

RESEARCH ARTICLE

Role of pharmacists in reducing antibiotic prescribing errors in an emergency department

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Abstract

Background: Clinical pharmacists and clinically trained pharmacists can detect and correct prescribing errors by reviewing physicians' orders. In addition, prescribing errors related to antibiotics occur frequently in emergency departments (EDs).

Aim: This study evaluated the role of pharmacists in reducing antibiotic prescribing errors in an ED.

Methods: One clinically trained pharmacist spent 4 h/day in the ED for 30 days. The pharmacist attended the ward rounds and reviewed medical records to identify prescribing errors related to antibiotics, and corrected these errors in consultation with emergency physicians. The types and severity of antibiotic prescribing errors were determined. The corrected errors were also classified.

Results: Antibiotics had been prescribed for 110 of 267 patients (41.20%). In all, 180 antibiotic prescriptions were identified for 57 patients, of which 78 had prescribing errors. The most common types of errors were incorrect drug selection (48/78; 61.50%) and wrong dose (19/78; 24.40%), and the most common actual severities were Type B (30/78; 38.46%) and Type C (35/78; 44.87%). In addition, 41 of 78 antibiotic prescribing errors were accepted as errors by emergency physicians. The corrected prescribing errors were categorised as two (4.88%) intercepted potential adverse drug events (ADEs), 35 (85.36%) mitigated ADEs and four (9.76%) ameliorated ADEs.

Conclusion: Pharmacists have a significant role in the identification and correction of antibiotic prescribing errors. In addition, collaboration between physicians and pharmacists can lead to appropriate antibiotic use in hospitals.

Keywords: medication errors, pharmacists, prescriptions.

INTRODUCTION

Prescribing errors are a type of medication error that occur during the prescription process that have the potential to lead to patient harm.¹ Prescribing errors have been defined as incorrect drug selection (based on indications, contraindications, known allergies and existing drug therapy, among other factors), dose, dosage form, route, concentration, rate of administration or instructions for use of an ordered drug.² Prescribing errors could potentially result in patient harm, cost burden, adverse drug events (ADEs) and prolongation of hospital stay.^{3,4}

Some studies have shown that antimicrobials are the most common medications associated with prescribing errors in hospital inpatients.⁵ Moreover, inappropriate

antibiotic prescriptions could lead to the emergence of resistant bacteria, which could reduce the efficacy of antibiotics.⁶

Prescribing errors related to antibiotics occur frequently in emergency departments (EDs).⁶ The reason for this is that EDs are fast-paced and high-pressure environments which can cause frequent interruptions to emergency physicians' work. This can increase the risk of errors.⁷

One of the strategies to reduce prescribing errors in EDs is the use of pharmacy services. Clinically trained pharmacists and especially clinical pharmacists can detect and correct prescribing errors by reviewing physicians' orders.^{1,3,8} This measure supports safe drug use and reduces ADEs and healthcare costs.⁹

In Iran, clinical pharmacists have a Doctor of Pharmacy degree and have completed 4 years of residency training. There are Iranian board-certified specialist pharmacists who work directly with medical professionals, usually in hospitals, and optimise medication use.

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Clinically trained pharmacists also hold a Doctor of Pharmacy degree and have undertaken a short-term training course (e. g. 3 months) to enable them to perform some clinical interventions in hospitals.

These pharmacists play a vital role in antimicrobial stewardship through variety of interventions such as optimising antibiotic selection, dose, route and duration of administration, as well as educating all healthcare professionals regarding antibiotic resistance and the appropriate use of antibiotics.¹⁰ Taking this into consideration, the aim of the present study was to evaluate the role of pharmacists in reducing antibiotic prescribing errors in an ED.

METHODS

Study Design and Setting

The present prospective cross-sectional study was conducted in the adult 15-bed ED of Afzalipour Hospital affiliated to Kerman University of Medical Sciences, in Kerman, Iran, from July to August 2017. The Ethics Committee of Kerman University of Medical Sciences approved this study. The confidentiality and privacy of patient data were maintained by the researchers.

One clinically trained pharmacist spent 4 h/day (from 9 AM to 1 PM) in the ED for 30 days. This time slot was chosen because the medical rounds were held during this time. The pharmacist attended the ward rounds, reviewed medical records, identified the prescribing errors related to antibiotics, communicated face-to-face with physicians and corrected the errors if the emergency physicians accepted them. Furthermore, another clinical pharmacist supervised the practice of the pharmacist. Before conducting this study, there had not been any pharmacy services at the prescribing stage in the ED of Afzalipour Hospital.

The pharmacist also recorded patient characteristics, including admission date, age, sex, chief complaint, initial diagnosis and antibiotics prescribed. In addition, the pharmacist evaluated patients' kidney and liver function for dose adjustment of antibiotics. The cost of inappropriate antibiotic prescriptions was calculated based on the number of doses of inappropriate antibiotics consumed by the patients before errors were identified. Moreover, every patient in the ED was included in the study, but only patients who were transferred to inpatient wards were followed-up to examine the appropriateness of the infectious diseases diagnosis and treatment provided by the ED physicians.

The definition of prescribing errors was based on the American Society of Hospital Pharmacists (ASHP) guidelines on preventing medication errors in hospitals.² In addition, the severity of prescribing errors was

classified based on two scoring systems, namely the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP)¹¹ for actual harm and that of Buckley *et al.*¹² in their study for potential harm (clinically insignificant, significant, serious, and life threatening). A team including a clinical pharmacist, a pharmacist and an infectious diseases specialist was responsible for classifying the severity of prescribing errors. The corrected prescribing errors were categorised as intercepted potential ADEs (corrected before reaching the patient), mitigated ADEs (errors corrected after reaching the patient but before causing harm), ameliorated ADEs (errors caught after resulting in some harm but corrected before causing more serious harm) and little or no potential for harm.¹³ Medscape Drug Reference (<https://reference.medscape.com/>, accessed 2017) and UpToDate (<http://www.uptodate.com>, accessed 2017) were used as drug information references.

Data Analysis

All data were analysed using SPSS version 20 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to describe all variables (i.e. the types and categories of prescribing errors). Chi-squared tests and independent samples *t*-tests were used to assess the effects of sex and age, respectively, on the occurrence of prescribing errors.

RESULTS

The medical records of 267 patients in the ED were reviewed. Antibiotics had been prescribed for 110 (41.2%) of 267 patients. Antibiotic prescribing errors occurred in 57 (51.82%) of those 110 patients. Demographic data for the patients included in this study are given in Table 1. Age ($p = 0.90$) and sex ($p = 0.44$) did not have any effect on the occurrence of antibiotic prescribing errors.

Of the 180 antibiotic prescriptions in 57 patients, 78 (43.33%) were found to contain prescribing errors. Table 2 lists the types of prescribing errors identified and the number corrected. The dose of antibiotic had not been adjusted based on renal function when required in 28 (35.90%) antibiotics prescriptions.

The severity of the identified and corrected antibiotic prescribing errors based on actual harm are summarised in Table 3. Severity, classified on the basis of potential harm, was clinically insignificant in 19 (24.36%) cases, significant in 54 (69.23%) cases and serious in five cases (6.41%). The most common antibiotics associated with the 78 prescribing errors were ceftriaxone ($n = 34$ errors;

Table 1 Demographic data for patients in this study

	Total no. patients	Sex		Age (years)
		Male	Female	
Antibiotics were prescribed	110	64 (58.20)	46 (41.80)	59.51 ± 17.20
Antibiotic prescribing errors	57	31 (54.40)	26 (45.60)	60.23 ± 17.27

Unless indicated otherwise, data are given as the mean ± SD or as *n* (%).

Table 2 Types of antibiotic prescribing errors identified and corrected based on American Society of Hospital Pharmacists guidelines²

Type of error	No. errors identified (%)	No. errors corrected (%)
Incorrect drug selection	48 (61.50)	24 (58.50)
Underdosing	12 (15.40)	4 (9.80)
Overdosing	7 (9.00)	7 (17.10)
Wrong duration ^a	8 (10.30)	3 (7.30)
Wrong frequency	2 (2.60)	2 (4.90)
Route of administration	1 (1.30)	1 (2.40)
Total	78 (100)	41 (100)

^aBased on the planned duration documented in the notes.

43.60%), vancomycin (*n* = 11 errors; 14.10%), ceftazidime (*n* = 7 errors; 9.00%) and metronidazole (*n* = 5 errors; 6.40%). The most common diagnoses related to antibiotic prescribing errors among the 57 patients were respiratory tract infection (*n* = 20; 35.08%), gastrointestinal infection (*n* = 7; 12.28%), urinary tract infection (*n* = 5; 8.77%) and sepsis (*n* = 5; 8.77%).

Forty-one (52.56%) of 78 antibiotic prescribing errors were accepted by emergency physicians and corrected. The types of drug selection errors, examples of pharmacists' interventions and reasons for rejection of recommendations are summarised in Table 4. The corrected prescribing errors were categorised as intercepted potential ADEs (*n* = 2; 4.88%), mitigated ADEs (*n* = 35; 85.36%) and ameliorated ADEs (*n* = 4; 9.76%). The cost of antibiotic prescribing errors before identifying them was equivalent to US\$267 during the present study.

Thirty-five of 57 patients with prescribing errors were transferred from the ED to inpatient wards. Evaluation of the emergency physicians' practice showed that the diagnosis and antibiotics prescribed were both correct for six (17.14%) patients, the diagnosis was correct but the antibiotics prescribed were incorrect for 22 (62.86%)

Table 3 Severity of antibiotic prescribing errors identified and corrected for actual harm based on the National Coordinating Council for Medication Error Reporting and Prevention¹¹

Error classification categories	No. errors identified (%)	No. errors corrected (%)
Category B: an error did not reach the patient	30 (38.46)	18 (43.90)
Category C: an error reached the patient but did not cause patient harm	35 (44.87)	12 (29.27)
Category D: an error reached the patient and required monitoring for possible harm	8 (10.26)	7 (17.07)
Category E: an error resulted in temporary harm and required intervention	3 (3.85)	2 (4.88)
Category F: an error resulted in temporary harm and required hospitalisation	2 (2.56)	2 (4.88)
Total	78 (100)	41 (100)

patients and the diagnosis and antibiotics prescribed were both incorrect for 7 (20.00%) patients. The pharmacists identified antibiotic selection errors in 28 of the 35 patients, but the physicians accepted only six.

DISCUSSION

In the present study the rate of antibiotic prescribing errors was 43.33% per antibiotics prescriptions, with the most common errors being incorrect drug selection and wrong dose. In a similar study in an ED in Saudi Arabia, the prevalence of inappropriate antibiotic prescriptions in adults was reported to be 38.70%, with the most common errors being wrong duration and dose of antibiotics.⁶ The results of the present study are comparable with those of the previous study in Saudi Arabia. To the best of our knowledge, there have been no studies in Iran focusing only on antibiotic prescribing errors. Studies regarding medication errors in Iranian EDs reported that 21.10%–60.80% of recorded medication errors were prescription errors and that 23.60–37.70% of these were related to antimicrobial medications.^{14,15}

In the present study, the acceptance rate by physicians of identified errors was 52.56%. Previous studies in developed countries have reported that physicians accepted more than 90% of pharmacists' recommendations in EDs.^{8,13} Furthermore, in a hospital in Oman, the acceptance rate was reported to be 67.00%,¹⁶ and this rate is close to that found in the present study. Possible reasons for this low acceptance rate in Iran compared

Table 4 Types of incorrect drug selection errors, examples of pharmacists' interventions and reasons for rejection of recommended changes

Type of selection error	No. selection errors ^a (%)	No. rejected recommendations ^b (%)	Examples of pharmacists' interventions	Type of intervention	Reason for rejection
No indications for antibiotics	31 (64.58)	16 (66.67)	Substituting ceftazidime with ceftriaxone in a patient with pneumonia who did not have any risk factors for pseudomonas infections	De-escalate	In a severely ill patient, pseudomonas could be covered
			Stopping azithromycin for the treatment of acute exacerbation of COPD	Unnecessary treatment	The patient might have concurrent pneumonia
No need for broad-spectrum coverage	7 (14.58)	5 (20.8)	Changing vancomycin and meropenem to azithromycin and ceftriaxone for treatment of CAP	De-escalate	Considering the patients' conditions, they chose to stay with vancomycin and meropenem
Antibiotics with overlapping activity	2 (4.17)	1 (4.17)	Discontinuing concurrent use of meropenem and metronidazole for aspiration pneumonia	De-escalate	Metronidazole has a better anaerobic coverage
Prescribing antibiotics for viral infections	6 (12.5)	2 (8.33)	Stopping ceftriaxone for viral respiratory infection	Unnecessary treatment	The physician had doubts about his own diagnosis
Omission of a necessary antibiotic in treatment regimens	2 (4.17)	0	Adding ceftriaxone to vancomycin and ampicillin for empiric treatment of meningitis	Inadequate empiric therapy	N/A

CAP, community-acquired pneumonia; COPD, chronic obstructive pulmonary disease; N/A, not applicable.

^aTotal number = 48.^bTotal number of rejected recommendations = 24.

with developed countries are that pharmacists' roles in hospitals in developing countries like Iran have not been determined, and there is a lack of standard pharmacist practice guidelines.^{17,18} Another reason could be inter-professional miscommunication. Pharmacists may not be able to communicate evidence-based recommendations effectively to physicians, so the rationale for the recommendation is unclear or misunderstood, leading to the physician choosing not to implement the suggestion. Improving interprofessional communication may be a solution to this barrier. However, hospital management support is required in this regard.¹⁹ In addition, prescribing medications is a collaborative process that includes the skills and experience of both physicians and pharmacists. Accordingly, cooperation between physicians and pharmacists is necessary for the safe and effective use of medications in hospitals.^{17,18} Moreover, in the present study the dosing of antibiotics based on renal function was incorrect in nearly 35% of cases. The significant impact of pharmacists on appropriate renal dosing adjustment of antibiotics in an ED has been reported previously.²⁰

In the present study, more than 80% of antibiotic prescribing errors were identified and approximately 90% of the accepted errors were corrected before causing harm to the patient. The most common potential severity was significant (69.23%). This finding emphasises the effective role of pharmacists in the safe use of antibiotics. In addition, in four EDs in the US, Rothschild *et al.*¹³ reported that nearly 94% of medication errors were corrected before causing patients harm, and that antimicrobial agents were associated with 32.10% of corrected medication errors. Rothschild *et al.*¹³ found that the most common potential severity of errors was serious (47.80%) and significant (36.20%). Moreover, another similar study reported that the most potential severities were serious and significant.²¹ It should be noted that the tools based on potential harm can assess the severity of errors in the absence of actual patient harm, but the outcomes are more subjective.²²

In the present study, the selection of more than 80% of antibiotics prescribed by emergency physicians was incorrect in patients subsequently admitted to inpatient wards. Although many of the antibiotic selection errors

were identified by the pharmacists, the physicians did not always accept the suggested changes. These results show that physicians should seek the help of pharmacists to reconcile and review medications orders. Moreover, education is an important approach to increase physicians' knowledge of medication administrations.⁹

Study Limitations

One of the limitations of the present study was its short duration. In addition, further studies should be conducted as multicentre studies, including more pharmacists and clinical pharmacists. Another limitation of the present study was that the patients who were discharged from the ED were not followed-up for the accuracy of their diagnosis and treatment to be evaluated.

CONCLUSION

In conclusion, pharmacists have a significant role in the identification and correction of antibiotic prescribing errors. In addition, collaboration between physicians and pharmacists can lead to more appropriate antibiotic use in hospitals.

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Conflict of interests statement

The authors declare that there is no conflict of interest.

AUTHORSHIP STATEMENT

All listed authors comply with the journal's Authorship policy. All the authors have contributed significantly to the manuscript (conception, design, acquisition of data, analysis, interpretation of data, drafting the manuscript and revising it).

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