Prescribing Errors Involving Medication Dosage Forms

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CONTEXT: Prescribing errors involving medication dose formulations have been reported to occur frequently in hospitals. No systematic evaluations of the characteristics of errors related to medication dosage formulation have been performed.

OBJECTIVE: To quantify the characteristics, frequency, and potential adverse patient effects of prescribing errors involving medication dosage forms.

DESIGN: Evaluation of all detected medication prescribing errors involving or related to medication dosage forms in a 631-bed tertiary care teaching hospital.

MAIN OUTCOME MEASURES: Type, frequency, and potential for adverse effects of prescribing errors involving or related to medication dosage forms.

RESULTS: A total of 1,115 clinically significant prescribing errors involving medication dosage forms were detected during the 60-month study period. The annual number of detected errors increased throughout the study period. Detailed analysis of the 402 errors detected during the last 16 months of the study demonstrated the most common errors to be: failure to specify controlled release formulation (total of 280 cases; 69.7%) both when prescribing using the brand name (148 cases; 36.8%) and when prescribing using the generic name (132 cases; 32.8%); and prescribing controlled delivery formulations to be administered per tube (48 cases; 11.9%). The potential for adverse patient outcome was rated as potentially “fatal or severe” in 3 cases (0.7%), and “serious” in 49 cases (12.2%). Errors most commonly involved cardiovascular agents (208 cases; 51.7%).

CONCLUSIONS: Hospitalized patients are at risk for adverse outcomes due to prescribing errors related to inappropriate use of medication dosage forms. This information should be considered in the development of strategies to prevent adverse patient outcomes resulting from such errors.

KEY WORDS: medication errors; error prevention strategies; medication dosage forms; adverse drug events.


Medication prescribing deficiencies are the most common cause of actual and potential adverse drug events.1–3 Factors related to prescribing errors include: inadequate drug therapy knowledge; inadequate consideration of patient characteristics; dose calculations; nomenclature; and dosage formulation.4 Detailed understanding of these contributing factors is useful in designing and implementing improvements in the medication use system.4–6 Medication dosage formulation is an important method of improving the utility of pharmacologic agents.7,8 Common goals of medication dosage form design include: improving drug bioavailability; allowing administration via alternative routes; providing “delayed” or “sustained” drug delivery; improving patient convenience; facilitating use in different indications; facilitating use in special populations (such as pediatrics); and facilitating final dose preparation processes. As a result, many medications are available in a number of different dosage forms and dose sizes. While substantial patient benefit and convenience are achieved through the proper use of available medication dosage formulations, inappropriate use of dosage forms poses risk to the patient.9–15 We have previously reported that prescribing errors involving medication dosage forms accounted for more than 10% of all errors detected in a long-standing medication errors detection and prevention program.4–7,10,46,47 The risk of such prescribing errors is compounded by the substantial deficiency in the understanding of medication dosage formulation issues by many health care professionals.11–14 The ever-growing number and complexity of available medication dose formulations are likely to result in growing risk to patients.9

Considering the available evidence,4,6,9–17 it appears that the risk to patients from errors involving medication dosage forms is under-appreciated, under-reported, and poorly understood. Increased awareness and improved understanding of the nature of such errors will be useful in the design and implementation of error reduction initiatives. The purpose of this study was to characterize prescribing errors involving or related to medication dosage forms.

METHODS

Identification of Medication Prescribing Errors

The study was conducted in a 631-bed tertiary care teaching hospital located in northeastern New York State. Medication prescribing error data used for study analysis were collected over the period of January 1, 1996 to December 31, 2000, as previously described.4–6,46,47 All
medication orders either written by or cosigned by a credentialed prescriber during the study period were included in the analysis. Medication orders were handwritten or in the form of preprinted order sets. Copies of the original orders were sent to the pharmacy via facsimile or via pneumatic tube. All medication orders were reviewed and entered into the pharmacy computer system by staff pharmacists prior to dispensing. Staff pharmacists routinely utilized all available information resources to evaluate medication orders for appropriateness. Following the identification of medication orders potentially in error, the pharmacist contacted the prescriber or a cross-covering provider to obtain additional information and to discuss the orders in question. Potential prescribing problems were defined as medication orders that involved: the wrong patient, drug, dose, dosing frequency, route of administration, or dosage form; inappropriate indication for use; inappropriate combinations of drugs; documented allergies to ordered medications; contraindicated therapy; missing critical information; and other miscellaneous problems. The medication order(s) in question were either confirmed as correct as written, or were clarified, changed, or discontinued following the discussion between the pharmacist and the physician. All identified problem orders that were jointly determined by the physician and the pharmacist to require a “correction” and that were subsequently changed were considered to be “confirmed problem orders.” All confirmed medication prescribing problems were further reviewed by a clinical pharmacist within 24 hours and by the author within 72 hours. This secondary review was to ensure that the proper actions were taken and to assure provision of appropriate therapy. Problem orders that were determined by the secondary review to be in error were then defined as “confirmed medication prescribing errors.”

The significance of each error was determined based on the general potential of the error to be carried out, and if carried out as ordered, to result in adverse consequences, either an increased risk of adverse effects or an inadequate therapeutic response. Orders that were unlikely to be carried out because of product characteristics, physical and mechanical factors, or the drug distribution and preparation processes of the hospital, etc., were not considered significant. Assessment of the potential adverse outcome of each error was based on available patient and pharmacologic information regarding the risk for adverse events. The potential significance of errant orders was evaluated using a previously described rating scale, and rated as either “Potentially Fatal or Severe,” Potentially Serious,” or “Potentially Significant.”

(See Appendix A). Consistency and reproducibility of assigning an error severity classification to specific errors has been previously validated. Examples of error ratings are as follows. Potentially fatal/severe: ordering amphotericin B at the dose for amphotericin B lipid complex; potentially serious: ordering “Humalog 70 units q AM” instead of Humulin N; and potentially significant: ordering “verapamil SR 240mg per tube q 24h.”

Errors related to dosage forms were defined as those in which there was an order for the inappropriate use of a specific dosage form, an order for the wrong dosage form (errors of commission), or the failure to specify the correct dosage form when more than 1 dose form is commonly available (error of omission). A classification schema for dosage form errors was developed based on evaluation of errors prior to September 1, 1999 (Table 1). All prescribing errors involving dosage formulation issues classified as at least “clinically significant,” i.e., either “potentially fatal/severe,” “potentially serious,” or “potentially significant” were included in this study.

All “clinically significant” medication prescribing errors involving medication dosage forms detected between January 1, 1996 and December 31, 2000 were used to determine trends in annual number of detected dosage form–related prescribing errors. Errors detected between September 1, 1999 and December 31, 2000 were evaluated in detail to provide a current assessment of medications involved, type of error, and the nature and severity of potential adverse effects had the order been carried out.

RESULTS

Frequency of Errors

A total of 1,115 confirmed “clinically significant” medication prescribing errors involving or related to medication dosage formulation were detected during the years 1996 to 2000. The total number of detected errors, and number of errors per 100 admissions and number per 1,000 new medication orders detected increased annually over this period (Fig. 1). Four hundred two confirmed “clinically significant” medication prescribing errors involving medication dosage forms were detected and averted from September 1, 1999 to December 31, 2000. These 402 errors were further evaluated for current determination of error characteristics, medications involved and potential for adverse outcomes. During these 16 months, errors were detected at a rate of 1.23 per 100 admissions, 1.84 per 1,000 patient days and 0.61 per 1,000 new medication orders.

Error Types and Medications Involved

Of the 402 errors detected between September 1, 1999 and December 31, 2000, the most common types of errors were: failure to specify controlled release formulation (total 280 cases; 69.7%), which included prescribing using the brand name (148 cases; 36.8%) and using the generic name (132 cases; 32.8%); prescribing controlled delivery formulations to be administered per tube (48 cases; 11.9%); and prescribing controlled delivery dosage forms to be administered “as needed” when either a continuous “around the clock” effect was indicated or the more rapid onset of effect from a noncontrolled delivery formulation was appropriate (30 cases; 7.5%). Table 1 lists the frequency of each type of error detected.