Quantifying the Impact of Prescription-Related Problems on Pharmacy Workload

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ABSTRACT

Objectives: To determine pharmacy workload related to resolving prescription-related problems, including ambiguous, illegible, and incomplete orders, and to determine the types of problems and the frequency of their occurrence.

Methods: An independent observer prospectively documented the time required to resolve prescription-related problems in the pharmacy of a major teaching hospital. The type and frequency of the problems were recorded according to predefined criteria.

Results: Pharmacists spent a mean total of 20.1 min to resolve each prescription-related problem from the time it was first identified to the time it was resolved and the prescription processed. The mean time per problem for clinical pharmacists was 3 times the mean time per problem for dispensing pharmacists; however, clinical pharmacists were involved in resolving fewer problematic orders (31% of orders) than dispensing pharmacists (92% of orders). About 13 prescription-related problems were encountered in the pharmacy during each 8-h day shift, so about 2 h of dispensing pharmacist time and about 2 h of clinical pharmacist time were required during each shift. The rate of prescription-related problems was 55.2 per 1000 orders, including 6.5 illegible orders and 5.9 incomplete orders per 1000 orders.

Conclusions: Pharmacists spent a substantial amount of time resolving prescription-related problems, many of which could be avoided if medication orders were complete and legible. The results of this study suggest that improvements could be made to the medication-ordering process.

Key words: workload, medication errors, prescription-related problems, prescribing errors

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RÉSUMÉ

Objectifs : Définir la charge de travail de la pharmacie consacrée à résoudre les problèmes liés aux ordonnances, y compris les prescriptions ambiguës, illisibles et incomplètes, et déterminer le type et la fréquence de ces problèmes.

Méthodes : Documentation prospective par un observateur indépendant du temps nécessaire pour résoudre les problèmes liés aux ordonnances dans une pharmacie d'un important hôpital d'enseignement. Le type et la fréquence des problèmes ont été notés selon des critères prédéfinis.

Résultats : Les pharmaciens ont passé une moyenne totale de 20,1 minutes à résoudre chaque problème lié à une ordonnance, à compter du moment de son identification jusqu'au moment de sa résolution et de l'exécution de l'ordonnance. Les pharmaciens cliniciens passaient en moyenne trois fois plus de temps par probléme que les pharmaciens d'officine. En revanche, ils ont résolu moins d'ordonnances problématiques (31 %) que les pharmaciens d'officine (92 %). On a compté environ 13 problèmes liés à des ordonnances au cours de chaque quart de huit heures à la pharmacie, ce qui équivaut à environ deux heures consacrées par le pharmacien d'officine et deux heures par le pharmacien clinicien par quart de travail. Le taux de problèmes liés aux ordonnances était de 55,2 pour 1 000 ordonnances, dont 6,5 étaient des ordonnances illisibles et 5,9 des ordonnances incomplètes.

Conclusions : Les pharmaciens ont passé un nombre important d'heures à résoudre les problèmes liés aux ordonnances, dont de nombreux auraient pu être évités si les prescriptions avaient été lisibles et complètes. Les résultats de cette étude laissent croire que des améliorations peuvent être apportés au processus de demande de médicaments.

Mots clés : charge de travail, erreurs de médication, problèmes liés aux ordonnances, erreurs posologiques

INTRODUCTION

The written prescription is a fundamental instrument in delivering appropriate patient care. It documents and conveys vital information from the prescriber to the pharmacist, and its ability to transfer this information effectively hinges on the clarity with which the information is presented. Consequently, high-quality communication is crucial in optimal drug therapy. Such communication has conventionally relied on physicians' handwritten orders to be complete (containing all the necessary information to fill the prescription), correct, unambiguous, and legible, especially for pharmacy technicians and pharmacists. Yet medication errors arising from prescription-related problems such as ambiguity, illegibility, and incompleteness prevail, despite numerous attempts to curb these practices.[1-5] Such medication errors may result in adverse drug events, which have been reported to compromise patient care, increase costs to institutions, and add substantial work for the physicians and pharmacy and nursing staff who have to resolve the problems.[6-8]

The detection of potential errors — errors that are identified and corrected through intervention before the medication is actually administered — should be a component of any institution's routine quality improvement process.[9] Many prescription-related problems are potential errors in the sense that they represent a potential harm to the patient if they are not detected and corrected during the medication-ordering process.

The study reported here was conducted to assist the Pharmacy and Therapeutics Committee at the authors' institution to make decisions regarding improvements to the medication-ordering process. By determining workload attributable to prescription-related problems and characterizing the type and frequency of such problems, it was felt that efforts could be more readily focused on improvements in specific areas within the existing system.

For the purposes of this study, a prescription-related problem was defined as any problem related to a written prescription that required some type of intervention by the dispensing pharmacist before the order could be processed (Table 1). The elements of this definition included prescribing errors, a category of medication errors encompassing selection of an incorrect drug (in terms of indications, contraindications, known allergies, existing drug therapy, and other factors), an incorrect dose or dosage form, an incorrect quantity or concentration, an inappropriate route or rate of administration, or incorrect instructions for use of the drug, as well as illegibility leading to errors.[9] Several other categories such as "nonformulary drugs" and "order requiring pharmacist's interpretation" were included to capture some of the other types of problems that occur.

The primary objective of the study was to quantify the time required to resolve prescription-related problems and to determine the type of pharmacy

Table 1. Types and Definitions of Prescription-Related Problems

Illegibility: one or more elements of drug order are not legible (e.g., drug name, strength, quantity, directions, or route of administration)
Incompleteness: one or more components needed to process the order are missing (e.g., drug name, dose, route, frequency, duration, or physician signature)
Incorrect drug choice: drug choice is deemed incorrect on the basis of pharmacist's clinical knowledge and availability of ancillary information (e.g., drug information, laboratory or culture results) that might not have been available to the prescriber at the time of ordering (e.g., order for a nephrotoxic drug for a patient with renal insufficiency or order for an antibiotic to which organisms are known to be resistant on the basis of sensitivity results)
Allergic contraindication: allergy to an ordered drug is documented on patient's allergy sheet or in computer database
Incorrect time or site: drug cannot be administered as prescribed because order specifies time of administration or unit/location of patient restricted by hospital's policies on certain drugs
Nonformulary drug: drug ordered is not available on hospital formulary
Pharmacist's interpretation: pharmacist must interpret physician's intent for an order that has been obviously misstated or for ordered nonprescription drugs, as outlined by the policies of the Pharmacy and Therapeutics Committee
Drug interaction: evidence for a potential drug–drug interaction, indicated by the computer's interaction database or the pharmacist's clinical knowledge
Other problems requiring clarification of inappropriate components of the order: dose appears too high or too low, directions for or frequency of administration (or both) appear inappropriate, concentration (if applicable) appears inappropriate, route different from that typically recommended for the drug, drug restricted to certain prescribers or medical services (e.g., infectious diseases)

personnel who solved the problems. The secondary objective was to characterize the type and frequency of prescription-related problems.

METHODS

The study was conducted in the main-floor pharmacy of a major teaching and referral hospital with 440 acute care beds. The 24-h on-site pharmacy used a traditional distribution system, in which physicians wrote prescriptions by hand on standard physician order sheets and had carbon copies sent by pneumatic tube to the pharmacy. Order entry into a computer system was done by pharmacy technicians, who also filled the orders after entry. Orders were then placed in line for the dispensing pharmacist, who evaluated them for appropriateness and checked for errors. If a technician identified a prescription-related problem during order entry, the order was flagged so that the dispensing pharmacist could resolve the problem, either by using his or her clinical judgement or by calling the physician, the ward-based clinical pharmacist, or the nurse caring for the patient.

An independent observer (the primary investigator, M.F.) observed and recorded the prescription-related problems encountered in the pharmacy for selected periods on weekdays between 0800 and 1700, from August 23, 1999, to January 24, 2000. The time required to resolve each problem was measured from the time when the problem was first identified by either the technician or the pharmacist to the time when it was resolved and the medication order could be processed. A standard data collection form was used to document these times, as well as to document which pharmacy staff members (pharmacy technician, dispensing pharmacist, or clinical pharmacist) were involved in resolving the problem. In addition, the type and frequency of prescription-related problems (as defined in Table 1) were documented and compared with the total number of orders processed during observation hours to determine the frequency of these problems during this period.

It was hospital policy for nurses administering medications to check the order and initial the time it was administered on the patient's medication administration record, the record of all active orders for each patient that is generated daily by the pharmacy department. If nurses identified medication orders that were missing from the medication administration record or recognized another discrepancy of some type (e.g., the drug dose appearing on the medication administration record differed from what had been ordered), a medication order memo was completed and forwarded to the dispensary by pneumatic tube. This mechanism conveyed information between the nursing staff and the pharmacy for resolving discrepancies and provided a back-up checking system to reduce medication errors. If a medication error actually occurred, a medication incident report was filed. These reports, which ranged in severity from minor (no injury; level 1) to major (death; level 5), identified adverse drug events that occurred despite the rigorous checking process by pharmacy and nursing staff. Medication order memos generated on observation days and all medication incident reports filed during the 5-month study period were collected and evaluated by the authors. The total number of memos and those reports that were judged to be attributable to a prescription-related problem were compared with the total number of orders processed during this period to gauge the extent of potential and actual errors.

RESULTS

Over the 5-month study period, data were collected during a total of 106 h. During this observation time, 3407 medication orders were processed, of which 176 presented a total of 188 prescription-related problems (55.2 problems per 1000 orders). A mean of 257 orders were processed by the pharmacy during an 8-h day shift on observation days, and a mean of 477 orders were processed over a 24-h period.

The mean total time (± standard deviation) spent in the pharmacy to resolve a prescription-related problem was 20.1 (± 38.3) min (median 3.8 min). Pharmacy technicians were involved in resolving problems for 97 (55%) of the orders with prescription-related problems, dispensing pharmacists for 162 (92%), and clinical pharmacists for 55 (31%). The mean time spent resolving prescription-related problems was 0.7 (± 2.8) min (median 0.2 min) for pharmacy technicians, 10.0 (± 21.6) min (median 2.1 min) for dispensing pharmacists, and 30.3 (± 51.2) min (median 3.0 min) for clinical pharmacists.

Table 2 illustrates the frequency of prescription-related problems encountered. The most common problems related to inappropriate dose and directions, nonformulary drug selections, illegibility of some component of the order, and incompleteness. Of the total number of orders with prescription-related problems, illegibility accounted for 22 (12%; Table 3). Problems with illegibility occurred with the directions, the strength, or the drug name. The fourth illegibility category (Table 3) represented the situation in which the

Table 2. Type and Frequency of Prescription-Related Problems

Category of Problem	No. of Problems	
	During Observation Period	Per 1000 Orders*
Nonformulary drug	24	7.0
Illegibility	22	6.5
Incompleteness	20	5.9
Allergic contraindication	15	4.4
Incorrect time or site	8	2.3
Drug interaction	4	1.2
Incorrect drug choice	1	0.3
Pharmacist's interpretation	1	0.3
Other problem requiring clarification		
Dose	46	13.5
Directions	33	9.7
Drug (because of restrictions)	13	3.8
Route	1	0.3
Strength	0	0
Total	188†	

*In total, 3407 orders were processed during the observation period.
†A total of 176 orders had prescription-related problems. Of these, 12 had both illegibility and one other type of prescription-related problem.

pharmacy carbon copy of the medication order was illegible because the physician had not pressed hard enough while writing the order or had used a felt-tip pen to write the order.

The number of medication order memos generated during observation hours and the number of medication incident reports filed in the 5-month study period (Table 4) were extrapolated, on the basis of the data captured during the collection period, to provide the rate per 1000 orders. There were 10.5 medication order memos per 1000 orders. Furthermore, of the 38 medication incident reports generated during the 5-month study period, only 3 were judged as being attributable to a prescription-related problem (0.04 reports per 1000 orders).

DISCUSSION

The present study revealed a rate of 55.2 prescription-related problems per 1000 orders at the authors' institution. Although various studies have documented statistics such as the incidence of medication errors and the workload associated with clinical pharmacy interventions, few published studies have documented prescription-related problems and the time it takes to resolve them.[8-11] Thus, because of differences in definitions and study design, direct comparison of these results with other studies was not possible. However, a study conducted in 1992 at the same institution characterized prescribing errors during central order review in the pharmacy.[12] Orders with errors were identified by the dispensing pharmacist, who was responsible for checking orders for accuracy and appropriateness. Prescribing errors, which were broadly classified as either therapeutic errors (the prescribing of drug therapy with potential for toxic effects) and communication errors (ambiguity or incorrect interpretation by health care professionals of the physician's intent for the prescribed drug therapy) occurred at a rate of 5.6 per 1000 orders. A proportion of this figure (3.4 per 1000 orders) was attributed to "problem orders", orders that were categorized under the headings illegible, omission, incorrect parameter, nonformulary, or a violation of hospital policy. Other studies of true medication error have reported an incidence of 3 to 19 medication errors per 1000 orders.[1,2]

The present study incorporated a much broader scope of data collection than previous studies, that of the prescription-related problem, defined as any problem that required a pharmacist's intervention to resolve. Furthermore, medication prescribing errors are identified far more readily through direct observation, as in this study, than by relying on spontaneous reports.[13] Consequently, it was expected that the rates of prescription-related problems would be higher than the previously reported rates of medication errors.

Table 3. Component of 22 Illegible Drug Orders that Was Illegible*

Illegible Component	No. (and %) of Illegible Orders	
Directions	7	(32)
Strength	5	(23)
Drug name	4	(18)
Other†	6	(27)

*Information about quantity and route of administration was always legible.
†Pharmacy copy illegible because physician did not press hard enough while writing or because physician used a felt-tip pen.

Table 4. Medication Order Memos Generated on Observation Days and Medication Incident Reports Filed during the 5-Month Study Period

Variable	No. of items
Mean no. of orders processed/24 h	477
Medication order memos (MOMs)	
Mean no. of MOMs/24 h	5.0
Extrapolated no. of MOMs/1000 orders	10.5
Medication incident reports	
No. of reports during study period	38
No. of reports attributable to prescription-related problems	3
Extrapolated no. of reports attributable to prescription-related problems/1000 orders	0.04

Of particular interest are the workload results obtained in this and other studies. In one study, the expenditure of time caused by medication errors was substantial.[8] The authors cited previous in-house studies in which they estimated that the resolution of a missing dose required on average 8 min of combined nursing and pharmacy times, which was extrapolated to about a half-hour per nursing unit each day.[8] Again, the results of this study are not directly comparable, but they do offer some insight into the scope of the problem. The workload results from the present study — a mean of 20.1 min per prescription-related problem — represent "real-time" measurements in the sense that they took into account the actual workload associated with solving these problems, concurrent with other duties, for pharmacists both in the pharmacy and on the ward. By extrapolating from the mean number of orders processed in an 8-h shift (257 orders/shift) and the mean number of problematic orders per 8-h shift (13.3 problematic orders/shift; calculated from 51.7 problematic orders per 1000 orders), the time spent resolving prescription-related problems amounted to more than 4 h per 8-h shift. Since dispensing pharmacists were involved in resolving about 12 problematic orders per 8-h shift (92% of problematic orders) and clinical pharmacists about 4 problematic orders per 8-h shift (31% of problematic orders), each pharmacist spent about 2 h per shift resolving prescription-related problems, most of which could have been avoided had the original orders been correct and legible. The significance of this workload lies in the fact that following up on delinquent orders detracts from the provision of pharmaceutical care. Pharmacists can have a greater impact on patient care by performing patient monitoring and counselling, providing drug information services, and monitoring drug therapy than by tracking down physicians to correct medication orders.[14-17] Of more importance is the fact that since many preventable medication errors occur at the ordering and transcription stage, the preponderance of prescription-related problems compromises patient safety by increasing the risk that a medication error goes undetected.[2] Each prescription-related problem introduces a potential error that could lead to misinterpretation of the medication order or that could be missed by the checking pharmacist. The result could be adverse drug events, which can cause morbidity and a substantial increase in institutional costs.[2,6,7]

Despite the rigorous process of checking prescriptions and resolving prescription-related problems, potential errors, in the form of discrepancies documented in medication order memos, surfaced at a rate of 10.5 per 1000 orders. In addition, of the 38 medication incident reports that were filed over the 5-month study period, 3 reports (0.04 reports per 1000 orders) were judged by the authors to be due to prescription-related problems (as opposed to errors in filling or administration). Two of the incident reports had level 1 severity (no injury), whereas the third had level 4 severity (serious injury, altered stay, or emergent or continued care). These medication order memos and incident reports represent errors and adverse drug events that were ultimately identified. It is possible that more such errors occurred but were not detected, for which the consequences to the patient cannot be determined.

One of the inherent limitations in an observational study of this type is the Hawthorne effect.[18] Because the investigator had to be present to document the types of prescription-related problems and to record the time involved in solving them, the technicians and pharmacists could not be blinded to the conduct of the study. Since they were aware of the investigator's intent, problems were probably identified more readily and resolved more promptly than might be the case outside a study setting. However, it would not have been feasible to have pharmacy staff time themselves and characterize the type and frequency of prescription-related problems, since this would have introduced even greater timing biases and might also have decreased the frequency of reporting.

Another limitation was the variable experience of the pharmacy technicians and dispensing and clinical pharmacists. Experienced staff may recognize and resolve problems faster than newly trained technicians and pharmacists. For example, a poorly written prescription may be easily deciphered by an experienced pharmacist familiar with the prescribing physician but completely illegible to a newly trained dispensing pharmacist. Nonetheless, the majority of dispensing shifts were covered by post-baccalaureate, residency-trained pharmacists rotating regularly through a predetermined schedule. Orders for complex medications such as those for oncology treatments and parenteral nutrition were processed in a separate section of the pharmacy specializing in those areas and were not covered by data collection for this study. Furthermore, the current reality is that hospital pharmacists are in short supply and new staff are continually being recruited and trained. Thus, the data from the present study, which incorporate data for new, less experienced dispensing pharmacists, provide a

Table 5. Recommendations for Preventing Medication Errors

Physicians
Write legible and unambiguous drug orders.
Use a ballpoint pen to write drug orders to ensure that the pharmacy receives a readable copy. Do not use a felt pen.
Write complete drug orders. A complete drug order includes the generic drug name, route and site of administration, dosage form, strength, quantity, and frequency of administration.
Use the metric system (not the apothecary system) for dosages and other quantities.
Avoid abbreviations for drug names (e.g., the abbreviation AZT could be interpreted as zidovudine, azathioprine, or aztreonam).
Use leading zeros to precede a decimal (e.g., 0.5 mL) and avoid trailing zeros after a decimal (e.g., avoid 5.0 mL).
Avoid "naked" decimals (e.g., avoid 5. mg).
Print the name of the drug when writing an order for an infrequently prescribed product.
Include the indication for the medication.
Pharmacists
Stay abreast of current therapy guidelines and recent drug developments.
Never assume or guess the intent of a confusing medication order.
Maintain order and cleanliness in the work area.
Maintain a good rapport with physicians so that problems can be resolved in a professional manner.
Institutions
Develop comprehensive policies and procedures for efficient and safe distribution of all medications.
Conduct ongoing, systematic programs of quality improvement and peer review with respect to the safe use of medications. Such programs should include a system for monitoring, reviewing, and reporting medication errors to assist in identifying and eliminating causes of errors and preventing their recurrence.
Implement technological systems such as physician order entry systems and computerized pharmacy checking systems.

reasonable representation of current hospital pharmacy practice.

Certain prescription-related problems might have been important without their resolution being urgent, and in these cases the time to resolution of the problem (especially for the clinical pharmacist), might have been longer than for urgent problems. In other words, the clinical pharmacists might have performed other duties before addressing non-urgent prescription-related problems. With respect to such "non-urgent" prescription-related problems, it was felt that the time recorded (i.e., the actual time to resolution of the problem, rather than the minimum possible time to resolution) would be of more relevance because it took into account the other duties of the clinical pharmacists.

The results of this study are applicable only for the weekday hours of 0800 to 1700. The rates of prescription-related problems at other times and their impact on pharmacy workload are unknown. However, since most medication orders are written on weekdays during times when full medical staff (attending physicians, residents, and medical students) are present (usually between 0800 and 1700), these results reflect the times when the pharmacy receives most of its workload.

Overall, the study design minimized the limitations outlined above to the greatest extent possible.

Many studies have proposed recommendations for preventing medication errors (Table 5).[4,5,9,19,20] Such error prevention initiatives involve educational programs such as continuing education seminars, newsletters, and proper training while in medical school. As a more reliable method of curbing medication prescribing errors, hospitals in the United States are increasingly turning to technology and the use of computerized direct physician order entry systems.[21,22] Not only have reductions in medication errors been documented with such systems, but they also provide many other benefits, including clinical decision support for physicians; efficient use of physician, pharmacy, and nursing time; encouragement of adherence to the formulary; less waste of paper; and minimization of the number of nonproductive encounters between the pharmacist and physician.[23] Currently, about 34% of US hospitals have a physician order entry system available,[24] and various hospitals in Canada are running pilot programs to determine the feasibility and efficiency of such systems. Despite the fact that, according to published studies, medication errors are reduced with such systems, some direct physician order entry systems have met with resistance. A recent study reported a lower degree of satisfaction among physicians, who felt that they had to perform more manual work to complete certain tasks.[25] High physician workload combined with unfamiliarity with the relatively new system were cited as possible reasons for these opinions. However, careful selection of a user-friendly system, educational programs, and adequate trial runs in all areas of the hospital can help to ensure smoother hospital-wide transition to such systems.[23,25,26]

In the study reported here, pharmacists spent a substantial amount of time resolving prescription-related problems, many of which could have been avoided if the original orders had been correct and legible. It should be noted that this analysis did not assess time spent by nursing staff, who are often instrumental in identifying and resolving prescription-related problems. Prescriptions with inappropriate doses and directions, nonformulary drug requests, illegible or incomplete orders, and allergic contraindications accounted for most orders requiring clarification. A potential method of preventing prescription-related problems is the use of a computerized direct physician order entry system. Such a system would eliminate the transcription process between prescriber and pharmacist, and thereby avoid many of the prescription-related problems associated with incorrect prescribing, incomplete orders, and especially illegibility.[23,24] The data from this study offer further support for implementation of direct physician order entry systems. A limited version of such a system is currently being assessed in the Emergency Department and Intensive Care Unit at the authors' institution. Whether direct physician order entry lessens pharmacy workload with respect to prescription-related problems, reduces medication errors, and improves patient outcomes at this institution remains to be studied.

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