Patient Safety

What Do We Know About Medication Errors in Inpatient Psychiatry?

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Providing care to patients always involves the possibility of causing unintended harm. Some types of unintended harm, such as hospital-acquired infections and adverse drug events (ADEs), are reported as causing alarming rates of patient injury and death, as well as substantial—and potentially preventable—expenditures of health care dollars.[1] For example, the Centers for Disease Control and Prevention has reported that approximately 2 million patients in the United States acquire infections each year while hospitalized, resulting in 88,000 deaths and an annual cost of $4.6 billion.[2] Cost estimates of medical errors are similarly staggering. The Institute of Medicine (IOM) report *To Err Is Human* estimated that preventable health care–related injuries cost from $17 to $29 billion annually, and half of these costs are direct health care costs.[1] In a study of medical errors in a large teaching hospital, the annual cost of errors was estimated at $5 million.[3] The same study estimated that the total annual cost of errors in all acute care facilities was $20 billion. The enormity of such personal and financial costs is an impetus to better understand the impact of medical errors on all patients, including hospitalized psychiatric patients.

Like hospital-acquired infections, ADEs have been increasingly implicated as a cause of substantial morbidity and mortality. Historically, psychiatrists have been successful in recognizing one category of ADE resulting from the use of psychopharmacologic agents: adverse drug reactions (ADRs). Examples of ADRs include the following:

- Movement disorders such as acute dystonia, drug-induced parkinsonism, and tardive dyskinesia;
- The neuroleptic malignant syndrome;

Article-at-a-Glance

Background: Adverse drug events (ADEs) have been implicated as a cause of substantial morbidity and mortality. Psychiatrists have successfully characterized one category of ADE—adverse drug reactions (ADRs), which have been studied from a medication-specific psychopharmacology frame of reference. The literature on ADEs, both preventable and nonpreventable, was reviewed within the broader patient safety framework.

Methods: English-language studies involving ADEs and medication errors in psychiatry for 1996 through 2003 were identified on MEDLINE and by using a hand search of bibliographies.

Results: Few reports on the incidence and characteristics of medication errors in psychiatric hospitals could be found. Psychiatrists may not be sufficiently aware of the harm caused by errors, methodological issues regarding error detection, the validity of reported medication error rates, and the challenge of creating a nonpunitive error-reporting culture.

Prevention strategies: Application of a systems-oriented approach to ADE reduction and the promotion of a nonpunitive culture are essential. Clinical and pharmacy staff could monitor the literature for published reports of preventable adverse events and review those reports in multidisciplinary team meetings.

Conclusions: Psychiatry would benefit from learning about the terminology used in describing medication errors and ADEs. Relatively few data are available regarding the frequency and consequences of medication errors in psychiatry; more research is needed.

- The serotonin syndrome;
- Obesity;
- Insulin resistance;
- Sexual dysfunction;
- QTc (Q-T interval corrected for heart rate) prolongation and torsade de pointes; and
- Various drug–drug interactions, especially through competitive inhibition of hepatic microsomal enzymes.

These ADRs have been studied from a medication-specific psychopharmacology frame of reference. In this article, we shift to a broader patient safety frame of reference, with a focus on the inpatient psychiatric setting, and examine preventable and nonpreventable ADRs. We also discuss medication errors and potential ADEs.

There are few reports of preventable ADEs or medication errors in inpatient psychiatry[4]; most data regarding ADEs come from general care settings. To assess the current state of knowledge in this area, we performed a review of the literature on medication errors and ADEs in inpatient psychiatry (one finding is that terms such as *ADEs*, *medication errors*, and *ADRs* are not yet listed as key words for search purposes in some widely read psychiatric journals.) We also provide an overview of ADEs and definitions of related terms commonly used in the general medical literature; a review of the stages of the medication process, including prescription, transcription, administration, dispensing, and monitoring; and a description of errors specific to each portion of the medication process. We then discuss issues regarding reporting of ADEs and medication errors. Finally, we discuss potential prevention strategies, including computerized physician order entry (CPOE), and conclude with recommendations that psychiatry adopt the medical error and ADE nomenclature used in the general medical literature.

Methods

Identification of Studies

To identify studies assessing the frequency and consequences of medication errors and ADEs in psychiatry, in late 2002 we performed an extensive search of the literature. English-language studies involving ADEs and medication errors in psychiatry were identified by reviewing the following keywords in MEDLINE from 1966 to 2002: *medication error*, *adverse drug event*, and *adverse drug reaction*—all cross-referenced with the term *psychiatry*. In addition, we hand searched the bibliographies of original and review articles and cross-checked relevant references with references identified through the computer search. Two of the authors [B.C.G., R.G.] initially screened titles and abstracts of the search results and then independently reviewed and abstracted data from articles identified as relevant. Studies were included in the review if they contained original data on medication errors or ADEs in psychiatry. All disagreements were settled by consensus of the two reviewers.

This search of the literature produced a substantial number of reports on medical errors in general, including studies of medication error rates, error detection methodologies, performance improvement initiatives focused on increasing error detection and reporting and decreasing error rates, and the use of informatics to diminish ADEs.[5–99] Virtually all these studies were conducted in general care hospitals.

Definitions

An *ADE* is an injury related to the use of a drug. It may range in severity from insignificant—such as a mild rash—to fatal. Some ADEs, such as complications of chemotherapy or unpredictable allergic reactions, are not preventable. Others are due to errors and are by definition preventable. An ADR, as defined by the World Health Organization (WHO), is a complication caused by a drug when used in the usual manner and dosage.[100] Although the WHO definition implies that there has been no error in the use of the drug, the definition is often broadened to include complications caused by misuse.

The National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) define a *medication error* as follows:

> A medication error is any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer. Such events may be related to professional practice, health care products, procedures, and systems, including prescribing; order communication; product labeling, packaging, and nomenclature; compounding; dispensing; distribution; administration; education; monitoring; and use.[101]

Although the NCC MERP definition is adequate in scope, we propose a more concise definition, as follows:

> Any error in identifying an indication for, prescribing, omitting, transcribing, compounding, dispensing, administering, assessing, and documenting a patient's capacity to understand and correctly use medication, teaching proper use, or monitoring and documenting a patient's response to, medication.

The Inpatient Medication Process

The medication ordering sequence involves prescribing a medication, transcribing the order from the order sheet to the medication administration record (MAR), sending the order to the pharmacy, transcribing the order into the pharmacy computer system, dispensing the medication from the pharmacy to the floor, administering the medication to the patient based on the MAR, documenting the administration of the medication, and assessing the medication's effect on the patient. The sequence has multiple subcomponents, and seemingly innocuous errors can result in patient harm.

In the traditional paper chart model, a prescriber evaluates a patient's condition and writes an order in the chart. Before writing the order, the prescriber interviews the patient, reviews the psychiatric and medical history, reviews drug allergies, considers laboratory data, considers probable ADRs, and attempts to match the patient's symptom profile and predisposition to incur certain side effects with the selection of a medication. In a study by Leape et al,[62] lack of correct patient-specific and lack of correct medication-specific information (Table 1, right) were the two leading causes of prescribing errors.

An order is transcribed when a nurse reads a medication order and transcribes it as written onto the MAR. With CPOE, the order is electronically sent to the pharmacy as prescribed. Whether an order is transcribed by hand or transmitted electronically, the nurse plays a pivotal role in independently reviewing the prescription, the transcribed order represented in the MAR, the medication dispensed by pharmacy, and the medication administered to the patient. Therefore, the nurse's knowledge of medications is of great consequence, regardless of the system used to prescribe medication (Table 2, p 394).

Table 1. Categories of Prescribing Errors*

- The absence of an indication for the drug.
- A medication is contraindicated.
- A medication order conflicts with known allergies.
- The medication is indicated, but the dose is inappropriate.
- The dosing frequency is inconsistent with the drug's pharmacokinetic profile.
- The order is illegible.
- The order is incomplete regarding:
  - drug
  - dose
  - frequency
  - route of administration
  - the indication for a prn order
  - the time interval for a prn order
- The dose is changed without discontinuation of prior order.
- The use of nonapproved abbreviations:
  - trailing 0 (eg, 1.0 mg)
  - use of U for units (eg, 10U Humulin vs 10 units Humulin 100 insulin)
  - absence of a leading zero (eg, .1 mg)
  - QD versus qday
  - use of X3d (could be doses or days)
  - use of D/C (confusion of *discharge* vs *discontinue*)
- The time interval for a prn order is not specified.
- The drug allergy designation is absent.

* prn, as required; QD, every day.

An order that has been transcribed is transmitted (often by fax) from the nursing station to the pharmacy. The pharmacist must then verify the correctness of the order, enter the order correctly into the pharmacy database, select the correct drug and dose, and dispense the drug to the floor (Table 3, 394).

To administer a drug without error, the nurse must correctly read and interpret the MAR, select the drug, and administer the right drug in the right dose to the right patient at the right time. The administration of the drug is then recorded on the MAR (Table 4, p 395), either

Table 2. Categories of Transcribing Errors*

- An order is not transcribed.
- An order is transcribed incorrectly for:
  - drug
  - dosage
  - frequency
  - identity of the patient
- A medication is discontinued without a physician order.
- There is more than 1 medication written in a box on the MAR.
- An order is transcribed after the first dose was scheduled to be given.
- An order is not faxed to pharmacy.
- An order is not faxed to the pharmacy on time.
- A drug allergy is not documented on:
  - the MAR
  - the physician order sheet

* MAR, medication administration record.

Table 3. Categories of Dispensing Errors

- An order is incorrectly entered or not entered in the pharmacy computer.
- An order is incorrectly filled by pharmacy staff.
- An order is incorrectly checked by the pharmacist.
- A cart fill error (or unit-based cabinet fill error) is committed by the pharmacy technician.
- A cart fill error (or unit-based cabinet fill error) is missed by the pharmacist.
- An error occurs in delivery of the drug.
- A significant potential drug–drug interaction is not reported by the pharmacy to the prescriber.

manually or electronically, depending on the type of system in place. After a drug is administered to the patient, the nurse administering the drug monitors and documents its effectiveness.

Incidence of Psychotropic ADEs in General Medical Settings

Studies addressing the incidence of psychotropic ADEs in general medical settings have primarily examined ADRs. Prior studies of ADEs associated with psychotropic medication were conducted either as part of larger general medical–surgical studies or of other ADE-reporting databases or were restricted to geriatric populations in nonpsychiatric restricted settings such as nursing homes and ambulatory clinics. For example, the U.S. Food and Drug Administration (FDA) recently reported 6,894 deaths from ADRs, including 848 (12.3%) deaths due to psychotropic medications[102]—which represented the third-largest category of drugs after antineoplastic/immunosuppressive drugs and cardiovascular drugs.

Other data have come from large studies using prospective cohorts and active detection approaches. In an 18-month study in a tertiary care hospital that used computerized monitoring to identify ADEs, Classen et al found 701 ADEs, including 18 due to psychotropic drugs (2.4%).[25] In a study using several active detection approaches, including daily chart review, among 4,031 medical–surgical inpatients, Bates and colleagues found 247 ADEs resulting in 6.5 events per 100 admissions, of which nearly one-third were judged to be preventable.[11] Although psychotropic medications were responsible for only 2% of the ADEs, they represented 7% of the preventable ADEs. In a more recent study of hospitalized patients, Bates et al found that psychotropic drugs accounted for 0.41% of serious medication errors. After implementing CPOE and a team intervention to prevent ADEs, this rate fell to 0.16% (p = .15).[15] In a study using pharmacist detection of prescribing errors with potential for harm in a teaching hospital, Lesar and colleagues found that among 11,186 errors, 146 (1.3%) were associated with psychotropic medications.[103]

Older patients may be particularly vulnerable to the harmful effects of psychotropic medications.[104] There are multiple reasons, including more frequent use of psychotropic medications among the elderly, increased susceptibility to drug effects, the greater risk of drug–drug interactions associated with polypharmacy use among older patients, and the increased difficulty in differentiating ADEs from changes in a patient's signs and symptoms.[105] In a 1-year study of 18 nursing homes, Gurwitz et al reported that among 546 ADEs (1.89 per 100 resident-months), 193 (35%) were due to psychotropic medications.[106] A greater proportion of ADEs due to psychotropic medications (63%), as compared to all other

Table 4. Categories of Administration Errors*

- A dose is missed (due to transcription process).
- A scheduled dose is not documented as administered.
- The medication is given to the wrong patient.
- The medication is given at the wrong time.
- The wrong dose is administered.
- The medication is administered via the wrong route.
- The medication is given in the wrong form.
- A medication is administered without a physician order.
- The time of an administered prn dose is not noted on the MAR.

* prn, as required; MAR, medication administration record.

drug classes (43%), was judged to be preventable. Falls are a particular risk among elderly patients who are prescribed psychotropic medications. Several studies have found the attributable risk of falls due to commonly used psychotropic drugs to be 1.7 to 2.0.[107,108] It is noteworthy that in a meta-analysis of psychotropic drugs and falls in the elderly,[109] only 2 of the 54 cited studies were conducted in inpatient psychiatric settings.

It is possible that psychotropic medications are disproportionately prescribed for older patients by internists and family practice physicians, as compared with psychiatrists. Studies have found that psychotropic medications represented 23% of inappropriate medication orders prescribed in nursing homes.[110] Older adults in ambulatory settings received an even higher proportion of inappropriate psychotropic medications (27% to 44%).[111,112]

Incidence of Medication Errors in Psychiatric Hospitals

We were able to find only a single published report on the incidence of ADEs occurring in inpatient psychiatric settings: a 1984 epidemiologic study of state psychiatric hospitals, which reported that 75% of randomly selected patients experienced ADRs.[113] However, its findings may not be generalizable because of methodological issues and inconsistencies with current ADE definitions. Another study of ADEs included both inpatient and outpatient settings and focused on the frequency, severity, causes, and costs of ADEs in an integrated system of care that included medical and psychiatric patients.[4] In this setting, medication errors were implicated in 13.6% of psychiatric readmissions, with medication noncompliance (considered part of the usual lexicon of medication errors) being implicated in 69% of hospitalizations. The rate of ADEs during psychiatric hospitalization was 4.2 events per 100 admissions. A related study examined the impact of ADEs on the need to transfer patients to a medical facility. Researchers at McLean Hospital found for a 2½-year period that 29 (0.26%) of 10,994 psychiatric inpatients required transfer to general hospitals because of ADRs.[114] However, overall rates of ADRs were not determined, and medication errors were not addressed. Other studies have addressed psychiatric admissions caused by ADRs to inpatient psychiatric units[115–117] and the impact of clinical pharmacists' interventions on the safety of psychiatric patients.[118]

We are unaware of any report of medication error rates among psychiatric inpatients other than a study we completed in 2002.[119] In our study, we retrospectively examined medication error rates for 31 patients during a 2-month period of hospitalization in a state psychiatric hospital. The usual modality of self-reporting of errors using incident reports yielded a rate of 9 errors per 1,448 patient days. When we convened a multidisciplinary team to independently review the same charts and patient days, we detected 2,194 errors per 1,448 patient days, resulting in a ratio of team-reported versus self-reported errors of 244:1. We also rated all detected errors for clinical significance. Of the 2,194 errors, 19% had the potential to cause minor harm, 23% had the potential to cause moderate harm, and 58% were rated as having the potential to cause severe harm.

Two studies in general care settings also examined the incidence of errors and compared self-report to another method of error detection. In one study Bates et al identified 530 errors in 10,000 orders at Brigham and Women's Hospital (Boston) and reported a ratio of detected to self-reported errors of ~1,000:1.[11] In a study using computerized error detection, Classen et al found 1,731 ADEs, which, when compared with 9 errors from self-report, yielded a ratio of 81:1.[25] The results of these three studies suggest that the widespread use of self-reporting as a methodology for determining medication error rates may substantially underestimate actual error rates.

Prevention Strategies

In recent years, considerable progress has been made in developing and researching strategies for decreasing ADEs.[120] Specific prevention strategies have been divided into short term—generally lower in cost, more circumscribed in scope, and therefore more easily implemented immediately—and long term—those costing more and that are more complex to implement.[121] Two elements are essential as the foundation for successful prevention strategies: application of a systems-oriented approach to ADE reduction[43,122,123] and the promotion of a nonpunitive culture that rewards error reporting.[63,120,123,124] Examples of short-term strategies relevant to inpatient psychiatry include the following:

- The use of medication ordering protocols for drugs that have a narrow therapeutic index and/or might be unsafe to initiate or resume without laboratory data (for example, lithium carbonate, clozapine, carpamazepine, divalproex);
- The use of unit-dose distribution systems in which medications are individually prepackaged and delivered in the exact dose to the point of administration;
- Access to drug information at the time of prescribing by including a clinical pharmacist in rounds and immediate drug database access using personal digital assistants (PDAs);
- Nurse and physician orientation and periodic education regarding the prescribing, transcribing, dispensing, and administration process; and
- Better patient education in the use of their own medications.[63,121,125]

In addition, clinical and pharmacy staff would benefit from systematically monitoring the literature for published reports of preventable adverse events and from reviewing these reports in scheduled multidisciplinary team (such as patient safety team) meetings, which would stimulate performance improvement initiatives directed at further prevention of adverse events. Safety alerts from the Joint Commission on Accreditation of Healthcare Organizations, the Institute for Safe Medication Practices, the FDA and others can also be valuable sources of anecdotal reports on patient safety that are not reported in published journals and not accessible through MEDLINE searches.

Informatics is being used to automate portions of the inpatient medication process by improving checks and controls in pharmacy software systems, incorporating machine-readable coding (bar coding) to ensure that the right drug is administered to the right patient, and preventing prescribing errors by using CPOE.[26,119,121,125] CPOE is capable of dramatically reducing the rates of many prescribing errors, such as inaccurate dosing, incomplete orders, incorrect routes of administration, and illegibility. When utilizing integrated software, the prescriber has current drug information including dosing, monitoring parameters, and potential ADRs prior to entering an order. CPOE also provides automated checks for allergies, drug interactions, and contraindications. CPOE systems can be integrated into other hospital data systems that include patient-specific clinical, demographic, and laboratory data.

There is empirical support for the success of medication error reduction after implementation of CPOE. One study conducted at Brigham and Women's Hospital in Boston demonstrated a 55% decrease in error rates,[15] and serious errors dropped by 88% in a subsequent study by the same group.[16] In another study conducted at LDS Hospital in Salt Lake City, CPOE implementation resulted in a 70% reduction in ADEs.[126] Limitations of CPOE include cost, complexity of installation and integration with existing hospital information management systems, maintenance, prescriber training needs, and prescriber resistance. A number of vendors now have CPOE products available.[127]

A simpler, less expensive application of informatics has been the use of PDAs. We reported on their use to enable electronic access to dictated admission evaluations and daily-updated patient medication profiles for nine full-time medical staff, at a total direct cost of less than $8,000.[44] In another study, we used PDAs to access each patient's list of discharge medications and to directly transcribe them from the PDA by using a printer with an infrared port.[45] Using this method, we reduced errors in the transcription of discharge medications from 22% to 8%.

Conclusions

Psychiatry has a rich history of researching, detecting, reporting, and successfully managing ADRs. Tardive dyskinesia is a prototypical ADR among psychiatric

patients treated with conventional antipsychotic agents, and its causes, clinical characteristics, incidence, risk factors, and proposed treatments have been widely researched.[128] Psychiatrists have also been successful in considering a medication's likely ADRs as well as intended therapeutic effects when matching a patient with a medication. On the other hand, there are few reports in the psychiatric literature of medication errors or preventable ADEs. The absence of data on medication errors increases the likelihood that psychiatrists are underestimating the significance of medication errors and the harm they can cause.

We believe that medication errors in inpatient psychiatry deserve more study. There should be a standardized, empirically validated methodology for medication error detection and reporting in psychiatric hospitals. Benchmarks for acceptable medication error rates in inpatient psychiatric settings should be established. Hospital-based psychiatrists need to know a hospital's methodology of error detection, the reported error rates, and current or future performance improvement initiatives that are under way to better detect, report, and rectify errors. If our studies of inpatient psychiatric settings and general care settings are considered, self-reporting of errors has missed 244–1,000 errors per each error detected by other means. If similar differences between the rates of self-reported and actual errors exist at other psychiatric hospitals, this would represent a substantial opportunity for improvement in psychiatry.

We also believe that psychiatry should adopt the widely accepted lexicon of medical error terms and definitions. Patients would benefit if psychiatrists and their medical and surgical colleagues spoke a common language when detecting, reporting, and managing ADEs. This might also increase awareness among psychiatrists that ADEs include not only ADRs but also medication errors. Broader incorporation of medical error terminology and performance improvement initiatives might also lead to a more standardized means of rating and comparing the quality of psychiatric care in hospital settings. Unintended harm from other modalities of psychiatric treatment may also meet the definition of *error* under certain conditions. Examples include suicide by patients undertreated for depression, the induction of mania in at-risk patients given antidepressants without mood stabilizers, and delirium induced by excessive doses and/or numbers of psychotropic medications. Recognition of such events as errors might prompt more vigilance in monitoring for such events and treating them.

Advances in pharmacogenomics may someday prevent ADEs that are currently nonpreventable by individualizing drug therapy on the basis of a patient's genetic makeup.[129] Genetic factors responsible for varying patient drug responses include genes responsible for drug-metabolizing enzymes, drug receptors, and drug transporters.[130] Variations—or polymorphisms—in the genes that code for an individual's ability to metabolize a drug may result in variable degrees of potential harm from patient to patient. The ability to identify individuals who manifest such polymorphisms would enable prevention of some ADEs.

Finally, fear of punishment may deter the reporting of errors. The establishment of a nonpunitive culture must accompany the incorporation of the mainstream lexicon of medication error terminology and a broader awareness of medical errors in psychiatry. Administrative and clinical leaders are responsible for establishing systems and an ethos that rewards frequent and open reporting of errors and the use of educational review to improve error-prone processes. Inherent in a nonpunitive culture is the recognition that most errors are systems issues and not issues of badly performing individuals. Fear of punishment should not be allowed to interfere with developments that diminish harm to patients. J

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