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Medication safety in a psychiatric hospital

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Abstract

Objective: We sought to assess the epidemiology of medication errors (MEs) and adverse drug events (ADEs) in a psychiatric hospital.
Methods: We conducted a 6-month prospective observational study in a 172-bed academic psychiatric hospital. Errors and ADEs were found by way of chart review, staff reports and pharmacy intervention reports. Physicians rated incidents as to the presence of injury, preventability and severity of an injury. Serious MEs were nonintercepted MEs with potential for harm (near misses) and preventable ADEs.
Results: We studied 1871 admissions with 19,180 patient-days. The rate of ADEs and serious MEs were 10 and 6.3 per 1000 patient-days, respectively. Preventable ADEs accounted for 13% of all ADEs (25/191). The most common classes of drugs associated with ADEs were atypical antipsychotics (37%). Nonpsychiatric drugs accounted for only 4% of nonpreventable ADEs but were associated with nearly one third of all preventable ADEs and near misses. MEs were most frequently associated with physician orders (68%), but there was also a high rate of nursing transcription errors (20%).
Conclusions: ADEs and serious MEs were common among psychiatric inpatients and similar to rates in studies of general hospital inpatients. Medication safety interventions targeting psychiatric care need further study.

Keywords: Medication errors; Psychiatry; Psychopharmacology; Patient safety

1. Introduction

The pharmacologic treatment of psychiatric disorders has improved in recent years. Specifically, many new psychopharmacologic agents have been developed; some of which have proved to be highly effective. As a result, many acute and chronic psychiatric illnesses can now be treated much more effectively than a decade ago. However, while these new agents have better side-effect profiles than many of the older drugs, the potential for medication errors (MEs) and adverse drug events (ADEs) continues to be an important problem. Furthermore, the psychiatric population is growing older (reflecting the demographics of the overall population), and many of these patients are receiving many other nonpsychiatric medications that may be unfamiliar to psychiatric providers.

In 1999, the groundbreaking report of the Institute of Medicine (IOM) brought national attention to the problem of preventable adverse events including many due to medications [1]. While substantial information regarding the frequency and prevention of MEs and ADEs in hospitalized patients is available [2–5], most of these studies have included few or no psychiatric patients. Specific populations such as critically ill patients and ambulatory oncology patients have been demonstrated to pose particular challenges

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to safe medication use [6,7]. The limited data available suggest that the psychiatric inpatients represent another high-risk population who pose particular challenges [8]. We previously found that ADEs were disproportionately frequent on psychiatric units compared with medical and surgical units; moreover, these ADEs were especially costly [2]. However, to date, few medication safety studies have been conducted in psychiatric hospitals [9]. A more recent IOM report, *Improving the Quality of Health Care for Mental and Substance-Use Conditions*, found only a "handful of studies" of ADEs in inpatient psychiatric hospitals [10].

Recently, a task force of the American Psychiatric Association (APA) recommended focusing on medication safety as one of the initial patient safety activities with high priority for psychiatric practice [11]. In order to develop effective patient safety strategies, it is necessary to better understand the epidemiology of inpatient psychiatric medication safety; we therefore conducted a prospective study of the incidence and nature of MEs and ADEs in the inpatient psychiatric setting.

2. Methods

The study was conducted prospectively between September 1, 2004, and February 28, 2005. The institutional review boards of the participating sites approved the study.

2.1. Study site

The study hospital was a 172-bed academic psychiatric hospital in the New England area. The hospital pharmacy receives nearly 70,000 medication orders and dispenses over 740,000 units of medications during a 6-month period. The study was conducted on six patient care units (133 beds), including an acute inpatient psychiatric satellite unit that was remote from the main campus. The on-campus study units included a dissociative disorders and trauma unit, a schizophrenia and bipolar disorders unit, a geriatric unit, an acute psychiatric short-term unit and a dementia and Alzheimer's short-term unit.

Medication orders were paper based. Both resident and attending psychiatric physicians wrote orders. In addition, hospital-based internists were available for medical consultation and comanagement of complicated medical patients. The main campus pharmacy was staffed during daytime and evening hours until 11 p.m. on weekdays and until 8 p.m. on weekends. The satellite unit used the main campus pharmacy for weekday delivery of medications. Staff nurses used unit-based pharmacy stock for urgently needed medications at the satellite unit and during the night at the main campus. Patients requiring continuous intravenous medications or telemetry monitoring required transfer to a medical hospital for subsequent care.

Structured admission order forms were available at the time of admission. Medication administration records (MARs) were maintained by staff nurses. A new MAR was recreated using manual transcription at or near the end of every 7 days of a patient's hospitalization. Diabetes management flow sheets, standardized supplemental insulin sliding scale order forms and anticoagulation (warfarin) dosing and test result flow sheets were not in use at the time of the study. Desktop computers were not readily available for drug information lookups, although some physicians used handheld computers [or personal digital assistants (PDAs)] with drug reference guides as resources. Pharmacists did not routinely round with physicians but were available for telephone consultations.

2.2. Definitions

We used definitions from prior inpatient medication safety studies [2]. MEs included errors during medication ordering, transcribing, dispensing, administering and/or monitoring. We excluded from analysis those MEs with little or no potential for harm. ADEs were injuries due to a medication and were classified as preventable (associated with an ME) or nonpreventable. An example of a nonpreventable ADE would be initiating lamotrigine at recommended doses to a patient with no prior allergy history who then develops a severe rash. An example of a preventable ADE would be administering lamotrigine to a patient with a known allergy to the medication who then develops Stevens–Johnson syndrome. A *near miss* or *potential* ADE was an ME that had the potential to cause harm but did not because it was either intercepted before reaching the patient (*intercepted near miss*) or reached the patient and fortuitously did not cause harm (*nonintercepted near miss*). *Serious* MEs were those that reached the patient and had the capacity to cause injury and included nonintercepted near misses and preventable ADEs. Intercepted near misses were excluded from this category because successful safety interventions can be expected to result in an increase in interceptions of these near-miss events.

2.3. Data collection and medication incident determination

Prior to study collection, nurse and physician leaders and the chief of pharmacy met with the research team to describe the medication processes used in the study hospital. Nurse researchers with experience in chart abstraction underwent training provided by study researchers with experience in prior medication safety research and a psychiatrist with expertise in psychopharmacotherapy.

Suspected MEs and ADEs or incidents were identified by methods detailed in our prior work [2]. Briefly, three methods were used for finding suspected medication incidents. First, chart abstraction was conducted on alternate weekdays, and findings were entered into structured data collection forms. Physician and nursing progress notes, medication orders, MARs and pertinent test results were reviewed. Secondly, solicited reports from both nursing and physician staff were also used to assist in incident finding. Lastly, nursing and pharmacy intervention reports were reviewed. We used institutional psychopharmacologic dosing guidelines, including research protocols, to determine dosing errors.

Suspected incidents were presented to two physicians, including an internist with experience in prior medication safety studies (J.M.R., D.W.B.) and a psychiatrist (K.M., J.A.C.), to independently rate incidents as to the presence of an ME and/or ADE. Physician raters judged severity using a four-point Likert scale (*significant*, *severe*, *life threatening*, *fatal*) and preventability using a five-point Likert scale (*prevented*, *definitely preventable*, *probably preventable*, *probably not preventable*, *definitely not preventable*), with the preventability scale collapsed to preventable or not preventable prior to analysis. Rater disagreements were resolved by discussion.

MEs were categorized as harmful or not and mapped to the National Coordinating Council for Medication Error Reporting and Prevention Levels E–I and B–D, respectively [12]. Serious MEs were analyzed for injury severity or potential severity as well as systems-related factors. ME stages were categorized as ordering, transcribing, dispensing, administration and monitoring. Error types such as wrong doses or known drug allergy were also identified. Incidents not rated as ADEs or MEs with potential for harm were excluded.

2.4. Statistical analysis

Incident rates were assessed as incidents per 1000 patient-days and per 100 admissions. Statistical programming was performed using SAS analytical software [13]. Interrater agreement was assessed using the kappa (κ) statistic.

3. Results

A total of 1559 patients with 1871 admissions and 19,180 patient-days were included in the study (Table 1).

Table 1
Characteristics of patients ($n=1559$) and admissions ($n=1871$)

Characteristics	Value
Age in years, mean (S.D.)	43.4 (18.5)
Female, *n* (%)	970 (62.2)
Length of stay in days, mean (S.D.)	10.25 (9.9)
Admission source, *n* (%)	
Transfer from general hospital	587 (31.4)
Physician or ambulatory center referral	435 (23.3)
Emergency department	423 (22.6)
Home	299 (16)
Skilled nursing facility	54 (2.9)
Other psychiatric hospital	33 (1.7)
Other	40 (2.1)
Primary diagnosis (*DSM-IV*), *n* (%)	
Mood disorders	1242 (66.4)
Depressive	659 (35.2)
Bipolar	429 (22.9)
Other	154 (8.2)
Schizophrenia and other psychotic disorders	249 (13.3)
Dementia	113 (6)
Other organic disorders	87 (4.7)
Adjustment disorders	71 (3.8)
Anxiety, dissociative and somatoform disorders	46 (2.5)
Other	63 (3.4)

DSM-IV, *Diagnosis and Statistical Manual of Mental Disorders, Fourth Edition* classification system.

Table 2
ADEs and near misses

	Severity or potential severity, *n* (%)			Rate[a]
	Significant	Serious	Life threatening	
ADEs [$n=191$]	127 (66)	60 (31)	4 (2)	10
Preventable [$n=25$]	17 (68)	6 (24)	2 (8)	1.3
Nonpreventable [$n=166$]	110 (66)	54 (33)	2 (1)	8.7
Near misses (potential ADEs) [$n=178$]	86 (48)	85 (48)	7 (4)	9.3
Intercepted [$n=83$]	35 (42)	42 (51)	6 (7)	4.3
Nonintercepted [$n=95$]	51 (54)	43 (45)	1 (1)	5
All MEs[b] [$n=203$]	103	91	9	10.6
Serious MEs[c] [$n=120$]	68	49	3	6.3

[a] Events per 1000 patient-days.
[b] All medication errors are intercepted and nonintercepted near misses and preventable ADEs.
[c] Serious medication errors are nonintercepted near misses and preventable ADEs.

The most common reasons for admission were mood disorders and schizophrenic disorders. The levels of interrater agreement for incident type, ADE severity, near-miss potential severity and incident preventability were good to excellent (.85, .49, .57 and .97, respectively).

3.1. Adverse drug events

We found 191 ADEs including 25 (13%) that were preventable and 166 (87%) that were classified as non-preventable (Table 2). The rate of ADEs was 10 per 1000 patient-days and 10.2 per 100 admissions. The severity of harm for most ADEs was significant (66%) with fewer being serious (31%) and life-threatening (2%) events. There were no fatal ADEs. The organ systems most frequently affected by ADEs were the central nervous system (127/191; 66.5%), cardiovascular (18/191; 9.4%) and

Table 3
Drug categories

	Preventable ADEs (error) [$n=25$]	Nonpreventable ADEs (no error) [$n=166$]	All ADEs [$n=191$]	Near misses (potential ADEs) [$n=178$]
Psychiatric, *n* (%)	17 (68)	159 (96)	176 (92)	124 (70)
Antipsychotic, atypical	8 (32)	63 (38)	71 (37)	41 (23)
Mood stabilizers	5 (20)	32 (19)	37 (20)	44 (25)
Antidepressants	2 (8)	34 (20)	36 (19)	16 (9)
Antipsychotic, typical	0 (0)	14 (8)	14 (8)	4 (2)
Anxiolytic–sedative	2 (8)	11 (7)	13 (7)	16 (9)
Other psychiatric	0 (0)	5 (3)	5 (3)	3 (2)
Nonpsychiatric, *n* (%)	8 (32)	7 (4)	15 (8)	54 (30)
Cardiovascular	2 (8)	4 (2)	6 (3)	11 (6)
Diabetes Rx	3 (12)	0 (0)	3 (2)	6 (3)
Analgesic	0 (0)	1 (1)	1 (1)	7 (4)
Anticoagulant	1 (4)	0 (0)	1 (1)	4 (2)
Antimicrobial	1 (4)	0 (0)	1 (1)	3 (2)
Thyroid replacement	0 (0)	0 (0)	0 (0)	7 (4)
Other nonpsychiatric	1 (4)	2 (1)	3 (2)	16 (9)

Table 4
Systems analysis of MEs

Error stage	Ordering, *n* (%)	Transcription, *n* (%)	Administration, *n* (%)	Other[a], *n* (%)
Preventable ADEs (*n*=25)	13 (52)	5 (20)	5 (20)	2 (8)
Near misses (*n*=178)	125 (70)	35 (20)	15 (8)	3 (2)
Intercepted (*n*=83)	77 (93)	4 (5)	0 (0)	2 (2)
Nonintercepted (*n*=95)	48 (51)	31 (33)	15 (16)	1 (1)
All MEs (*n*=203)	138 (68)	40 (20)	20 (10)	5 (2)

[a] Includes pharmacy filling, monitoring and dispensing.

allergic or dermatologic reactions (13/191; 6.8%). While approximately 50% of all medication orders were psychiatric related, they were responsible for 92% of all ADEs. The most common class of drugs associated with ADEs was atypical antipsychotics (37%; Table 3). Nonpsychiatric drugs, also associated with approximately 50% of all medication orders, accounted for only 4% of nonpreventable ADEs but were associated with 30% of all preventable ADEs. Cardiovascular drugs were the most common nonpsychiatric drug class associated with near misses.

3.2. Medication errors

We found 178 near misses, including 95 nonintercepted near misses, and 25 preventable ADEs resulting in a serious ME rate of 6.3 per 1000 patient-days and 6.4 per 100 admissions (Table 2). The most common types of MEs were wrong dose (50/203; 24.6%), drug–drug interaction (DDI; 35/191; 17.2%) and omitted medication (28/191; 13.8%). MEs were most frequently associated with physician orders (68%). We also found a high rate of nursing transcription errors (20%) and administration errors (10%; Table 4). Errors during transcription and administration deserve additional consideration because they were infrequently intercepted (4/50), unlike ordering errors that were often intercepted "downstream" by pharmacists or nurses (77/125). Examples of near misses and ADEs are provided in Table 5.

Human factors and systems-related causes for errors were judged to be most frequently due to performance deficit such as a slip or lapse (34.5%), knowledge deficits (21.7%) and technical errors such as errors in transcription (19.2%) or communication errors (7.4%).

Physician raters judged that the serious MEs in this study could have been prevented by computerized physician order entry (CPOE) with decision support such as DDI and drug–dose checking (44%), basic CPOE alone to ensure legibility and completeness (16.7%) and bar-coded medication administration (BCMA) with an electronic MAR (15.2%).

4. Discussion

We found that ADEs were common in an academic psychiatric hospital; the overall rate was about a third higher

Table 5
Examples of ADEs and near misses

Event type	Preventability	Severity	Description
ADE	Preventable	Significant	A patient with a history of depression and a known allergy to sulfa drugs was started on trimethoprim/sulfamethoxazole and developed an immediate rash.
		Serious	A patient admitted with manic psychosis developed hyponatremia after starting divalproex. Urine electrolytes confirmed the diagnosis of SIADH. Salt tablets were added but the hyponatremia worsened. The divalproex was discontinued 2 weeks later.
		Life threatening	An elderly patient with a history of dementia and increasing agitation was given a total of 275 mg, po, of quetiapine and 50 mg, po, of trazodone at night. The next morning, the patient was found lethargic and fell out of bed resulting in a cervical spine fracture.
	Nonpreventable	Significant	A young patient with a history of schizoaffective disorder developed severe restlessness after an increase in the dose of risperidone. The symptoms resolved with the addition of benztropine.
		Serious	A patient with a history of schizoaffective disorder developed tremors and severe lethargy after starting perphenazine.
		Life threatening	An elderly patient with a history of bipolar disease was treated with trazodone, divalproex and clozapine. The patient developed difficulty with swallowing, delirium and unsteady gait.
Near miss	Intercepted	Significant	A young patient admitted for a suicide attempt was ordered bisacodyl (Dulcolax) 20 mg every 4 h. The order was intercepted and changed to every 4 days.
		Serious	A patient with no history of diabetes was admitted for polysubstance abuse and was ordered glargine insulin (Lantus) 10 U, sc, daily. The order was intended for a different patient but, later, the physician intercepted the error and placed the order on the correct patient's chart.
		Life threatening	A young patient with a history of substance abuse was ordered benztropine 50 mg, im or po, for chemical restraint. The order was intercepted by the pharmacy and was replaced by an order for diphenhydramine 50 mg.
	Nonintercepted	Significant	An elderly patient with Alzheimer's disease and increasingly aggressive behavior did not receive a dose of his daily morning dose of 22 U, sc, glargine insulin. His blood glucose was stable.
		Serious	A patient admitted for possible drug overdose and erratic behavior was ordered Lithobid 300 mg twice daily and ibuprofen 600 mg every 4 h as needed. The patient did not receive the ibuprofen (potential DDI).
		Life threatening	An elderly patient with a history of depression and suicidal ideation was ordered and given extended release metoprolol 125 mg instead of the correct dose of 25 mg. The patient's heart rate and blood pressure remained stable.

SIADH, syndrome of inappropriate antidiuretic hormone.

than previously found in a similar study in general hospitals, although a much lower proportion were preventable: 13% versus 28% [2]. In addition, in contrast to findings in general hospitals, there were fewer life-threatening and no fatal ADEs, possibly due to the lower potential toxicity of commonly used psychiatric medications compared with those used in general care. While ADEs due to psychotropic medications were far more common than nonpsychotropic medications, nonpsychotropic medication ADEs were more likely to be associated with an error and are, therefore, preventable. We also found many near misses, both intercepted and nonintercepted. We found a higher proportion of errors committed during the ordering (68%) and transcription stages (20%) when compared to a similar study in general hospitals (49% and 11%, respectively) [2]. However, the rate of administration errors was lower (10%) than the general hospital study (26%) [2].

This represents what could probably be the largest prospective study of medication safety that has been done in the psychiatric hospital setting. While there has been a tremendous reduction in the number of hospitalized psychiatric patients, due in large part to advances in psychopharmacotherapy, these patients still represent a large proportion of the national inpatient population. There are nearly a quarter of a million 24-h hospital and residential psychiatric treatment beds in the United States [14], and more than a quarter of all hospital admissions are for psychiatric hospitalizations [15].

This study is also important because previous studies of inpatient psychiatric medication safety have most commonly been retrospective and studied nonpreventable ADEs [also known as adverse drug reactions (ADRs)], studied psychotropic medication use among general medical–surgical patients or included psychiatric inpatients as part of general hospital medication safety studies.

A 1984 epidemiologic study of a psychiatric hospital found that 75% of randomly selected patients had suffered ADRs [16]. However, this study included very broad ADR inclusion criteria (e.g., drugs were continued without change in two thirds of patients with an ADR), and independent case reviews were not performed. A more recent study conducted at McLean Hospital found that over a 2.5-year period, among 10,994 admissions, 29 (0.26%) required transfer to a general hospital due to an ADR [17].

In a state psychiatric hospital, Grasso et al. [18] conducted a retrospective study of 31 admissions with 1448 patient-days and found 2194 MEs. Their unusually high rate of MEs was, in part, due to the inclusion of errors with little potential for harm and an unusually high frequency of missing documentation for medication administration. In a 1-day audit of 241 United Kingdom psychiatric wards, 20% of patients were prescribed total doses of antipsychotic medication that exceeded guideline recommendations [19]. These researchers found that antipsychotic polypharmacy was associated with younger age, being male, being detained for admission on a rehabilitation or forensic ward and a diagnosis of schizophrenia [20]. Following a 2003 study of MEs collected by voluntary incident reports from 44 Japanese psychiatric hospitals [21], an analysis of organizational and human factors was conducted to predict failures to intercept near misses [22]. Near misses that reached the patient were associated with patients with frequent admissions, receiving more tablets and being exposed to a higher patient-to-staff ratio during the evening shifts.

Other studies have addressed the frequency of ADEs in hospitalized patients in general and have assessed the frequency associated with psychotropic drugs. In a tertiary care general hospital setting, Bates et al. [2] found 6.5 ADEs per 100 admissions, of which nearly a third were judged to be preventable. While psychotropic medications were responsible for only 2% of the ADEs, they represented 7% of the preventable ADEs. In a later study, Bates et al. found that psychotropic drugs accounted for 0.41% of serious MEs in an academic medical–surgical hospital. After CPOE and a team intervention to prevent MEs, this rate fell to 0.16% (P=.15) [23]. In a 9-year study in a teaching hospital, Lesar et al. [5] found more than 11,000 prescribing errors, of which 146 (1.3%) were associated with psychotropic medications.

Older patients may be particularly vulnerable to the harmful effects of psychotropic medications. The reasons are multifactorial and include the following: more frequent use of psychotropic medications among the elderly, the increased susceptibility of older patients to drug effects (both intended and unintended), the greater risk of DDIs associated with polypharmacy use among older patients and the increased difficulty in diagnosing ADEs as a cause of older patients' new or worsening symptoms [24]. We found several falls that may have been associated with medications in our study. Falls are a particular risk among elderly patients who are prescribed psychotropic medications, especially SSRIs [25]. In a meta-analysis of psychotropic drugs and falls in the elderly, only 2 of 54 studies were conducted in inpatient psychiatric settings [26].

There is now a growing body of literature that addresses psychotropic ADEs in the general population and nursing homes. The FDA Medwatch reported 6894 deaths from ADRs, including 848 (12.3%) deaths due to psychotropic medications, the third largest category of drugs after antineoplastic/immunosuppressive drugs and cardiovascular drugs [27]. A recent analysis of the quality of antipsychotic drug prescribing in U.S. nursing homes found that most atypical antipsychotics were inappropriately prescribed [28]. In a 1-year study among 18 nursing homes, 35% of ADEs were due to psychotropic and antidepressant medications. A greater proportion of ADEs due to psychotropic medications (63%), as compared to all other drug classes (43%), were preventable [29]. This finding is similar to data described earlier in a hospital-based study [2] but contrasts to our finding that a higher proportion of the ADEs associated with errors were associated with nonpsychiatric medications

(8/15; 53%) rather than with psychiatric medications (17/176; 9.7%). Our findings might be explained in two ways: psychiatric medications could have a higher risk for nonpreventable adverse effects, and the total number of ADEs unrelated to error may be much greater; just as nonpsychiatrists with less experience and knowledge than psychiatrists may have led to more errors when prescribing psychiatric medications, psychiatrists may also commit more MEs when managing diabetes, anticoagulation or cardiovascular disorders.

Improving inpatient psychiatric medication safety will entail adopting lessons learned from general hospitals and other settings as well as developing strategies targeting the unique challenges of inpatient psychiatry. Leape et al. [3] found that systems-related factors are responsible for many errors in the general hospital setting, including deficient drug knowledge, deficient patient-specific information, inadequate allergy defense, lack of standardization of processes, poor communication between services and inadequate monitoring and feedback of ADEs.

It has been posited that psychiatry has been slower to address medical errors than other specialties. Dr. Miles Shore, cochair of the APA Task Force on Patient Safety, has suggested that psychiatry's "late arrival" on the medical error scene may be due to several factors [30]: the type of medical errors that come to public attention more commonly are nonpsychiatric, such as those involving invasive procedures; psychiatry practice is more private and confidential such that near misses may be less often seen or reported; and psychotherapy training's emphasis on individual responsibility may make psychiatrists less acceptable of the nonpunitive system's approach to error reduction that has been adopted in other medical specialties.

Inpatient psychiatric pharmacotherapy may be associated with different rates and types of MEs because of differences associated with psychiatric patients, psychopharmacologic agents and the psychiatric inpatient setting. For example, inpatient diabetes management is more complicated for psychiatric patients who intermittently refuse to eat or unexpectedly refuse to take their medications. Such noncompliance is rare in the general medical–surgical inpatient population. Psychiatric patients may also differ from nonpsychiatric patients with respect to their longer lengths of stay and reduced capacities to report prior drug allergies or potential active drug side effects. Characteristics of the psychiatric inpatient setting that may differ, as compared with general medical–surgical units, include lower ratios of nursing staff to patient, greater physician expertise in the use of psychotropic agents but possibly less knowledge concerning other medication classes, different nursing processes for patient monitoring and other systems-related factors. Medication regimens for psychiatric inpatients may be associated with increased risks for errors due to the greater incidence of DDIs associated with psychotropic use [31].

In recent years, several interventions have been found to be effective in reducing inpatient MEs in general care. Interventions to reduce serious MEs include CPOE [23], pharmacist participation in intensive care unit rounds [32] and medication reconciliation at hospital admission and discharge [33]. However, few safety intervention studies have been conducted in the inpatient psychiatric setting. A review of the impact of clinical pharmacists on psychiatric patients suggested that pharmacists reduced unnecessary and often costly medications [34]. In some hospitals, pharmacists function as drug information officers who are available as consultants to physicians to enhance safe medication prescribing. PDAs have been demonstrated to improve medication reconciliation at the time of discharge from a psychiatric hospital [35] and may provide additional medication safety benefits in this setting [36]. The data from this study suggest that the interventions that would prevent the largest proportion of serious MEs are CPOE with decision support and BCMA. In the study hospital, several interventions have been undertaken or are in the early planning stages and include the introduction of improved physician–nursing communication techniques [37], CPOE and an electronic MAR.

The overwhelming majority of ADEs related to psychiatric care in this study were considered nonpreventable (159/176; 90%). Advances in pharmacogenomics may provide individual drug metabolism profiles for future patients and could allow the prevention of many of these current "nonpreventable" ADEs [38].

This study has several limitations. It was conducted at a single institution so that the results may not be generalizable to other organizations or settings. Our detection approach relied on finding events from the chart, and some ADEs may have not been reported in the medical record. Assessing whether or not a specific set of symptoms are ADEs provides particular challenges in psychiatry, especially in severely ill patients, in whom it may be acceptable to have certain symptoms if a regimen appears to be effective in treating the underlying disorder.

5. Conclusions

In conclusion, this study in a psychiatric hospital showed that MEs and ADEs are common and occur with the same frequency as they do in general hospitals. They cause harm to psychiatric inpatients but tend to be less life threatening and fatal than in general hospitals. Additional studies are needed to determine which intervention strategies are most efficacious in this setting, although computerization of prescribing and implementation of BCMA appear to have great potential. In addition, strategies should address nonpsychiatric medication use especially since this is likely to result in harm.

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