Int J Clin Pharm (2012) 34:475–480
DOI 10.1007/s11096-012-9632-4

RESEARCH ARTICLE

Physicians and pharmacists: collaboration to improve the quality of prescriptions in primary care in Mexico

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Received: 29 August 2011 / Accepted: 29 March 2012 / Published online: 17 April 2012

Abstract *Background* Inappropriate prescription is a relevant problem in primary health care settings in Mexico, with potentially harmful consequences for patients. *Objective* To evaluate the effectiveness of incorporating a pharmacist into primary care health team to reduce prescription errors for patients with diabetes and/or hypertension. *Setting* One Family Medicine Clinic from the Mexican Institute of Social Security in Mexico City. *Method* A "pharmacotherapy intervention" provided by pharmacists through a quasi experimental (before–after) design was carried out. Physicians who allowed access to their diabetes and/or hypertensive patients' medical records and prescriptions were included in the study. Prescription errors were classified as "filling", "clinical" or "both". Descriptive analysis, identification of potential drug–drug interactions (pD–DI), and comparison of the proportion of patients with prescriptions with errors detected "before" and "after" intervention were performed. *Main outcome measure* Decrease in the proportion of patients who received prescriptions with errors after the intervention. *Results* Pharmacists detected at least one type of error in 79 out of 160 patients. Errors were "clinical", "both" and "filling" in 47, 21 and 11 of these patient's prescriptions respectively. Predominant errors were, in the subgroup of patient's prescriptions with "clinical" errors, pD–DI; in the subgroup of "both" errors, lack of information on dosing interval and pD–DI; and in the "filling" subgroup, lack of information on dosing interval. The pD–DI caused 50 % of the errors detected, from which 19 % were of major severity. The impact of the correction of errors post-intervention was observed in 19 % of patients who had erroneous prescriptions before the intervention of the pharmacist (49.3–30.3 %, $p < 0.05$). *Conclusion* The impact of the intervention was relevant from a clinical point of view for the public health services in Mexico. The implementation of early warning systems of the most widely prescribed drugs is an alternative for reducing prescription errors and consequently the risks they may cause.

Keywords Family doctors · Intervention · Mexico · Patient safety · Prescription errors

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Impact of findings on practice

- Pharmacotherapy recommendations to physicians provided by pharmacists, can improve appropriate prescribing in patients with diabetes and/or hypertension in Mexico.
- Having pharmacists as part of the primary health care team in Mexico is a valuable alternative for improving the quality of care and patients' safety.

Introduction

Patient safety can be considered as the absence, prevention or minimizing of harm during the process of health care. A safe clinical practice requires clinicians to identify which diagnostic and therapeutic procedures are safe and effective, ensure they are applied to those who need them, and perform them correctly and without error [1]. A study of primary care patients reported that patient safety is affected by problems related to prescriptions in up to 48.2 % of cases [2]. Other authors have reported that drug-related adverse events are among the ten leading causes of mortality [3], and that the prescription error rate in primary care is higher than that for hospitalized patients [4]. It has also been found that adverse events related to the use of drugs may be preventable or modifiable if specific actions are taken [5].

The literature points to prescribing and monitoring problems as underlying causes of medication errors in primary care [6, 7]. It has been proposed that the incidence of medication errors would be reduced if general practitioners were persuaded to recognize that (1) the use of drugs involves a risk that is commonly associated with adverse events, (2) the violation of certain rules, e.g. prescribing drugs that are contraindicated for a specific patient, carries risks, and (3) strict monitoring systems need to be developed for patients who use high risk drugs, e.g. periodical phone calls or reminders [8].

In order to improve the use of medications, four types of interventions have been described: educational, managerial, economic and regulatory [9]. One strategy that has been tested primarily in hospitals is to include a pharmacist in the health care team [10–12]; currently, such participation has reached the ambulatory setting, where the pharmacist offers assistance to other health professionals by providing information about products or reviewing pharmacological schemes and giving advice on the appropriate use of medicines to those who prescribe them [13, 14].

In Mexico, inappropriate prescription is a relevant problem in health care provision. In ambulatory settings, 42.5 % of hypertensive patients receive combinations of drugs that could potentially lead to a pharmacological interaction [15]. Previous studies have evaluated educational strategies for improving physicians' prescriptions for chronic diseases in primary health care settings [16]. However, the role of pharmacists has not been incorporated into the health care team. Therefore, there are currently no evaluation studies regarding the role of pharmacists in supporting correct prescription in ambulatory care.

Aim of the study

The aim of this study was to evaluate the effectiveness of incorporating a pharmacist into primary care health teams to reduce prescription errors for patients with diabetes and/or hypertension. The pharmacists were assisting the Mexican Institute of Social Security (Instituto Mexicano del Seguro Social, IMSS), the main public health-care system in the country, which provides health care to more than 40 % of the Mexican population.

Method

A quasi-experimental study (before–after comparison) was conducted at one Family Medicare Clinic (FMC) belonging to the IMSS in Mexico City. This served as a "model", since all FMC across the country have the same type of pharmacy service (dispensing) and have no professionally trained staff in this area. The intervention consisted of incorporating two pharmacists in the morning shift and two in the afternoon shift into the health team; their responsibility was to introduce a new service called "pharmacotherapy intervention", with the aim of offering advice to medical doctors. The research protocol was reviewed and approved by the National Scientific Research Committee of the IMSS.

Physicians with a permanent post, assigned to outpatient care and willing to participate, were included. They agreed that pharmacists and nurses would interview their diabetic and hypertensive patients when they came for medical visits; they also granted access to the medical records and the prescriptions (one prescription can include one or two drugs) of the patients who were interviewed. Physicians who changed their assignment location during the study period were eliminated.

Sample size was estimated according to the assumption of a 25 % reduction (difference) before–after intervention in the proportion of patients receiving prescriptions with errors; under this assumption, the required sample size was 109 patients. The main outcome variable was the difference between the proportion of patients who received prescriptions with errors, detected when the pharmacists reviewed those prescriptions (before), and the proportion who received prescriptions when the physician had reconsidered his original decision after reviewing the pharmacist's feedback and the "pharmacotherapy intervention" (after).

Prescription errors were classified as "filling", "clinical" or "both". "Filling" included the following types: lack of information on dosing interval, lack of information on the dose, lack of information about the duration of the treatment, incorrect amount of medication to be supplied, lack of information about the scheduled medication intake, illegible handwriting and lack of name or signature of the prescriber. The types of "clinical" errors were: potential drug–drug interactions (pD–DI), drug–disease interactions, incorrect dose interval, therapeutic dose lower or higher

than recommended, inappropriate drug for the patient, unnecessary drug, and inappropriate prescription of the drug in view of the patient's age. In both groups, prescriptions were included that had at least one "filling" and one "clinical" error. Severity of pD–DI was classified as follows: "Major", when the interaction could be life-threatening and/or require medical intervention to minimize or prevent serious adverse events; "Moderate", if the interaction could be result in a exacerbation of the patient's condition and/or require and alteration in the therapy; and "Minor" if the interaction would have limited clinical effects. Manifestations could include an increase in the frequency or severity of the side effects but generally would not require a major alteration in therapy [17].

The researcher responsible for the study and one of the collaborators presented the research protocol to the physicians on both working shifts (morning and afternoon) at the FMC. The study objectives, its logistics, and the process for obtaining informed verbal consent were emphasized. Once consent was confirmed, two nurses (previously trained) per shift were sent to the clinic waiting rooms every day in order to identify patients who had already been diagnosed with diabetes mellitus and/or hypertension; this continued until the necessary number of patients had been gathered. Whenever a suitable patient was identified, the nurse formally invited him/her to participate in the study. The invitation included an explanation of the objectives of the study and an assurance that the patient's acceptance would allow the pharmacist to review the prescription prior to its supply by the pharmacy. The explanation required approximately 20 min. Once verbal consent was obtained, the nurse recorded the patient's general data. After the medical visit, the nurse accompanied the patient to a module where the pharmacists reviewed the pharmacological profile of each drug prescribed with the help of the program Micromedex® DrugReax® System (Healthcare Series 2006) [17]. Whenever a prescription error was detected, the pharmacist printed the information he considered relevant and, if necessary, complemented it with additional bibliographical material [18]; then he met the physician for a joint review of the case. Pre-printed material was used to assess the need to change the prescription; however, the outcome depended on the physician's decision to accept or reject the pharmacist's suggestions, in whole or in part.

For the statistical analysis, an Access database was created and statistical package SPSS version 17 was used. Descriptive analysis was performed for the variables of the physicians in the study (gender, age, continuing education and teaching). Each interaction and its severity were analyzed using the program Micromedex® DrugReax® System. In order to measure the effect of the "pharmacotherapy intervention" directed towards the physicians, a nonparametric McNemar test was used to compare the proportions of patients with prescriptions with errors detected "before" and "after" intervention.

Results

Of the 69 physicians included in the study, 57 % were women; 45 % had an average of 20 ± 7 years' experience; 77 % were specialists in family medicine, and the remaining 23 % were general practitioners; 71 % had received continuing medical education (including discussion of clinical guidelines for diabetes and hypertension management) during the past 2 years; and 52 % reported teaching on an undergraduate or graduate program in medicine and/or nursing.

Prescriptions from 160 patients were included. The patients' average age was 58 ± 10 years; most were females (79 %); 30 % had a diagnosis of diabetes mellitus type 2 (DM2), 35 % had hypertension, and another 35 % had both diagnoses (Table 1).

At least one kind of error was detected in 79 (49.3 %) of the prescriptions for the 160 patients included. In 47 (59 %) cases, the error was "clinical"; in 21 (27 %) it was "both", and in 11 (14 %) it was "filling". In the subgroup of patients

Table 1 Characteristics of patients

Characteristics	Frequency (%) n = 160
Age (years)	58 ± 10[a]
Gender	
Female	126 (79)
Male	34 (21)
Education	
Illiterate	5 (3)
Elementary schooling	85 (54)
High school or equivalent	44 (27)
University education	26 (16)
Occupation	
Home	74 (46)
Employed	70 (44)
Retired	16 (10)
Marital status	
Widowed or single	51 (32)
Married	94 (59)
Other	15 (9)
Chronic disease	
Diabetes mellitus type 2 (DM)	48 (30)
Hypertension (HTA)	56 (35)
DM and HTA	56 (35)

[a] Mean ± SD

who received prescriptions with "clinical" errors, the predominant type was pD–DI (Table 2). In patients with prescriptions that had "filling and clinical errors", the most frequent type of "filling" error was lack of information on dosing interval, and the most common "clinical" error was pD–DI (Table 3). Two or more types of "filling or clinical" errors were identified in twelve patients' prescriptions. Finally, for patients whose prescriptions had "filling" errors, nine had one type of error and two had two types. The most frequently identified types of "filling" error were lack of information on dosing interval (4), lack of name or signature of the prescriber (4), and incorrect information about the use of the medication (2), followed by lack of information on the dose (1), lack of information on the duration of treatment (1) and illegible handwriting (1).

A total of 161 prescriptions (one patient received two prescriptions) were reviewed by the pharmacists; they involved 46 different drugs, which were grouped into 16 categories. The most frequently prescribed categories were nonsteroidal antiinflammatory drugs (NSAIDs). One hundred and thirty-two prescribing errors were documented in 42.8 % of the prescriptions, and the drug categories most frequently involved were NSAIDs, vitamins, antibiotics and statins.

About 50 % of the total number of errors found (132) were of the pD–DI type, in which 62 combinations of pairs of drugs were identified. Drug categories involved in pD–DI were oral hypoglycemic agents (glibenclamide/glyburide and metformin) (51.6 %), NSAIDs (41.9 %), antihypertensives (captopril, enalapril, metoprolol, nifedipine, verapamil, chlorthalidone and furosemide) (37 %), antibiotics (ciprofloxacin, trimethoprim with sulfametozaxol) (20.9 %), and histamine H_2 antagonist (ranitidine) (11 %). The most frequent pD–DI drug combinations were hypoglycemic agents with antibiotics (11), with NSAIDs (10), and with proton pump inhibitors (7); inhibitors of angiotensin converting enzyme with NSAIDs (7); and pravastatin with bezafibrate (7). The analysis of each interaction showed that 74 % of pD–DIs were of moderate severity, 19 % of major severity and 6 % of less serious severity (Table 4).

"Filling" and "clinical" errors were corrected before the drugs were dispensed in 15 (19 %) of the 79 cases of patients who had prescriptions with detected errors; the difference was statistically significant ($p < 0.05$). Of the prescription errors corrected, 6 out of 47 (13 %) were "clinical", 7 out of 21 (33 %) were both types, and 2 out of 11 (18 %) were "filling" errors.

Table 2 Clinical errors

Errors	Frequency (%) n = 47
One error n = 37	
pD–DI[a]	21 (46)
Incorrect dose interval	8 (17)
Unnecessary drug	3 (6)
Contraindication	2 (4)
Therapeutic dose lower	2 (4)
Therapeutic dose higher	1 (2)
Two errors n = 10	
pD–DI + incorrect dose interval	4 (8)
Therapeutic dose higher + pD–DI	2 (4)
Therapeutic dose lower + potential drug-food interaction	1 (2)
Therapeutic dose higher + incorrect dose interval	1 (2)
Therapeutic dose lower + pD–DI	1 (2)
pD–DI + contraindication	1 (2)

[a] Potential drug–drug interaction

Table 3 Filling and clinical errors

Errors	Frequency (%) n = 21[b]
Filling	
Lack of information on dosing interval	10
Illegible handwriting	4
Lack of information about the duration of the treatment	4
Lack of name or signature of the prescriber	4
Lack of information on the dose	3
Wrong directions for use	2
Incorrect amount of medication supply	1
Clinical	
pD–DI[a]	11
Incorrect dose interval	8
Low therapeutic dose	5
High therapeutic dose	2
Contraindication	4
Unnecessary drug	2
Potential drug–disease interaction	1
Inappropriate prescription of the drug due to patient's age	1

[a] Potential drug–drug interaction, [b] 12 patients have two or more filling or clinical errors

Discussion

The strategy used in this study revealed little impact in the Mexican context (19 %) compared to that reported in the literature, which has been as high as 72 % [14, 19]. This difference could be a consequence of the short duration of the pharmacotherapy intervention, which is a limitation of the study. Evaluation of the low response to the pharmacists' interventions will be necessary so that specific actions can be developed to increase physicians' willingness to accept

Table 4 Frequency and severity of potential drug–drug interactions

Potential drug–drug interactions	n = 62	Severity
Oral hypoglycemic agents with antibiotics	11	Major (5)
		Moderate (6)
Oral hypoglycemic agents with NSAIDs	10	All moderate
Oral hypoglycemic agents with histamine H_2 antagonist	7	All moderate
Oral hypoglycemic agents with beta-adrenergic blocker	4	All moderate
ACEIs with NSAIDs	7	All moderate
Beta-adrenergic blocker with NSAIDs	3	All moderate
Calcium channel blocker with NSAIDs	2	All minor
Diuretics with NSAIDs	3	All moderate
Pravastatin/bezafibrate	7	All major
Other	8	Moderate (6)
		Minor (2)

NSAIDs non-steroidal anti-inflammatory drugs, *ACEIs* angiotensin converting enzyme inhibitors

pharmacists as part of the health team in order to improve the reliability of prescriptions. This is relevant because the proportion of prescribing errors detected in this study was higher than reported in previous studies [4, 20, 21]. It is important to emphasize the high proportion of patients who received prescriptions with at least one prescription error, which was more the double that in another report [22]. Also, the most common drug categories involved have been described as 'over-used' in up to 41 % of cases; e.g. NSAIDs and antibiotics, which have also been associated with increased morbidity and mortality [8, 23, 24]. These results show the potential for unnecessary risk for a large number of patients.

It should be emphasized that almost 50 % of the "clinical" errors were secondary to the combination of drugs that can potentially cause interactions. Moreover, in a significant percentage (19 %), which is higher than quoted in the literature (13 %) [5], the severity was considered "major", meaning that the pD–DI threatened the patient's life and/or required medical intervention in order to reduce or prevent serious adverse effects. This finding also differs from reports on other studies, in which the most frequent types of errors have been about the dose, frequency and/or route of administration [4]. This difference supports the hypothesis that prescription problems are local and actions to avoid them should also be local.

Demonstration of improvement in the appropriateness of prescription after pharmacotherapy recommendations by pharmacists to physicians can be considered the main strength of the study. Although the effect on the correction of prescription errors was lower than expected, it was still clinically significant. The fact that the proportion of cases with erroneous prescriptions was more than we had considered likely a priori suggests an urgent need to implement actions to support physicians in the prescribing process. It is also necessary to work with them in order to identify the reasons for rejecting the suggestions made by the pharmacists and to consider the pertinence of "peer" support when making treatment decisions.

Conclusion

The impact of the intervention was relevant from a clinical point of view for the public health services in Mexico. The implementation of early warning systems aimed specifically at groups of the most widely used drugs, which entail a greater risk for the patient, is another alternative to consider and evaluate. Therefore, this study offers the opportunity to test new hypotheses in an area of knowledge that is limited in Mexico.

Acknowledgments We wish to thank all patients, the general practitioners and authorities of the participant Family Medicine Clinics at IMSS for their contribution to this study.

Funding This research was supported by a grant of the Instituto Mexicano del Seguro Social through Fondo para el Fomento de la Investigación Médica.

Conflicts of interest None.

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