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A SURVEY ON THE CAUSES OF MEDICATION ERRORS FROM THE PERSPECTIVES OF PHYSICIAN, PHARMACISTS, NURSES, PARAMEDICS IN TEACHING HOSPITALS AND HEALTHCARE CENTERS OF CHAHARMAHAL VA BAKHTIARI AND PRACTICAL STRATEGIES TO REDUCE THEM

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ABSTRACT

Background and purpose: Medication errors represent a class of unforgivable human errors. Lack of national statistics and ethnographical studies of medication errors, and refusal to report these errors are some of challenges ahead. It is essential to detect these challenges to develop strategies to deal with committing or recommitting medication errors. This study was conducted to survey the perspectives of physicians and paramedics in Chaharmahal va Bakhtiari province about the causes of medication errors. **Methods:** First, 91 physicians and paramedics who attended a 2-day workshop in May, 2016 were randomly divided into eight groups of 10 people and a group of 11 people and asked to enlist medication errors. Then, the medication errors were recorded in a questionnaire consisting of items rated by 5-point Likert scale, with confirmed validity and reliability. Data were analyzed by descriptive statistics (frequency and percentage) and Fisher's exact test in SPSS 16. The level of significance was considered 0.05. **Results:** The errors related to physician bad handwriting (83.3%), physicians' moodiness (65.9%), and excessive fatigue (56.8%), new personnel's lack of familiarity with drug storage conditions (59.3%), pharmaceutical calculations (58.2%), drug prescription (55.6%), lack of compliance of pharmacological courses with pharmaceutical duties (58.1%), lack of pharmacists' mastery over scientific topics (58.0%), accessibility to pharmacist in three shift works (52.5%), and medication rounds (59.8%), drug shape confusion (56.8%), and caregiver's error (79.3%) were reported to be (very) highly and significantly important, and the frequency and causes of medication errors were different ($p < 0.05$). **Conclusion:** Detecting the causes of medication errors in different wards and hospitals, and holding in-service training for nurses, physicians, hospital pharmacists, and patients caregivers can help prevent incidence of medication errors.

INTRODUCTION

In all human communities, it has been acknowledged that human is likely to do wrong. Although medical errors are considered to be some kind of human errors, people do not tolerate any errors committed by medical community for several errors, which doubles the significance of this issue. Medication errors are a class of medical errors that all medical professionals have experienced at least once, and it is essential to pay attention to these errors [1]. A medication error refers to any preventable event that may cause or lead to inappropriate drug use or patient harm while this error can be related to the performance of health care professionals, pharmaceutical products, system, or processes including prescribing to using pharmaceutical product [2].

Each year, thousands of medication errors committed by medical and paramedical staff in the USA are reported. According to the latest figures, At least 100000 people die due to medication errors and side effects in the USA every year. The majority (49%-56%) of unintentional drug events have been reported to occur due to prescription errors committed by physicians [3]. Nurses and pharmacy personnel have been reported to commit 26%-34% of the medication errors [14]. In European countries, 19%-28% of inpatients are affected by medication errors. The primary and expectable outcome of such errors is the lengthened duration of hospitalization and increased expenses, and occasionally severe harm and even death [5].

According to evidence, one per five drug prescriptions in the USA is associated with medication error. Given the side effects of different drugs, the figures represent the depth of risk that threatens patients. A study demonstrated that only in two hospitals, 40 patients lost their lives due to medication errors and each patient during hospitalization was exposed to two medication errors by average [6]. Therefore, collaboration among physicians, nurses, pharmacists, and other members of treatment team is essentially required. Undoubtedly, many of these errors remain unreported and real figures can be even more regrettable [7]. Besides that, although incidence of these errors may be similar in most cases and highly consistent with the findings of studies conducted in other countries, it is not necessarily the same [8].

Therefore, it is essential to conduct ethnographical studies on medication errors in Iran. Moreover, many medication errors are left unreported in many cases for several reasons [9]. Therefore, indirect yet practical approaches can contribute significantly to preventing the repeated incidence of the errors. This study was conducted to ethnographically investigate incidence of medication errors in hospitals from the perspectives of physicians, nurses, pharmacists, and paramedics about the frequency of medication errors and strategies to prevent them.

KEY WORDS

Medication errors, pharmacist, physician, nurse, patient caregiver

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MATERIALS AND METHODS

First, 91 general practitioners, teaching and non-teaching specialists working in hospitals, nurses, paramedics, and hospital pharmacists working in teaching health care centers, and university-affiliated and Social Security Organization-affiliated hospitals who attended a workshop on hospital safety principles were randomly assigned to 10 workgroups of 10 people each and one workgroup of 11 people and asked to write down the most important medication errors on a paper and deliver it to the workgroup leader. Then, with a statistician's assistance, the medication errors written down by the participants were listed, duplicate errors were removed, and a questionnaire consisting of items rated by 5-point (of very low importance, of low importance, of moderate importance, important, and highly important) Likert scale was developed to investigate the frequency of the medication errors. The validity and reliability of the items were investigated and confirmed. Then, data were encoded according to different hospital wards and analyzed by descriptive (frequency and percentage) and analytical (Fisher's exact test) statistics.

RESULTS

Of the 91 participants, 9 (10.8%) worked in ICUs and nursing office, 16 (19.3%) in orthopedics and surgical wards, 29 (34.9%) in neurology and internal wards, 23 (27.7%) in emergency and medical emergency wards, and 6 (7.3%) in ENT and ophthalmology wards. Eight people did not respond to the question "Which ward do you work in"?

Table 1: Frequency and percentage of medication errors reported by the studied people

Row	Medication errors	Highly and very highly important	Moderately important	Lowly and very lowly important
1	Lack of physicians' mastery over drug interactions	35 (38.5)	47 (51.6)	9 (9.9)
2	Lack of physicians' full knowledge about food-drug interactions	38 (41.8)	44 (48.4)	9 (9.9)
3	Lack of physicians' full knowledge about drug incompatibilities (syringe-serum)	41 (45.6)	34 (37.8)	15 (16.7)
4	Physicians' bad handwriting	75 (83.3)	10 (11.1)	5 (5.6)
5	Moodiness and bad temper that cause stress to the nurse.	60 (65.9)	20 (22.0)	11 (12.1)
6	Lack of physicians' paying attention to drugs prescribed by advisory physicians	37 (41.6)	31 (34.8)	21 (23.6)
7	<i>lack of pharmacy's informing the staff about different drug shapes or changing them on time (e.g. ENOXA 4000 instead of ENOXA 8000)</i>	48 (53.9)	33 (37.1)	8 (9.0)
8	Lack of nurses' mastery over different shapes of a drug (ophthalmic-cutaneous tetracycline, etc.)	36 (39.6)	31 (34.1)	24 (26.4)
9	Lack of physicians' correct diagnosis	42 (46.2)	35 (38.5)	14 (15.4)
10	Wrong dose	38 (41.8)	35 (37.4)	19 (20.9)
11	Lack of paying attention to patients' pharmaceutical history	42 (47.2)	34 (38.2)	13 (14.6)
12	Lack of paying attention to patients' physiological conditions (pregnancy, etc.)	34 (37.4)	31 (34.1)	26 (28.6)
13	Not labeling the drugs appropriately after dilution	39 (43.3)	27 (30.0)	24 (26.7)
14	Not implementing drug orders at appointed time	29 (31.9)	22 (24.4)	39 (43.3)
15	Injecting many drugs before conducting relevant tests	36 (39.6)	32 (35.2)	23 (25.3)
16	Lack of similarity between the same medical equipment (injection pump, insulin syringe, etc.) with different brands	27 (29.7)	39 (42.9)	25 (27.5)
17	Lack of familiarity with drug storage conditions	30 (33.0)	43 (47.3)	18 (19.8)
18	Lack of nurses' familiarity with pharmaceutical calculations	46 (50.5)	32 (35.2)	13 (14.3)
19	Lack of physicians' familiarity with pharmaceutical calculations	35 (38.5)	39 (42.9)	17 (18.7)
20	Lack of nurses' mastery over the methods of drug administration	37 (45.1)	24 (29.3)	21 (25.6)
21	Drug name confusion	42 (51.9)	21 (25.9)	18 (22.2)
22	Drug shape confusion	46 (56.8)	21 (25.9)	14 (17.3)

23	Handling beds by patients or caregivers	33 (41.8)	30 (38.0)	16 (20.3)
24	Patients' or caregivers' prescribing drug by oneself or unknowledgeably	42 (51.9)	21 (25.9)	18 (22.2)
25	Nurses' fear of reporting medication errors	41 (50.6)	24 (29.6)	16 (19.8)
26	Lack of pharmacy managers' ward monitoring	47 (58.0)	26 (32.1)	8 (9.9)
27	Lack of technical officials' pharmaceutical round	46 (56.8)	30 (37.0)	5 (6.2)
28	Lack of technical officials' mastery over drug scientific materials	37 (46.2)	33 (41.2)	10 (12.5)
29	Lack of pharmacy staff's mastery over drug scientific materials	39 (48.8)	30 (37.5)	11 (13.8)
30	Medication errors due to wrong containers or labeling	35 (43.2)	25 (30.9)	21 (25.9)
31	Errors in transferring the physician's order from the medical file to the Kardex	32 (40.5)	28 (35.4)	19 (24.1)
32	Lack of injection of patient with sufficient dose of drug due to low quality injection products	32 (40.0)	25 (31.2)	23 (28.8)
33	Mistaking medical equipment in emergencies (blood collection set, serum collection set)	30 (37.5)	24 (30.0)	26 (32.5)
34	Lack of paying attention to expiry date and using it	32 (39.5)	25 (30.9)	24 (29.6)
35	Lack of physicians' mastery over drug gavage	30 (38.5)	20 (25.6)	28 (35.9)
36	Lack of nurses mastery over drug gavage	24 (30.0)	29 (36.2)	27 (33.8)
37	Lack of selecting appropriate solvent or diluter for venous infusion	28 (30.8)	21 (26.9)	29 (37.2)
38	Nurses' excessive fatigue	41 (51.2)	26 (32.5)	13 (16.2)
39	Physicians' excessive fatigue	46 (56.8)	21 (25.9)	14 (17.3)
40	Lack of faculty trainers' full knowledge about pharmacological materials	42 (52.5)	32 (40.0)	6 (7.5)
41	Lack of novice staff's familiarity with drug prescription	45 (55.6)	29 (35.8)	7 (8.6)
42	Lack of novice staff's familiarity with pharmaceutical calculations	46 (58.2)	24 (30.4)	9 (11.4)
43	Lack of novice staff's familiarity with drug storage conditions	48 (59.3)	25 (30.9)	8 (9.9)
44	Use of inappropriate abbreviations in physicians' prescribing drugs	35 (43.8)	30 (37.5)	15 (16.5)
45	Mismatch between the studied drug information and pharmacological materials during academic nursing studies and pharmaceutical duties in the ward after graduation	50 (58.1)	32 (37.2)	4 (4.7)
46	Physicians' incomplete order (e.g. prn or administration method)	46 (52.3)	37 (42.0)	5 (5.7)
47	Cordial belief in sensitivity of medication errors issue	45 (51.2)	34 (38.6)	9 (10.2)
48	Lack of paying attention to patients' physiological conditions (pregnancy, lactating, etc.)	41 (47.7)	34 (39.5)	11 (12.8)

From the perspectives of most participants, lack of implementing drug orders at the appointed time (43.3%) and lack of selecting appropriate solvent or diluter for venous infusion (37.2%) were of low or very low importance, and lack of physicians' mastery over drug interactions (51.6%), lack of physician's full knowledge about food-drug interactions (48.4%), lack of similarity between the same medical equipment (injection pump, insulin syringe, etc.) with different brands (42.9%), lack of nurses' familiarity with drug storage conditions (47.3%), lack of physicians' familiarity with pharmaceutical calculations (42.9%), and lack of nurses' mastery over medication gavage (36.2%) were moderately important.

Highly important and important causes of the medication errors, from the participants' perspectives, were physicians' bad handwriting (83.3%), physicians' moodiness and bad temper that cause stress to the nurse (65.9%), lack of novice staff's familiarity with drug storage conditions (59.3%), mismatch between the studied drug information and pharmacological materials during academic nursing studies and pharmaceutical duties in the ward after graduation (58.1%), lack of pharmacy managers' ward monitoring (58.0%), drug shape confusion (56.8%), lack of medication rounds by technical officials (56.8%), physicians' excessive fatigue (56.8%) (Figure 1), lack of novice staff's familiarity with drug prescription (55.6%), lack of pharmacy's informing the staff about different drug shapes or changing them on time (e.g.

ENOXA 4000 instead of ENOXA 8000) (53.9%), and lack of faculty trainers' full knowledge about pharmacological materials (53.2%).

Medication errors related to lack of physicians' familiarity with drug-food interactions, lack of physicians' familiarity with drug incompatibilities (e.g. syringe-serum), lack of pharmacy's informing the staff about different drug shapes or changing them (e.g. ENOXA 4000 instead of ENOXA 8000), lack of implementing drug order on the appointed time, drug shape confusion, and errors in transferring the physician's order from the medical file to the Kardex were significantly associated with the wards ($p < 0.05$), and other errors were not associated with the wards ($p > 0.05$).

Most participants working in the ICU and nursing office (66.7%), orthopedics and surgical wards (62.5%), and neurology and internal wards (58.6%) considered lack of physicians' full knowledge about drug-food interactions to be moderately important, most of them in emergency and medical emergency wards (60.9%) considered it to be highly important or very highly important, and most of them in ENT and ophthalmology wards (50%) considered it to be of low or very low importance.

Most participants working in the ICU and nursing office (66.7%), neurology and internal wards (62.1%), considered lack of physicians' full knowledge about drug incompatibilities to be moderately important, most of them in emergency and medical emergency wards (65.2%) and orthopedics and surgical wards (43.8%) considered it to be important or highly important, and most of them in ENT and ophthalmology wards (66.7%) considered it to be of low or very low importance.

Most participants working in the ICU and nursing office (55.6%), orthopedics and surgical wards (62.5%), and ENT and ophthalmology wards (66.7%) considered lack of pharmacy's informing the staff about different drug shapes or changing them on time (e.g. Enoxaparin 4000 instead of Enoxaparin 8000) to be moderately important, and most of them in neurology and internal wards (50%) and emergency and medical emergency wards (72.7%) considered it to be important or highly important.

Most participants working in the ICU and nursing office (62.5%), emergency and medical emergency wards (47.8%), and ENT and ophthalmology wards (83.3%) considered lack of implementing drug orders at the appointed time to be highly or very highly important, and most of them in neurology and internal wards considered it to be of low or very low importance (43.8%) and highly or very highly important (43.8%).

Most participants working in the ICU and nursing office (87.5%), neurology and internal wards (48%), and ENT and ophthalmology wards (100%), and emergency and medical emergency (52.4%) considered drug shape confusion to be highly or very highly important, and most of them in orthopedics and surgical wards (53.3%) considered it to be moderately important.

Most participants working in the ICU and nursing office (71.4%) and neurology and internal wards (56%) considered errors in transferring the physician's order from the medical file to the Kardex to be highly or very highly important, most of them in emergency and medical emergency (50%) considered it to be of low or very low importance, most of them in the ENT and ophthalmology wards (100%) considered it to be highly important, and 33.3% of them in orthopedics and surgical wards considered it to be of low or very low importance, 33.3% moderately important, and 33.3% highly or very highly important.

The errors related to physicians' bad handwriting, physicians' moodiness and bad temper, excessive fatigue, physicians' incomplete order, lack of observing prescription principles, and lack of taking into account previous conditions of the patient and advisory physician's order were the most frequent causes of medication errors committed by the physicians, and lack of novice staff's familiarity with pharmaceutical calculations and drug storage conditions, nurses' fear of reporting medication errors, drug shape and name confusion, lack of hospital pharmacist's monitoring and ward rounds, and lack of pharmacy's informing the staff about different drug shapes or changing them on time were the most frequent causes of medication errors committed by nurses and pharmacists [Table 1].

DISCUSSION

The incidence of medication errors in hospitals is unavoidable, but frequency of these errors can be reduced by adoption of sensible and practical approaches and detecting the most common ones. Study of the type and causes of medication errors is the first step to prevent incidence of them.

Medication errors are a multidimensional issue and therefore, multidimensional approaches should be sought out to resolve them. In this study, lack of cordial belief in the sensitivity of medication errors issue and especially the nurses' fear of reporting medication errors were found to be highly frequent, which causes other medication errors to occur. Jolaei et al. study on medication errors committed by nurses and its association with working conditions in university-affiliated hospitals in Iran demonstrated the mean number of nurses' medication errors during three months 5.19 and the mean number of the reported errors 3.1 [10].

In the current study, physicians' fatigue and physicians' moodiness and bad temper were among the highly frequent causes of medication errors. Although problems in the incidence of medication errors in hospitals have already been reported, the frequency of such errors' causes, especially physicians' bad handwriting

has been reported to be much less frequent than that in our study. It seems that practical strategies including training prescription principles should be adopted to reduce medication errors.

In addition, lack of novice staff's familiarity with drug prescription, pharmaceutical calculations, and drug storage conditions after dilution were found to be among the most important causes of medication errors in this study. According to the findings of a study in Japan, the most important medication error committed by recently graduated nurses was wrong intravenous injection and the most important reason for this error low pharmacological knowledge [11]. leape et al. study demonstrated that 15% of medication errors committed by nurses are due to insufficient pharmacological knowledge [12].

This study also indicated that mismatch between the studied drug information and pharmacological materials during academic nursing studies and pharmaceutical duties in the ward after graduation in the ward had a highly important role in incidence of medication errors. Obviously, in the three-credit course of pharmacology in academic nursing studies, the main purpose is to achieve an introductory familiarity with drugs because of the density of the material and what is presented largely in the second and third terms, and fewer subjects on pharmaceutical calculations, drug storage and maintenance conditions, drug incompatibilities, and drug interactions are taught.

Besides that, in the current survey, lack of pharmacists' sufficient information and repeated ward rounds was reported to be an important cause of medication errors. Unfortunately, in pharmacology curriculum, full familiarity with hospital drugs or the minimum scientific skills of hospital pharmacy has not been taken into account. In addition, a study found that few refresher courses for hospital pharmacists has been considered by the relevant authorities and formal and scientific courses are deeply needed. Moreover, continuous training for physicians is needed to enhance hospital pharmaceutical care [13].

In the current study, drug name and shape confusion, e.g. Confusion of colors, shapes, names, and units of ceftriaxone and cefazolin is an example, was one of the highly frequent medication errors. Unfortunately, pharmaceutical companies have not yet take serious measures to assign different colors and packaging to different hospital intravenous drugs, but alas, this deficiency is on rise. Lack of injection of patient with sufficient dose of drug due to low quality injection products was one of the highly frequent medication errors. Furthermore, some products are usually reported when the product has been consumed, which causes a lot of problems [14].

Lack of nurses' mastery over pharmaceutical calculations was one of the frequently reported causes of medication errors. Studies have indicated that nurses need in-depth training about how to calculate the dose of injection soluble drugs, combination drugs, and additive drugs to serum. Kuzoowa et al. found that nurses faced certain problems due to not paying attention to the prescribed drugs doses, converting drug units erroneously, and not being able to apply their theoretical knowledge in clinical services [15]. Moccia et al. reported that 58% of nurses were unable to calculate pharmaceutical doses appropriately. Moreover, Bindler et al., consistent with Santanaria et al. study, reported that 81% of nurses were unable to calculate pharmaceutical doses appropriately [16-17].

Errors related to patients' care givers interference were reported to be highly frequent. Unfortunately, handling beds by patients or caregivers, prescribing drug by oneself or unknowledgeably, which was frequently reported, may cause incidence of bitter and occasionally fatal medication errors. These errors have been less frequently investigated to date, which doubles the significance of ethnographical study of medication errors. In addition, the causes of medication errors had similar frequency in different wards. According to this survey, first, although the hospital medication errors reported by the participants in this study were largely similar to those reported by previous studies, the causes of such errors in Iran are not necessarily similar to those in other countries and therefore it is necessary to conduct ethnographical studies on medication errors. Secondly, the incidence frequency of errors are not considered to have equal levels of importance in different wards, and the incidence frequency of each error should be closely determined in each ward and then basic strategies should be developed based on prioritization of preventing incidence of the errors.

Thirdly, the contents of nursing and pharmacy courses should be revised to make fundamental changes such that essential skills of hospital pharmacology are inserted in the curricula. Moreover, continuous and occasionally face-to-face training sessions should be held for pharmacists and nurses working in hospitals should be conducted. Moreover, short-term training at the onset of employment and introductory training on hospital medication errors should be conducted for novice staff and skills of hospital pharmacy related to medication errors should be trained to pharmacists and physicians by officials in charge.

Conclusion: In the light of the findings of this survey, medical professionals in hospitals and teaching, treatment healthcare centers have low levels of information about hospital pharmaceutical calculations, serum-syringe drug incompatibilities, drug storage and maintenance conditions, and scientific principles of gavage therapy. Therefore, it is essential to train these subject matters to staff to reduce the incidence of medication errors.

CONFLICT OF INTEREST

There is no conflict of interest.

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