

Using nurses and office staff to report prescribing errors in primary care

AMANDA G. KENNEDY¹, BENJAMIN LITTENBERG² AND JOHN W. SENDERS³

¹Research Assistant Professor of Medicine, Division of General Internal Medicine, University of Vermont College of Medicine, 371 Pearl Street, Burlington, VT 05401, USA, ²Henry and Carleen Tufo Professor of Medicine, Division of General Internal Medicine, University of Vermont College of Medicine, and ³Principal Scientific Consultant to the Institute for Safe Medication Practices (ISMP)

Abstract

Objective. To implement a prescribing-error reporting system in primary care offices and analyze the reports.

Design. Descriptive analysis of a voluntary prescribing-error-reporting system

Setting. Seven primary care offices in Vermont, USA.

Participants. One hundred and three prescribers, managers, nurses and office staff.

Intervention. Nurses and office staff were asked to report all communications with community pharmacists regarding prescription problems.

Main Outcome Measures. All reports were classified by severity category, setting, error mode, prescription domain and error-producing conditions.

Results. All practices submitted reports, although reporting decreased by 3.6 reports per month (95% CI, -2.7 to -4.4 , $P < 0.001$, by linear regression analysis). Two hundred and sixteen reports were submitted. Nearly 90% (142/165) of errors were severity Category B (errors that did not reach the patient) according to the National Coordinating Council for Medication Error Reporting and Prevention Index for Categorizing Medication Errors. Nineteen errors reached the patient without causing harm (Category C); and 4 errors caused temporary harm requiring intervention (Category E). Errors involving strength were found in 30% of reports, including 23 prescriptions written for strengths not commercially available. Antidepressants, narcotics and antihypertensives were the most frequent drug classes reported. Participants completed an exit survey with a response rate of 84.5% (87/103). Nearly 90% (77/87) of respondents were willing to continue reporting after the study ended, however none of the participants currently submit reports.

Conclusions. Nurses and office staff are a valuable resource for reporting prescribing errors. However, without ongoing reminders, the reporting system is not sustainable.

Keywords: medication errors/statistics and numerical data, medical errors/statistics and numerical data, adverse drug reaction reporting systems/classification, primary health care/methods/standards, community pharmacy services

Introduction

Recent data suggest over 1.5 million preventable adverse drug events, or injuries due to medications, occur in the United States annually [1, 2]. In outpatients older than 65 years, preventable adverse drug events are estimated to exceed 530 000 annually [3]. Approximately one-third of

outpatient adverse drug events may be preventable or ameliorable [4]. Many adverse drug events are the result of undetected medication errors. An error is 'the failure of a planned action to be completed as intended or the use of a wrong plan to achieve an aim [5]'. A medication error therefore is 'any error occurring in the medication use process [6]'.

Address reprint requests to: Amanda Kennedy; Research Assistant Professor of Medicine Division of General Internal Medicine, University of Vermont College of Medicine, 371 Pearl Street, Burlington, VT 05401, USA. Tel: (802) 847-8268; Fax: (802) 847-0319; E-mail: amanda.kennedy@vtmednet.org

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Not all medication errors cause injury. A prescribing error occurs when, 'as a result of a prescribing decision or prescription writing process, there is an unintentional significant (i) reduction in the probability of treatment being timely and effective or (ii) increase in the risk of harm when compared with generally accepted practice [7]'. Data suggest ~2% of all new prescriptions requires pharmacists to intervene with prescribers to correct or clarify prescriptions before the medication is safely dispensed to a patient [8, 9]. This roughly translates to 60 million pharmacist interventions during the dispensing of 3 billion prescriptions annually in the United States. Many of these pharmacist interventions are to correct prescribing errors, although the exact frequency is not known due to the lack of standards for classifying errors.

Voluntary error reporting has been proposed to help identify and understand medication errors [1, 5], however few studies in primary care (Internal or Family Medicine) have been published. Most of the published reporting systems involve clinician reporting and include all types of medical errors [10–12]. Medication errors are frequently reported in those systems.

The limited literature of primary care error reports suggests a high frequency of medication errors. However, more focused studies are needed to identify and describe the types of medication errors detected. Although collecting errors via self-report is difficult and likely excludes some important errors, voluntary reporting may prove useful in primary care as a basis for quality improvement. We describe a voluntary error-reporting system that was developed and implemented in our local primary care practices. The study targeted prescribing errors, a subset of all medication errors, using existing office systems. The primary reporters were nurses and office staff, since they often receive the communication from the community pharmacy that a problem has occurred.

Methods

Participants

A voluntary outpatient prescribing-error-reporting system was developed and implemented in a convenience sample of seven primary care (Internal or Family Medicine) practices in Chittenden County, Vermont. Chittenden County occupies 539 square miles of Vermont and is the only county in Vermont federally designated as urban with a population estimate of 150 000. The community has 94.8% white with a median annual income of US\$52 843 [13]. The practices reflect the demographics of Vermont primary care, with a median of five prescribers per practice, including physicians, physician assistants or nurse practitioners (range: 2–13 prescribers).

Vermont's Quality Assurance law, 26 V.S.A. Sections 1442 and 1443, provided the necessary liability and confidentiality safeguards for peer-review protections. All participating staff, nurses, managers and prescribers (physicians, nurse practitioners and physician assistants) signed statements of consent. This project was approved by the University of Vermont Committees on Human Research.

Nurses and office staff were asked to report all communications with pharmacists about prescribing problems for 6 months. These two groups of workers were selected as primary reporters because they are often telephoned by community pharmacists when there is a problem with a prescription. Depending on the nature of the problem, the nurses and staff will resolve the problem by reviewing the notes in the medical chart or by communicating with the prescriber. Rarely, the community pharmacist will request to speak to the prescriber directly. Using pharmacist communications as the signal for a potential error is somewhat limited in scope as many medication errors occur outside of this pathway. However, we wished to explore the kinds of insights about prescribing errors that can be revealed using this existing practice within primary care.

Reporting system

Nurses and office staff were asked to report whenever a pharmacist telephoned the practice (i) with a question about a prescription or (ii) to report a problem with a prescription. Although the reporting system was designed to be a job function of the nurses and staff, prescribers were also encouraged to report their own errors. Reports were submitted by telephone, mail or to a research assistant who visited each practice weekly.

We wished to explore the utility of existing office systems serving as error reports. Therefore the nurses and office staff were encouraged to use their usual methods for documenting pharmacist communications as the reports. No standard reporting form was used and there were no incentives to report. None of the practices used electronic medical records. Examples of reporting methods include notes on pre-printed message forms or medication refill forms, copies of de-identified patient chart notes and brief notes written on self-sticking message pads.

At periodic 1-h site visits, we shared data with the practices. The intervals for the site visits were determined by having gathered enough new reports or having completed the 6-month study. Frequent, dangerous or unusual errors were highlighted. A 1-page newsletter prepared by the Principal Investigator described recent de-identified reports submitted by the practice, as well as an overall summary of reports submitted by other practices.

The exit process included a thank you letter, survey and a \$1.00 lottery ticket mailed to each participant with a postage-paid return envelope. The purpose of the survey was to gather basic information from participants regarding satisfaction with the reporting system. The survey asked about several aspects of the reporting system we believed were important to satisfaction, including importance, burden, incentives, reminders and feedback. The majority of responses were dichotomous (yes/no) or based on a five-point Likert scale from strongly disagree to strongly agree. We maximized our survey response with additional mailings at 10 and 20 days after the initial letter.

Analysis

The analytic plan included analysis of the reporting system and analysis of the submitted reports. Analysis of the

reporting system included descriptive statistics of the survey results, estimation of reporting rates and linear regression comparing reports submitted over time. We used Microsoft® Excel 2002 (Microsoft Corporation, Redmond, WA) and Stata/SE, version 9.0 (StataCorp LP, College Station, TX) for statistical analyses. $P < 0.05$ was required for statistical significance.

Analysis of submitted reports included a descriptive classification. We desired a taxonomy that would be simple for prescribers to understand without additional patient safety training. Although several classification systems and taxonomies have been proposed and evaluated [14–20], none of them seemed appropriate for analyzing outpatient prescribing errors. Therefore we classified all prescription reports five ways: (i) severity, (ii) setting, (iii) error mode, (iv) prescription domain and (v) error-producing conditions (environmental, team, individual or task factors that affect performance) [21]. Severity was assigned using the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) Index for Categorizing Medication Errors [22]. Likely settings included the provider office, pharmacy or with the patient. Error modes included omission (failure to carry out the necessary steps in the prescription) [23], commission (failure to prescribe correctly) [24], no error or indeterminate. Prescription domain included drug, strength, route, dose, formulation etc. Error-producing conditions were grouped by important themes, such as confusion with abbreviations and illegibility.

A pharmacist (AK) and a physician (BL) independently assigned each report a severity category, setting, error mode and prescription domain. Since a goal of the study was to understand what can be learned using existing office systems, only the submitted reports were considered in the analysis. For example, errors were classified as reaching a patient only if the report specifically mentioned the patient being involved. Most reports did not include reasons why errors occurred. There was moderate agreement among AK and BL ($\kappa = 0.552$, standard error 0.044, $P < 0.001$).

Categorization discrepancies were resolved through discussion until consensus was reached.

Results

Participants

One hundred and three people from five Internal Medicine practices and two Family Medicine practices participated. They included 31 physicians, 8 nurse practitioners, 2 physician assistants, 26 non-prescribing nurses, 10 medical assistants, 20 office staff and 6 non-physician office managers. Data collection occurred from June 2004 through July 2005.

Reporting system

All practices contributed reports. The majority were submitted directly to the research assistant. Only seven reports (3.5%) were contributed by prescribers. Total reports per practice varied from 10 to 62 reports (median 32 reports per practice). Although the intervention was designed to be 6 months, the end date for practices was greater than 6 months due to scheduling difficulties for exit sessions with the practices (median 32 weeks, range 28–44 weeks).

Table 1 describes estimated reporting rates by practice. Total prescriptions written and total pharmacy calls per practice were not collected. On the basis of the United States physician productivity statistics and ambulatory care survey data, it is estimated that the average prescriptions written per visit is 1.7 [25] with an average of 84 visits per week by family physicians and general internists [26]. Combining these estimates yields an average of 146 prescriptions written per week by family and internal medicine physicians. The average rate of pharmacy calls to the office for clarifications is 2% [8]. These averages were used to estimate reporting rates for each of the seven practices, which ranged from 3.1 to 8.6% with a median reporting rate of 6.1%.

Table 1 Reporting rates by practice

Practice	Setting ^a	Prescribers	Weeks in study ^b	Estimated prescriptions written ^c	Estimated errors/callbacks ^d	Total reports submitted	Estimated reporting rate
1	IM	2	36	10499	210	18	8.6
2	FM	5	32	23332	467	39	8.4
3	IM	5	44	32081	642	40	6.2
4	IM	3	28	12249	245	15	6.1
5	IM	9	32	41997	840	32	3.8
6	IM	13	44	83411	1668	62	3.7
7	FM	4	28	16332	327	10	3.1
Total		41		219903	4398	216	6.1 (median)

^aIM, internal medicine; FM, family medicine.

^bAlthough the intervention was designed to be 6 months, the end date for practices was greater than 6 months due to scheduling difficulties for exit sessions with the practices.

^cOn the basis of an average of 146 prescriptions per provider per week [25–26].

^dOn the basis of 2% of prescriptions requiring callbacks [8.]

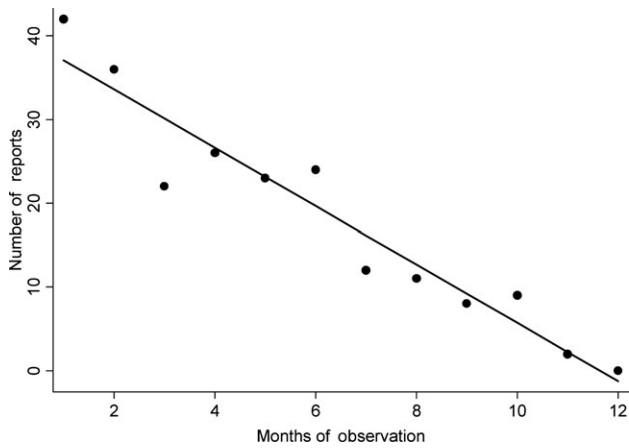


Figure 1 Linear regression of reporting over time

Overall reporting statistically decreased by 3.6 reports per month (95% CI, -2.7 to -4.4 , $P < 0.001$). See Fig. 1. After the study end date, only one report was received. None of the practices have continued to submit reports.

Submitted reports

The reports described 216 near-misses or errors, 116 unique drugs and 2 non-drug products (lancets and test strips for patients with diabetes). Over 65% (141/216) of the reports identified the medication by trade name rather than generic name. Antidepressants (38/216), narcotics (32/216) and anti-hypertensives (24/216) were the most frequent drug classes reported. Bupropion was the individual drug most often reported (12/216), followed by levothyroxine (6/216) and metoprolol (6/216). Twenty percent of near-misses or errors (43/216) concerned 'high-alert' medications or medications that 'have a high risk of causing injury when they are misused [27]' (Table 2).

Table 3 describes the severity classification of all 216 near-misses or errors according to the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) Index for Categorizing Medication Errors. One hundred and sixty-five were errors, 49 were near-misses (Category A) and 2 problems did not contain enough information to determine a severity category. Nearly 90% (142/165) of the errors were Category B, errors that did not reach the patient. Nineteen errors reached the patient without causing harm (C), and four errors caused temporary harm requiring intervention (E). We did not observe any errors in NCC MERP Categories D, F, G, H or I. Examples of reports by category are also presented in Table 3.

Table 4 describes the setting, error mode, prescription domain and error-producing conditions of the submitted reports. The majority of near-misses or errors originated within prescribers' offices. Only 16 near-misses or errors originated within the pharmacy or patient environment. Fifty-five percent of errors were commissions (90/165). The remaining errors (75/165) were omissions. Issues with strength were found in over 30% (66/216) of near-misses or

Table 2 Frequently reported medications or high-alert medications

Medication ^a	N	(%) ^b
Narcotics^a		
Codeine alone or in combination	8	
Hydrocodone in combination	8	
Oxycodone alone or in combination	8	
Methadone	3	
Fentanyl	2	
Hydromorphone	1	
Morphine	1	
Propoxyphene	1	
Bupropion	12	(5.6)
Oral hypoglycemics^a		
Acarbose	1	
Glipizide	3	
Glyburide	1	
Pioglitazone	1	
Rosiglitazone	1	
Levothyroxine	6	(2.8)
Metoprolol	6	(2.8)
Diltiazem	5	(2.3)
Trazodone	5	(2.3)
Citalopram	4	(1.9)
Escitalopram	4	(1.9)
Prednisone	4	(1.9)
Insulin ^a	3	(1.4)
Warfarin ^a	1	(0.5)

^aInstitute for Safe Medication Practices 'high-alert' medications [36]. 'High alert' medications 'have a high risk of causing injury when they are misused [27]'.
^bPercent of 216 near-misses or errors.

errors, including 23 prescriptions written for strengths not commercially available.

Illegibility was the most frequent error-producing condition. Approximately 45% (22/49) of the near-misses (Category A reports) were reports of 'illegible handwriting'. Three Category B reports also had evidence of illegibility. Confusion due to look-alike or sound-alike medication names was found in 5% (12/216) of near-misses or errors. Other error-producing conditions included multiple formulations available (11/216), calculations or decimal points (7/216), unusual schedules such as weekly doses or tapers (6/216), confusion due to abbreviations (3/216), use of multiple pharmacies (3/216) or multiple prescribers (2/216) and the availability of multiple drugs within a therapeutic class (5/216). An example of multiple drugs within a therapeutic class is prescribing 'Actos 4 mg'. The available strengths for Actos (pioglitazone) are 15, 30 and 45 mg. However, the available strengths for Avandia (rosiglitazone), a different drug within the same therapeutic class, are 2, 4 and 8 mg. Since the trade names are similar and both drugs belong to the same therapeutic class, it is possible there was confusion with the correct prescribing information for each drug.

Table 3 Frequency and examples of submitted reports according to the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) Index for Categorizing Medication Errors [22]

Severity	Reports ^a	Description (includes severity definition followed by examples ^b)
A	49	<p>Circumstances or events that have the capacity to cause error</p> <ul style="list-style-type: none"> • Was on Cozaar (losartan) 1 BID, called in as 1 daily. Correct? Per chart change to 1 daily • Amitriptyline 25 mg or 10 mg? 10 mg as was called in • We called in the script for Celexa (citalopram) to the pharmacy, but they want to know if you are decreasing to 10 mg or increasing to 30 mg. She currently takes 20 mg. MD to restart her at 10 mg
B	142	<p>An error occurred but the error did not reach the patient</p> <ul style="list-style-type: none"> • Please clarify directions for Premarin (conjugated estrogens) vaginal cream. Apply QD × 7 days then BID. Should it be QD × 7 then 2 × /week? Per MD, yes • Actonel (risedronate) 35 mg. Written for QD. Pharmacist asked to change that dose to QWeek. Okay • Pt received script written with wrong dose. Written for Synthroid (levothyroxine) 150 mg, but should have been 50 µg. Error was taken care of
C	19	<p>An error occurred that reached the patient but did not cause patient harm</p> <ul style="list-style-type: none"> • Fluoxetine called to pharmacy. Should have been paroxetine. Pt did not take fluoxetine. Med changed to paroxetine • Pt takes Toprol XL (metoprolol) 100 mg QD and is noted in her chart. I accidentally gave her Rx for 50 mg. She called us to get a new Rx • Pt brought prednisone bottle in. She was concerned that the pharmacy had filled the Rx incorrectly. However, after speaking with the pharmacist and having them fax the copy to us, it is apparent that the Rx was written incorrectly. Directions should read 20 mg 2 PO daily (not QID) Pt was clear that she had been told to take two pills daily. This was then verified by the chart note and also by a phone call to the provider
D	0	<p>An error occurred that reached the patient and required monitoring to confirm that it resulted in no harm to the patient and/or required intervention to preclude harm</p>
E	4	<p>An error occurred that may have contributed to or resulted in temporary harm to the patient and required intervention</p> <ul style="list-style-type: none"> • Patient prescribed Synthroid (levothyroxine) 0.25 mg. Pharmacy filled prescription as 0.025 mg. Patient alerted MD who wrote a new prescription. Patient went to a second pharmacy with the correct prescription and again received 0.025 mg. Pt suffered 1 month without correct Rx and felt lethargic and swollen • Pt reports that insulin she picked up yesterday is clear—usually cloudy. Advised to check with pharmacy. Pharmacy reports discrepancy with what we called in and what they heard. Will give her Novolog Mix (insulin aspart 70/30) syringes. Pt received regular insulin rather than mix. Pt called and had a headache all day. Also hungry. Advised to check blood sugars throughout day. Will go pick up correct insulin from pharmacy and take as prescribed • Ortho-Cyclen (ethinyl estradiol/norgestimate) received. Thinks pills are different. Different color and also experiencing moodiness, diarrhea and heavy period. Per pharmacy, Ortho-Cyclen (ethinyl estradiol/norgestimate) dispensed. Rx changed to Ortho-Cept (ethinyl estradiol/desogestrel)
F	0	<p>An error occurred that may have contributed to or resulted in temporary harm to the patient and required initial or prolonged hospitalization</p>
G	0	<p>An error occurred that may have contributed to or resulted in permanent patient harm</p>
H	0	<p>An error occurred that required intervention necessary to sustain life</p>
I	0	<p>An error occurred that may have contributed to or resulted in the patient's death</p>

^aThe 49 Category A reports do not meet the definition of 'error'. Two reports could not be classified and are listed as unknown. Therefore, of the 216 identified problems, only 165 are classified as errors.

^bThe examples of submitted reports included the following changes from the original reports: limited editing for ease of reading; generic names added in parentheses in reports that only include trade names.

Table 4 Taxonomy for classifying prescribing errors

Category	N
Setting	
Prescriber office	199
Pharmacy	12
Patient	4
Unknown	1
Error mode	
Commission	90
Omission	75
Prescription domain	
Strength	67
Medication name	25
Multiple problems or entire prescription	20
Frequency	16
Quantity	15
Dose	14
Directions	14
Formulation	12
Signature	10
Patient name	9
Date	7
Refills	3
Prescriber information	2
Form	1
Route	1
Error-producing conditions	
Illegible	25
Look-alike or sound-alike medication names	12
Multiple formulations available	11
Calculations or decimal points required	7
Unusual dosing schedules	6
Multiple options within a therapeutic class	5
Confusion with abbreviations	3
Use of multiple pharmacies	3
Multiple prescribers	2

Exit survey

84.5% (87/103) of participants completed the exit survey (Table 5). The survey respondents included 33 prescribers, 24 nurses, 6 medical assistants, 16 office staff and 5 managers. Three respondents did not list their profession. Seventy-eight (68/87) were female and 92% (80/87) were white. Over 90% of respondents stated that the reporting system is important to patient care (77/85) and will improve patient care (76/84). Nearly 60% (60/87) of respondents stated a standard reporting form would have improved the system. Interestingly, respondents were undecided about having more reminders and feedback. Approximately half of respondents agreed or were neutral that more reminders and feedback were needed. Nearly 90% (77/87) were willing to continue participating in the reporting system after the study ended. Only two respondents indicated that the reporting system was burdensome to them and to their office. One

Table 5 Survey responses

The prescription error reporting system	Strongly or mildly disagree		Strongly or mildly agree		Total responses
	N	(%)	N	(%)	
1 Was a burden to me	77	(90.6)	2	(2.4)	85
2 Was a burden to my office	71	(84.5)	3	(3.6)	84
3 Is important to patient care	1	(1.2)	77	(90.6)	85
4 Will improve patient care	2	(2.4)	76	(90.5)	84
5 Should have had more incentives for me	66	(78.6)	2	(2.4)	84
6 Should have had more incentives for my office	62	(73.8)	3	(1.2)	84
7 Should have had more reminders	38	(45.2)	26	(31.0)	84
8 Should have provided more feedback	42	(51.2)	23	(28.0)	82

Participants who responded neutral to the eight survey questions are as follows: 1) six, 2) ten, 3) seven, 4) six, 5) sixteen, 6) nineteen, 7) twenty, 8) seventeen.

respondent was neutral about personal burden, but indicated that the system was burdensome to their office.

Discussion

We successfully implemented a prescribing-error-reporting system in busy outpatient primary care practices using existing office systems. This approach required minimal provider and staff effort. The system was easily transferable from practice to practice, despite operational differences in handling pharmacist communications. Providers, nurses, office staff and managers overwhelmingly accepted the system, with most willing to continue their involvement. However, none of the practices have continued to send reports.

It is unclear why the reporting system failed to work beyond the study. Although there was disagreement among the survey respondents about the need for more reminders and feedback, it is likely that some intervention is required to keep participants active. Given the decrease in submitted reports over time during the study, it is likely that our reminders and feedback were insufficient to create a sustainable system.

Errors in strength, dosage form [28] and decimal point or calculations [29] have been reported in the literature for more than 30 years. Why should these types of errors still be reported? First, reporting is important for local surveillance

and education. Our data suggest feedback to providers about prescribing bupropion and strengths not commercially available would be useful for local quality improvement efforts. Second, reporting promotes a discussion of error. Since the majority of reports concerned circumstances or errors that did not reach the patient, prescribers discussed the errors without fear of litigation. Third, reporting is hypothesis-generating for strategies that may then undergo rigorous testing. For example, error reports stimulated us to develop and test a modified prescribing form [30]. Reports may be used to stimulate other 'basic science' research into the understudied nature of error [31]. Lastly, reporting can help evaluate new technology after implementation. Although computerized technology is widely promoted as a means of reducing prescribing errors, these systems do not prevent all types of prescribing errors, have induced new errors and have questionable generalizability [32–35]. Reporting systems detect unanticipated errors and can guide revisions of new technology.

The strengths of this reporting system include simple design, outpatient focus, easy translation to multiple primary care offices and minimal disruption of the office. The system allows for local surveillance of prescribing errors, promotes a discussion of errors among prescribers, nurses and office staff, and generates ideas for future research.

The limitations of this study include low reporting rates, inability to capture many important errors, small sample size, geographic restriction to one state and limited follow-up analysis with participants. We did not have patient information or the prescribers' perspectives on the circumstances surrounding the error. A more detailed survey or semi-structured interviews would have enhanced our understanding of the strengths and weaknesses of our system. It is unknown if this system would transfer well to specialty practices. We do not know if any of the practices have made changes or conducted quality improvement projects based on the feedback received from the reporting system. Finally, since none of the practices in this study use electronic prescribing technology, it is unknown if the detected errors would be similar or different.

Nurses and office staff may not have fully understood the complexities of the prescriptions and pharmacology of the medications well enough to submit complete reports. Additionally since the nurses and office staff were often intermediate parties, many of the reports did not contain the resolution of the problem. These limitations are recognized, however there was still interesting and useful information contained in the submitted reports.

As with all voluntary reporting systems, the true error rate is unknown, the ability to capture important errors is unpredictable and the reporting rates are consistently low. We only have data that participants deemed 'reportable'. For example, participants may have felt a heightened awareness around narcotics compared with other classes of drugs, contributing to higher reporting. However, errors involving another class of drugs may have been more frequent or more dangerous. Additionally many medication errors, such as administration errors or errors corrected with the patient at the pharmacy

before dispensing are not detected by this system and are therefore never reported.

These data are not rich enough to further specify errors mechanisms. For example, one report described a prescription for 120 tablets of oxycodone, but the pharmacist dispensed 180 tablets. With more data, we may be able to determine if this error was a substitution of 180 for 120 or a repetition of a count of 60. This insight is important as different solutions are required depending on the mechanism of the error.

Nurses and office staff are a valuable resource for reporting prescribing errors in primary care practices. However, without ongoing reminders, the reporting system is not sustainable. Important information about outpatient prescribing errors is available using existing office systems. Simple taxonomies for outpatient prescription errors may be useful to primary care practices who wish to conduct local quality improvement efforts, although further study is required to explore the effectiveness of these efforts and applicability to practices with electronic prescribing systems.

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References

1. Aspden P, Institute of Medicine (US). Committee on Identifying and Preventing Medication Errors. *Preventing Medication Errors*. Washington, DC: National Academies Press, 2006.
2. Bates DW, Cullen DJ, Laird N *et al.* Incidence of adverse drug events and potential adverse drug events. Implications for prevention. ADE Prevention Study Group. *JAMA* 1995;**274**:29–34.
3. Gurwitz JH, Field TS, Harrold LR *et al.* Incidence and preventability of adverse drug events among older persons in the ambulatory setting. *JAMA* 2003;**289**:1107–16.
4. Gandhi TK, Weingart SN, Borus J *et al.* Adverse drug events in ambulatory care. *N Engl J Med* 2003;**348**:1556–64.
5. Kohn LT, Corrigan J, Donaldson MS. *To Err Is Human: Building a Safer Health System*. Washington, DC: National Academy Press, 2000.
6. Bates DW, Boyle DL, Vander Vliet MB *et al.* Relationship between medication errors and adverse drug events. *J Gen Intern Med* 1995;**10**:199–205.
7. Dean B, Barber N, Schachter M. What is a prescribing error? *Qual Health Care* 2000;**9**:232–7.

8. Rupp MT, DeYoung M, Schondelmeyer SW. Prescribing problems and pharmacist interventions in community practice. *Med Care* 1992;**30**:926–40.
9. Hulls V, Emmerton L. Prescription interventions in New Zealand community pharmacy. *J Soc Admin Pharm*. 1996;**13**:198–205.
10. Plews-Ogan ML, Nadkarni MM, Forren S *et al*. Patient safety in the ambulatory setting. A clinician-based approach. *J Gen Intern Med* 2004;**19**:719–25.
11. Elder NC, Vonder Meulen M, Cassidy A. The identification of medical errors by family physicians during outpatient visits. *Ann Fam Med* 2004;**2**:125–9.
12. Fernald DH, Pace WD, Harris DM *et al*. Event reporting to a primary care patient safety reporting system: a report from the ASIPS collaborative. *Ann Fam Med* 2004;**2**:327–32.
13. United States Census Bureau. *State and County QuickFacts*. <http://quickfacts.census.gov/qfd/states/50/50007.html> (18 February 2008, date last accessed).
14. Dovey SM, Meyers DS, Phillips RL, Jr *et al*. A preliminary taxonomy of medical errors in family practice. *Qual Saf Health Care* 2002;**11**:233–8.
15. Morimoto T, Gandhi TK, Seger AC, Hsieh TC, Bates DW. Adverse drug events and medication errors: detection and classification methods. *Qual Saf Health Care* 2004;**13**:306–14.
16. Elder NC, Dovey SM. Classification of medical errors and preventable adverse events in primary care: a synthesis of the literature. *J Fam Pract* 2002;**51**:927–32.
17. Brixey J, Johnson TR, Zhang J. Evaluating a medical error taxonomy. *Proc AMLA Symp* 2002;**71**–5.
18. Chang A, Schyve PM, Croteau RJ *et al*. The JCAHO patient safety event taxonomy: a standardized terminology and classification schema for near misses and adverse events. *Int J Qual Health Care* 2005;**17**:95–105.
19. Vitillo JA, Lesar TS. Preventing medication prescribing errors. *DICP* 1991;**25**:1388–94.
20. Nebeker JR, Hurdle JF, Hoffman J *et al*. Developing a taxonomy for research in adverse drug events: potholes and signposts. *Proc AMLA Symp* 2001;**493**–7.
21. Dean B, Schachter M, Vincent C *et al*. Causes of prescribing errors in hospital inpatients: a prospective study. *Lancet* 2002;**359**:1373–8.
22. National Coordinating Council for Medication Error Reporting and Prevention. *NCC MERP Index for Categorizing Medication Errors*. <http://www.nccmerp.org/pdf/indexBW2001-06-12.pdf> (10 July 2007, date last accessed).
23. Reason J. Combating omission errors through task analysis and good reminders. *Qual Saf Health Care* 2002;**11**:40–4.
24. Sanders MS, McCormick EJ. *Human Factors in Engineering and Design*. New York: McGraw-Hill, 1993.
25. Hing E, Cherry DK, Woodwell DA. *National Ambulatory Medical Care Survey: 2004 summary. Advance data from vital and health statistics; no 374*. Hyattsville, MD: National Center for Health Statistics, 2006.
26. Heath Resources and Services Administration. *Physician Supply and Demand: Projections to 2020*. <http://www.bhpr.hrsa.gov/healthworkforce/reports/physiciansupplydemand/dlinkexhibit8.htm> (25 July 2007, date last accessed).
27. Cohen MR, American Pharmaceutical Association. *Medication Errors*. Washington, DC: American Pharmaceutical Association, 1999.
28. Lesar TS. Prescribing errors involving medication dosage forms. *J Gen Intern Med* 2002;**17**:579–87.
29. Lesar TS. Tenfold medication dose prescribing errors. *Ann Pharmacother* 2002;**36**:1833–9.
30. Kennedy AG, Littenberg B. A modified outpatient prescription form to reduce prescription errors. *Jt Comm J Qual Saf* 2004;**30**:480–7.
31. Cook R. Lessons from the war on cancer: The need for basic research on safety. *J Patient Saf* 2005;**1**:7–8.
32. Gandhi TK, Weingart SN, Seger AC *et al*. Outpatient prescribing errors and the impact of computerized prescribing. *J Gen Intern Med* 2005;**20**:837–41.
33. Koppel R, Metlay JP, Cohen A *et al*. Role of computerized physician order entry systems in facilitating medication errors. *JAMA* 2005;**293**:1197–203.
34. Nebeker JR, Hoffman JM, Weir CR *et al*. High rates of adverse drug events in a highly computerized hospital. *Arch Intern Med* 2005;**165**:1111–6.
35. Chaudhry B, Wang J, Wu S *et al*. Systematic review: impact of health information technology on quality, efficiency, and costs of medical care. *Ann Intern Med* 2006;**144**:742–52.
36. Institute for Safe Medication Practices. *ISMP's List of High-Alert Medications*. <http://www.ismp.org/Tools/highalertmedications.pdf> (10 July 2007, date last accessed).

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