. A-1). The study defined an errant chart order as a potentially lethal error if certain consequences (such as cardiopulmonary arrest if administered at the dose ordered) resulted. The authors found that incorrect doses and missed doses were the most prevalent errors. Overdoses accounted for 55 percent of the dosing errors, while underdoses led to 26.9 percent of all errors.

In a study of adverse events in hospitalized patients, Leape et al. reviewed 30,195 randomly selected hospital records and identified 1,133 patients whose disabling injuries were caused by medical treatment (Ref. A-2). Errors in dose or method of use accounted for 42 percent of all errors.

In a study of two urban teaching hospitals, Kaushal et al. found dosing errors to be the most frequent medication error (which the authors defined as errors in drug ordering, transcribing, dispensing, administering, or monitoring) and the most frequent preventable adverse drug event (Ref. A-3).

Lesar et al. conducted a study of prescribing errors at a teaching hospital (Ref. A-4). The authors' review of 289,411 medication orders revealed 905 prescribing errors that were detected and averted, and overdoses and underdoses accounted for 28.7 and 17.8 percent of total errors respectively.

McCarthy, Kelly, and Reed studied the medication administration practices of school nurses (Ref. A-5). The authors found that 48.5 percent of school nurses surveyed reported medication errors, and overdoses or double doses were the third most commonly reported error (22.9 percent of medication errors).

#### *Administering a Drug to a Patient Who Is Known to Be Allergic*

In the Lesar review of medication orders, 6.7 percent of all medication order errors that were detected and averted involved prescribing a drug to a patient who is allergic to the prescribed drug (Ref. A-4).

In an article by Classen et al. involving a case control study of all

patients admitted to a hospital in a 3-year period, medication errors due to known drug allergies represented 1.5 percent of all adverse drug events, and all were preventable (Ref. A-6).

#### *Administering the Wrong Drug to a Patient or Administering a Drug to the Wrong Patient*

A study by Thur et al. observed how nurses in two surgical units prepared to administer parenteral admixtures (which the authors defined as including only fluids to which one or more drugs were added directly into a single or primary bottle) (Ref. A-7). The authors defined "medication error" as including the administration of the wrong drug or solution, the wrong dosage of a drug or solution volume, an unordered or discontinued drug, or two or more pharmaceutically incompatible drugs in the same admixture. The study involved 100 observations where 331 parenteral admixtures were prepared; unordered drugs accounted for 3 percent of the errors that were observed. In one instance, the drug was administered two times per day for 4 days, even though the order for the drug had been discontinued earlier.

In the Classen et al. article that involved a case control study, of 905 prescribing errors that were detected and averted, 1.1 percent of all errors involved prescribing a drug to the wrong patient (Ref. A-6).

#### *Administering the Drug Incorrectly*

In the study by Kaushal et al. that examined 10,778 medication orders at two urban teaching hospitals, errors involving the drug's route of administration were the second most common form of medication error and accounted for 18 percent of the medication errors (Ref. A-3). These medication errors also accounted for the third-most common form (14 percent) of potential adverse drug events, which the authors defined as a medication error having a significant potential for injuring a patient.

#### *Administering the Drug at the Wrong Time or Missing Doses*

In a study of two pediatric critical care units by Tisdale, "wrong time" errors, which were defined as medications administered 30 minutes before or after the scheduled administration time, were the most prevalent error and accounted for a 16 percent error rate (Ref. A-8).

In McCarthy, Kelly, and Reed's study of school nurses, of the 315 school nurses who reported a medication error,

251 cited missed doses as the most common medication error (Ref. A-5).

In their study of the relationship between medication errors and adverse drug events, Bates, Boyle, et al. found that 53 percent of the medication errors surveyed involved at least one missing dose of medication (Ref. A-9).

A recently published study by Barker et al. examined 36 institutions in Colorado and Georgia and found that 19 percent of the doses administered were in error and that the most prevalent error (at 8 percent of the medication errors) was "wrong time" medication errors (Ref. A-10). The authors defined "wrong time" as administration of a dose more than 60 minutes before or after the scheduled administration time, or a 30 minute window for medications that were ordered before, with, or after a meal. However, the "wrong time" medication error rate ranged between zero percent for some nonaccredited hospitals in Georgia to 26.2 percent for a nonaccredited hospital in Colorado.

### **II. Frequency of Medication Errors**

Table 1 illustrates the variation in medication error rates among several studies. Some studies suggest a medication error rate of under 7 percent, whereas others suggest a rate at or above 20 percent. The differences may be due, in part, to different definitions of medication error or different research methodology that focused on fatalities, injuries, or medication orders.

**TABLE 1.—MEDICATION ERROR RATES  
REPORTED IN VARIOUS STUDIES**

Study	Definition of Medication Error Used	Medication Error Rate
Observation of nurses in two surgical units by Thur (Ref. A-7).	"Medication error" defined as wrong drug or solution; wrong dosage of a drug or solution volume; an unordered or discontinued drug; or two or more pharmaceutically incompatible drugs in the same admixture.	21%.