

Detection and Management of Medication Errors in Internal Wards of A Teaching Hospital by Clinical Pharmacists

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Abstract- Any suboptimum treatment in the management of patients can lead to medication errors (MEs) that may increase morbidity and mortality in hospitalized individuals. By establishing well-designed patient care activities within the managed care setting, clinical pharmacists can cooperate with other health care professionals to provide quality care and maximize safety. The aim of this study was to evaluate the frequency and prevention of MEs by clinical pharmacists. This was a cross-sectional interventional study conducted in internal wards of a teaching hospital during a two-month period. During this period, patient records, and physician orders were reviewed by clinical pharmacists. Any prescription error identified was documented. Incorrect drug selection, dose, dosage form, frequency, or route of administration all were considered as medication errors. Then, the clinical pharmacist discuss about findings with the clinical fellows to change faulty orders. The frequency and types of MEs in different wards that were detected and prevented by clinical pharmacists was documented. During the study period, in 132 patients, 262 errors were detected (1.98 per each). Wrong frequency 71 (27%), forget to order 37 (14.1%), wrong selection 33 (12.5%), drug interactions 26 (9.9%), forget to discontinue 25 (9.5%) and inappropriate dose adjustment in renal impairment 25 (9.5%) were the most types of errors. Cardiovascular medications were the class with the highest detected errors (31.6%) followed by gastrointestinal agents (15.6%). Medication errors are common problems in medical wards that their frequency can be restricted by the intervention of clinical pharmacists.

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Introduction

Medication therapy management, or pharmaceutical care, is a dynamic component of the health care system. Its role is to ensure that medications are being used appropriately so that it improves a patient's health condition (1). By having established well-designed patient care activities and services within the managed care setting, pharmacists are authorized to cooperate with other health care professionals to provide permanent quality care on behalf of individual patients, improve outcomes, maximize safety and control health care costs (2). Medication errors may lead to sub-optimal treatment. The origins of medication errors are multifactorial. The reason behind this statement is that there are various factors that may induce medication errors which could be summarized as follows; illegible

orders, inadequate medical knowledge, and increased patient load particularly in teaching hospitals, failure to monitor drug concentration and therapy, and not having adjusted the dosage of medications in renal or hepatic impairments (3). These medication errors may put the patients in a danger of increasing morbidity and mortality (4). Furthermore, the confidence of the patient's in health care system may decrease and a great burden of cost would be imposed on the patients (5).

Although a long time has been elapsed since the emergence of clinical pharmacy specialist in Iran, the importance of their role and services in managed care teams had not yet been completely elucidated in all teaching hospitals. In this observational study we are about to introduce the medication errors in two months evaluation.

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Materials and Methods

This cross-sectional study was done in Gastroenterology and Endocrinology wards of Taleghani Hospital (affiliated to Shahid Beheshti University of Medical Sciences, Tehran, Iran) a well-known center of gastrointestinal and endocrine diseases in Iran.

In these wards, the process of medication ordering and administration all were hand-written based that means physicians write their orders on patient files and nurses transcribe these medication orders on separate sheets. The study was done during a two-month period from September through November 2009.

Patients were under the care of five attending gastroenterologists and six clinical fellows of gastroenterology, and five attending endocrinologists and four clinical fellows of endocrinology, also there were six internal medicine residents. Stagers and interns also participated in daily clinical rounds. Standard practice at the wards included daily medical rounds by the fellowships and the resident in charge. Furthermore, there were teaching rounds of the head of the wards who were one of the attending on Saturdays. All of the fellows and residents were obliged to attend at this particular round, the clinical pharmacist also participate in the teaching round. If there were any complicated patient the fellows consult the attending physician regarding the management. The fellow assessed the patients and made recommendations, and the resident would make changes to the prescriptions according to the recommendations.

During the period of study, patient records, laboratory data, and physician orders were reviewed by clinical pharmacists who were present in the wards three times a week throughout the day. Any prescription error identified by the clinical pharmacists was documented. Incorrect drug selection, dose, dosage form, frequency, or route of administration all were considered as prescription errors.

Then, the clinical pharmacists discuss about findings with the clinical fellows in charge of that patient who the medication error was regarded to. These discussions were approved and resulted in change of the faulty orders most of the times. The type of prescribing error used in this study was defined in table 1.

Data were analyzed using SPSS version 16 and expressed as mean \pm SD or percentages as appropriate.

Results

During the study period, 132 patients who were 70 (53%) females with mean \pm SD of age 55.5 ± 18.4 years old were evaluated for medication errors by clinical pharmacists. In 132 patients, 262 errors were detected (1.98 per each) and managed appropriately. The frequencies of identified errors were as followed: Wrong frequency 71 (27%), forget to order 37 (14.1%), wrong selection 33 (12.5%), drug interactions 26 (9.9%), forget to discontinue 25 (9.5%), inappropriate dose adjustment in renal impairment 25 (9.5%), under dose 16 (6.1%), overdose 15 (5.7%), lack of monitoring 14 (5.3%).

Table 1. Definitions and types of medication errors encountered in internal wards

Type of error	Definition/Example
Wrong frequency	Interval of administration was outside of a scheduled administration time. Salbutamol ordered QID instead of PRN
Wrong selection	Inappropriate selection of a medication based on the patient's conditions, Administration of atenolol in the management of portal hypertension
Overdose	Dose was greater than patient's requirements. Enoxaparin 80 mg/daily for deep venous prophylaxis
Forget to discontinue	Forget to discontinue of an ordered drug that was not necessary for patient. Forget to discontinue fluticasone after administration of seretide
Forget to order	No medication was prescribed for patient whereas a potential indication was existed. Forget to order stress ulcer prophylaxis in a patient with INR=1.7
Under dose	Dose was less than patient's requirements. Spironolactone 50 mg daily instead of 100 mg daily for intractable ascites
Lack of Monitoring	Deficiency of monitoring. Despite Albumin=3.5 g/dl, Albumin 20% was administered for the patient.
Drug Interaction	A drug interaction is a situation in which a substance affects the activity of a drug, i.e. the effects are increased or decreased. Drug interaction between clopidogrel and omeprazole.
No dose adjustment	Forget to calculate or wrong calculation of GFR or forget to decrease medication dosage based on patients GFR. Forget to discontinue Metformin in stage 4 of CKD.

CKD: Chronic kidney disease; GFR: Glomerular filtration rate; PRN: Per needed; QID: Four times daily

MEs' detection by clinical pharmacists

Cardiovascular medications were the class with the highest encountered errors 83 (31.6%), after which gastrointestinal agents 41 (15.6%) had the highest rank. Hormonal medication was the class with the lowest frequency of error. The most prevalent types of error in cardiovascular agent were belonged to wrong frequency 38 (46%) and wrong selection 13 (15.6%). The most common types of medication errors in gastrointestinal drugs were forget to order 19 (46.3%) and wrong frequency 11 (26.8%), respectively. The most frequent errors in respiratory drugs were related to forget to discontinue and forget to order. The most prevalent errors related to central nervous system agents were wrong selection followed by under dose. Fifty percents of identified interactions were related to interaction between ciprofloxacin and calcium and the second important one was the interaction between omeprazole and clopidogrel 4 (15.3%). The main error in dose adjustment was associated with wrong glomerular filtration rate (GFR) calculation based on Cockcroft-Gault formula including inappropriate dose adjustment for metformin 4 (16%) and antibiotics 4 (16%).

Discussion

Medication error is a preventable event that may lead to inappropriate medication use or patient's harm which can contribute to an undesired outcome of patients (1). Only few observational studies were done to assess the prevalence of medication errors within a teaching hospital in Iran. This may be due to the fact that clinical pharmacy is a novel profession in Iran with limited number of graduates. This is the first report of medication errors' prevalence in gastroenterology and endocrinology wards observed by clinical pharmacist in Iran. We have found that the mean number of medication errors per patient was 1.98 in this study. Surprisingly the rate of medication error per patient hospitalized in the intensive care unit (ICU) was in the range of 0.15 to 0.33 in previous studies (6,7). Poly-pharmacy is routinely applied for patients who hospitalized in ICU, because these patients have many medical problems simultaneously, therefore the range of encountered medication error in ICU should be logically higher compared to those hospitalized in internal wards. It is believed that the attendance of clinical pharmacist in medical care system can reduce the number of medication errors, maximized safety and lowered the health care costs (8,9). Leap *et al.* and Kucukarslan *et al.* found that the attendance of clinical pharmacist could help in lowering the adverse drug reactions and

medication errors significantly (10,11). However, clinical pharmacists not only did not attend clinical rounds of gastroenterology and endocrinology wards but also they did not visit patients hospitalized in these wards routinely. Therefore, this can potentially explain the higher frequency of medication errors in this study compared to what reported for ICU despite lower number of medications administered concomitantly in patients enrolled in our study.

Cardiovascular agents were the class with highest frequency of errors in the present study. Concomitant cardiovascular disorders such as portal hypertension was common in cirrhotic patients admitted to gastroenterology ward also metabolic syndrome and consequently hypertension and hyperlipidemia are highly prevalent clinical entity among diabetic patients, in endocrinology ward (12). Therefore, the appropriate use of cardiovascular agents including beta blockers and angiotensin converting enzyme inhibitors that are necessary to manage these patients (13), was an important concern in this study. Nevertheless, because of the limited knowledge of gastroenterologists and endocrinologists about cardiovascular agents, forget to reorder the cardiology residents' notes for patients transferred from cardiology wards or lack of attention to the medications that were previously prescribed for outpatients, the use of this class of medication was with lots of errors in this study.

In our study the most encountered errors were related to wrong frequency of medications especially for cardiovascular agents. This can be partly explained by the fact that in teaching hospitals internal medicine residents are in charge of patients hospitalized in endocrinology and gastroenterology wards while they do not have the complete knowledge regarding different therapeutic classes of cardiovascular medications. This statement is the potential reason behind why they administer medications that should be prescribed once daily in four divided doses or vice versa. Also we found that the second main medication error among cardiovascular agents was related to wrong selection of best choice according to patient conditions such as administration of propranolol for diabetic patients or furosemide for the management of hypertension (13).

After cardiovascular agents, the highest medication errors were observed in gastrointestinal medications. That was related to forget to order and after which, wrong frequency of these medications' administration. The reason for the high prevalence of forgets to order medication error was the neglect to order the gastrointestinal agents for the prevention of stress

related ulcer. The large majority of these errors being seen commonly due to the physicians' forgetfulness of taking a good history from patients about gastric ulceration or bleeding prior to the admission to hospital and may be related to a lack of perception of stress ulcer prophylaxis indications (14).

Medication errors of respiratory agents mainly related were to metered dose inhalation drugs and forget to change scheduled salbutamol spray to use as needed after chronic obstructive pulmonary disorder exacerbation management (15).

Drug-food and drug-drug interactions are important features of treatment among hospitalized patients. Interactions may change the effects of drugs in different manners such as absorption, metabolism, excretion and other aspect of kinetics parameters (16). Among medication errors in internal wards drug interactions are commonly seen and unfortunately most of the time physicians don't take these interactions serious. The large number of interactions in this study was seen between ciprofloxacin and calcium products, which were utilized at the same time, and as a result the absorption of ciprofloxacin was decreased (17). The second significant interaction was co-administration of clopidogrel and omeprazole; several studies showed that omeprazole can decrease the levels of the active form of clopidogrel in the blood and reduce its anti-platelet effects (18).

One of the complications of diabetic patients is nephropathy and chronic kidney disease (CKD) (19), so it is vital to measure the serum creatinine, calculate GFR and adjust medication dose based on CKD stages (20). However, this concept is missed frequently, and different errors take place in this area. Another kind of medication error in this regard was related to the use of actual body weight of obese patients instead of ideal body weight in GFR calculation which may lead to overestimation of GFR in these patients and consequently over dosage of medications (21). Metformin is the cornerstone of diabetes management, and it is recommended to be discontinued in GFR<60 ml/min, 16% of our medication errors were related to continuation of metformin despite of low GFR (22).

It is proven in previous studies that clinical pharmacists are needed as a key recourse for improving the quality of patient's health condition (23). Furthermore, collaboration of pharmacists with health care organizations make reductions in prescription errors and improvements in the management quality in patients of any settings, such as nephrology ward (24), and ICU (25). Medication errors may put the patients in danger of

increasing morbidity and mortality (4). So the attendance of clinical pharmacists in almost all medication wards rounds and in the time of decision making of clinical fellows and specialists for selection of the medications for each patient can help to reducing medication errors which can be harmful for the patients. Clinical pharmacists can review the medical records and check the physician's orders for detecting the probable errors which may be partly related to nursing staff errors. Pharmacist's consultations reduced the antibiotic consumption and have lead to an improved clinical response, better outcomes and a decrease in medication errors in previous studies (26-29). Our study was done in the gastroenterology and endocrinology wards also revealed a high number of medication errors that was prevented by the presence of clinical pharmacists. Some of these errors may even be life-threatening such as metabolic acidosis that can be precipitated by administration of metformin in end stage renal disease. In order to reduce medication errors and potential harms of these faults to patients we recommend that the attendance of a clinical pharmacist in all wards of hospital in collaboration with physicians and other health care systems is necessary in management of patients' diseases. Clinical pharmacists' attendance at the internal wards may help in detection and management of prescription errors therefore prevents patients from untoward consequences of various types of medication errors.

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