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Research Article

Underlying Factors of Medication Errors at a Tertiary Care Hospital in Pakistan

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Abstract

Background: Medication error is considered to be an important indicator of a patient's safety. Several error producing factors contribute to its occurrence.

Methods: Using a quantitative design, this study aimed to identify the underlying factors of medication errors at a tertiary care hospital in Karachi, Pakistan. Following the eligibility criteria, 64 medication errors, reported in the period from December 2011 to March 2012, were included in the study. Data was collected by reviewing documents pertinent to the errors, a self-administered survey questionnaire, with doctors, pharmacists, and nurses who had committed an error.

Results: Analysis of the quantitative data showed that of the 64 errors, 49 were actual errors, 15 were near misses and 2 were classified as sentinel events. The highest percentage of errors was committed in the administration phase, by nurses, in the morning shift.

Conclusion: These findings have implications for the hospital administration to bring an improvement in the system.

Keywords: *Medication Errors; Factors; Patient Safety*

Introduction

Medication error is a complex issue to address because several personal and contextual factors contribute to its occurrence. Heavy workload, decrease in staffing, lack of supervision by managerial staff, and mishandling of new technologies are referred to as contextual factors [1-3]. To minimize the consequences of medication errors, it is important to understand their underlying factors associated with medication errors.

Although in the past, studies have been conducted at Tertiary hospital, in Pakistan about the types of errors and reasons for under reporting medication errors [1,4-6]. One study reported perceived factors contributed by nurses [3], no study has been done to investigate the underlying factors among health care professionals including physicians, pharmacists and nurses, why these errors occurs in the Pakistani context. In view of the above information, it is important to explore the underlying factors that cause medication errors among multidisciplinary health care team.

Study Purpose

The purpose of this study was to identify the underlying factors that contribute towards medication errors at the tertiary hospital, Pakistan. In particular, this study was designed to answer the following questions:

1. What are the underlying causes that lead to medication errors?

Literature Review

A systematic and comprehensive search was done, to access research studies on factors underlying medication errors. Various words and phrases were used to guide the search that included: medication errors, medication adverse event, and causes of medication error. Data bases such as CINAHL, Mosby Nursing Consult, PubMed, Sage, and Science Direct were used to guide the search. The search ranged from 2010 up to 2017.

In a prospective study, Coombes, Stowasser, Coombes, and Mitchell [7] investigated the causes of prescribing errors made by interns over a period of 5 months in Australia. A total of 47 errors were reported, out of which 14 interns were recruited for face to face interview. Data were organized into individual, team, environment, task, and patient factors. Lack of knowledge, skills, and competence were included in the individual factors. Poor supervision and a lack of communication between or within the team were categorized as team factors. Environmental factors included a hectic work load, a noisy or distracting environment, and decrease in staffing; whereas, task factors involved ambiguous guidelines, and the patient factors included complicated cases.

Likewise, in Finland, Jylha, Saranto, and Bates [8] used a National data of 6 years (2001 to 2007) to explore factors that contributed to drug errors by doctors, pharmacists, and nurses. Data collection was based on patient complaints, patient records, and statements of experts and health care personnel who were involved in drug errors. A total of 67 drug errors that occurred and 57 statements were reviewed. Using content analysis, researchers discussed their findings under several themes, which included human factors, communication, information transfer, and the use of data. The human factors included miscalculations, misunderstandings, and inadequate knowledge. However, poor communication among doctors and nurses was also identified as a factor in all the incidents. Transferring of patients' information from one unit to another and misinterpretation of the patients' data were identified as sources of problem between nurses and doctors.

Using the snowball sampling technique, Kim., *et al*. [2] recruited 224 Korean nurses for a survey. Participants were asked to fill out a questionnaire. The study results showed that around 140 nurses had been associated with medication errors; 67.2% of these errors were related to intravenous administration and about 43.3% of the errors occurred during the day shift. In response to causes of error, about 45.5% of the participants ranked unfamiliarity with drugs as the main cause, followed by administration without rechecking (45%), heavy workload (40.9%), and miscommunication (34%) as contributory factors to medication errors.

Correspondingly, in their telephonic survey about causes of drug errors, Lu and Roughead [9] accessed 10,910 patients in seven countries: Australia, Canada, New Zealand, United Kingdom, United States, Germany, and the Netherlands. Of these patients, 1291 had experienced an error in the past two years. The results of the study indicated that poor coordination among health team members was the most significant cause of medication errors.

In addition, Sajjad., *et al*. [3] conducted study in Tertiary care hospital in Pakistan to identify perceived factors of medication errors by using cross sectional study design. Factors that contribute to error were shortage of nursing staff, and environmental interruptions during medication preparation phase (26%). The study recommended the use of electronic medication administration system to prevent errors.

Study population and setting

The study included all medication errors at the Tertiary Hospital that were reported through the online incident reporting system from December 2011 to March 2012. Moreover, the nurses, physicians, and pharmacists involved in the reported drug incidents, were included in the study.

Inclusion and exclusion criteria

1. Those drug errors that have led to or could have led to a substantial injury to patients were included in the study. However, those cases of drug errors that were reported but not confirmed by the clinical affairs physicians, pharmacy supervisors, or nursing managers were excluded. Those cases of drug error that involved more than one health care professional were also excluded from the study.

2. Only those health care professionals who agreed to participate voluntarily in the study, and also provided a written consent, were included in the study.

Data collection strategies

Data was collected through three strategies which included: documents pertinent to medication incidence and a survey questionnaire.

Documents: Details about the description of medication error were obtained from the online incident report document and other supporting evidences, such as patient files.

Survey questionnaire: A self-developed survey questionnaire was used to collect contextual information about the error. Besides eliciting demographic information of the health care professionals involved in the error, information about their work hours, type of shift worked, workload, and the open ended written question was asked.

Sample size and sampling

Following the eligibility criteria, all the medication errors (n= 64) that occurred between December 2011 and March 2012 were included in the study. A total of 64 health care professionals took part in this study and filled the questionnaire.

Process of data collection

The following steps were used to access information on medication errors and to access the staff involved in making those errors.

1. After getting the approval from the Director Clinical Affairs, Director Pharmacy Services, and Director Nursing Services, the Lead Clinical Analyst, who receives all the data regarding the incidents of the medication errors, informed the researcher about the incidents as they were reported.

2. The information about the incidents was shared with the research expert to assess its eligibility for inclusion in the study.

3. After inclusion, the researcher confirmed the incident with the concerned division/department of medicine, pharmacy, and nursing.

4. Once the concerned health care professionals showed an interest to participate, the researcher sought an informed consent from them.

5. After the participants had filled the questionnaires, these were returned to the researcher by the participants. Based on the confirmation for an interview by the health care professionals, and their available contact number written in the questionnaire, the researcher contacted the participants.

Reliability and validity

For the quantitative data, a questionnaire was developed on the basis of a literature search. Face validity of the questionnaire was established by a panel of experts (Director of Nursing, two nursing faculty members, and a nurse manager), who had extensive experience in the hospital system.

Organization and data analysis

To record the quantitative data entries, a code book was prepared by the researcher to reduce errors during data entry and its analysis. Double entry of the data into SPSS version 20 was done to ensure the accuracy of the data entered to get a descriptive analysis. Frequencies and percentages were calculated for age, experiences, number of hours worked per week, and number of hours worked on the day of the error, etc.

For the analysis of open ended written questions, the researcher typed the written statements in the word document. Themes and codes were noted in front of the written statements in separate margins.

Ethical considerations

This study involved access to confidential information, that is, medication errors at the tertiary Hospital. The principles of anonymity, confidentiality, and respect for human dignity were followed consistently throughout this study [10].

Results

Description of medication errors

A total of 83 medication errors were reported during the study period from December 2011 to March 2012. The reporting time of errors after the actual incident varied from 6 to more than 48 hours. Twenty-nine incidents (45.3%) of the drug errors were reported within 6 hours, 23 (35.9%) within twenty four hours while 12 (18.8%) were reported a day after the incident. Most of the errors occurred on the medical unit followed by the surgical, critical care and pediatrics units (Table 1).

Unit	n	(%)	Number of beds/patients	Nurse-patient ratio
Medical unit	22	(34.4)	56	1:10
Surgical unit	14	(21.9)	56	1:10
Critical care	11	(17.2)	14	1:1
Pediatrics	9	(14.1)	57	1:5-7
Gynecology	4	(6.3)	53	1:15
Psychiatric	3	(4.7)	18	1:9
Consulting Clinics	1	(1.6)	1300-1500 patients per day	1:15

Table 1: *Distribution of medication errors by units.*

Of the 64 errors, 49 (76.5%) were categorized as actual errors while 15 (23.4%) were categorized as near miss–errors which did not reach the patient but could have caused harm. Of the 49 actual errors, 47 did not result in severe harm to the patient, 2 errors (3.1%) did and were classified as sentinel events–errors that caused serious harm to the patient.

As shown in table 2, most of the reported (38) errors were related to the administration cycle. Fifteen errors occurred in the dispensing phase while 9 in the prescribing phase. Of the 64 health care professionals who participated in this study, 9 were doctors, 15 were pharmacists and 40 were nurses (Table 3). With regards to the type of error, the common errors were dispensing of a wrong medicine or administration of a wrong dose, followed by missing a dose of medication. Self-administered questionnaire was used to obtain contextual information about what may have contributed to the occurrence of error. All of them were full time employed, but one was part time. Their age ranged from 21 to 50 years (See table 3). Most of them who committed the errors were under the age group of 26 to 30 years.

Type of Errors	Prescribing	Dispensing	Administering	Monitoring	Total (n)	Percentage (%)
Wrong drug	4	10	3	1	18	28.1%
Wrong dose	5		10		15	23.4%
Medication not given			12		12	18.7%
Delayed administration		4	5		9	14%
Medication reaction			2	1	3	4.69%
Wrong route			2		2	3.12%
Expired drug		1	1		2	3.12%
Given but not prescribed			1		1	1.56%
Wrong patient			1		1	1.56%
Wrong frequency			1		1	1.56%
Total	9	15	38	2	64	100%

Table 2: *Type of errors and the phases of medication management.*

Profile	Sub-profile	N	%
Occupation	Doctors	9	14.1%
	Pharmacists	15	23.4%
	Nurses	40	62.5%
Age	21 - 25 years	24	37.5%
	26 - 30 years	32	50%
	> 31 years	8	12.5%
Shift duties	Rotate all shifts	59	92.1%
	Fixed shift	5	7.8%

Table 3: *Participant's profile.*

With regard to the category of medicines (Table 4), the highest number of errors involved hypoglycemia agents followed by electrolytes, chemotherapeutic agents, and antihypertensive drugs.

Categories	n	%
Hypoglycemic agent	13	20.3%
Electrolyte and nutritional supplements	11	17.1%
Chemotherapy	8	12.5%
Antihypertensive	7	10.9%
Antibiotic	6	9.37%
Analgesic (narcotic, non-narcotic)	5	7.8%
Laxative	4	6.25%
Steroids	3	4.68%
Anticoagulants	3	4.68%
Antipsychotics	2	3.12%
Miscellaneous	2	3.12%
Total	64	100%

Table 4: *Category of medicines.*

Contextual information of the medication errors

The majority (59 of them, 92%) had been working in rotating shifts and very few (5, 7.8%) worked in fixed shifts. Majority of the health care professionals (33, 51.6%) made the medication errors in their first two years of their joining the profession, followed by three to five years of experience.

In terms of hours worked per week, the study results indicated that nearly 87.5% of the health care workers were working more than 45 hours per week and very few (12.5%) were working less than 45 hours (See table 5).

Hours worked per week	n	%
<4 5 hours	8	12.5%
46 - 54 hours	36	56.25
> 54 hours	20	31.25
Total	64	100

Table 5: *Hours worked per week.*

With reference to the working shift on the day of the errors, most of the errors (34, 53.1%) were reported in the morning shift and fewer errors were reported in the night shift. Most of the errors (48, 75%) occurred on weekdays as compared to the weekend (16, 25%). It was identified that most of the health care professionals (52, 81.1%) had worked more than 7 hours on the day (See table 6). From the analysis point of view of the last "day off" before the occurrence of the drug error, it was reported that 70.3% of the health care professionals got a day off three days before the drug incident occurred.

Attributes	Sub-attributes	n	%
Type of shift	Single	57	89%
	Double	7	10.9%
Working shifts	Morning	34	53.1%
	Evening	19	29.7%
	Night	11	17.2%
Working day	Weekday	48	75%
	Weekend	16	25%
Number of hours worked	< 6 hours	12	18.9%
	> 7 hours	52	81.1%
Last day off before the current drug incident	1 - 2 days before	19	29.7%
	> 3 days	45	70.3%

Table 6: *Attributes of work on the day of the incident.*

With reference to their workload, most of the doctors (44.4%) had prescribed 5 to 15 medications on the day of errors. With regards to dispensing of the medication, most of the pharmacists (60%) had dispensed less than a hundred medications on the day of the error(s) occurred. 26.6% of the pharmacists had dispensed more than 200 prescriptions on the day of the error. Only16 nurses (40%) had administered 15-30 medications and about 7 nurses had administered more than 60 medications on the day the error(s) occurred (See table 7).

Number of Administration	n	%
< 15	8	20%
15 - 30	16	40%
30 - 60	9	22.5%
> 60	7	17.5%
Total	40	100%

Table 7: *Approximate, number of administration by nurses on the day of error.*

Open-ended written questions

As stated earlier, 40 (62%) participants responded to the open-ended questions and many of them wrote multiple comments (see table 8). The comments were categorized according to the theme: error-producing conditions. The error producing conditions included workload, communication gap and personal stressors of the health care professionals, malfunctioning of infusion pumps, distractions and introduction of the electronic medication administration record (EMAR) system. Most of the respondents ranked workload as the major cause for the error.

Themes	Categories	(n)	(%)
Error-Producing conditions	Excessive work load/demanding patients/duplication of work	18	31%
	Communication gap	5	8.6%
	Personal stressors of the staff	4	6.9%
	Malfunctioning of IVAC	3	5.1%
	Distractions: “multiple things happening at the same time with medication administration”	2	3.4%
	Introduction of new EMAR system	2	3.4%
	Total	34	58.6%

Table 8: *Participants’ comments in response to the open-ended questions.*

Discussion

Description of medication errors

Studies by other researchers [11] report that medicine and critical care areas have the highest medication error rates. Similarly, in the current study the highest numbers of errors were reported in the medical and surgical unit as compared to the other units. This could be due to the fact that the average daily census/admission, patient acuity are very high in these units and were supported by the quantitative data. Moreover, the patients belong to multiple specialties; consequently, the influx of the medical staff and the patients’ relatives is high, multiple consults are generated and their visiting policy is also different from the other high dependency units. All these factors make the environment very noisy and distracting.

The findings revealed that most of the errors (38) occurred during the administration phase, followed by the dispensing (15) and the prescribing phase (9), which is similar with the findings in some other studies [1,3,12]. The possibility of fewer prescribing and dispensing error rates in the present study could be because most of the errors were very often prevented and corrected by the pharmacists and nurses at the time of dispensing and administering, whereas if administration errors occurred by the nurses, they cannot be prevented [12,13]. While studying the working conditions on the acute care nursing units, Potter., *et al*. (2005) acknowledged that the nursing task is difficult as nurses not only provide continuous care to patients whose condition changes frequently, but they also have to deal with the doctors and the pharmacists. In such a distracting environment, it is not easy to concentrate on the task [13]. However, this is unlike the results of studies done by Jylha., *et al*. [8] and Khowaja., *et al* [5]. They reported that more errors occurred in the prescribing and dispensing phase of the medication. The reason was that they studied all the underreported medication errors in their studies.

Underlying factors of medication errors

Moreover, the study results found that errors often occurred among the age group between 26 and 30 years (50%) and most of them had working experience of more than two years (47%). The reason could be that most of them are mature, work as team leaders, have multiple responsibilities at home, and face multiple stressors. Findings are concurrent with other study [6].

The findings also revealed that 51.6% of the medication errors occurred when the health care professionals had less than two years of working experience. This finding corresponds with the participants' open ended written statements, which indicated that a new environment, unfamiliarity with the computerized physician order entry system (CPOE), the electronic medication administration record (EMAR), and the generic names of the drug increased their stressors and led to errors. Similar findings have been reported by other researchers [1,3,14].

The present study findings reported that most of the errors occurred during the morning shift, which is consistent with the findings of Kim., *et al* [2]. The higher rate of medication errors in the morning shift could be because a higher number of medications are prescribed, dispensed, and administered in the morning. It is also possible that the reporting of medication errors is more accurate in the morning shifts due to better monitoring by the management staff.

The current literature is divided with regard to the association of work hours per day and per week with making of medication errors. The Institute of Medicine [15] recommended that nurses should not work more than 12 hours a day and 60 hours per week. A study by Rogers, Hwang, Scott, Aiken, and Dinges [16] reported that the chances of medication errors significantly increased when nurses worked more than 12 hours per day (OR = 3.29) and forty hours per week. The present study findings revealed that 80 percent of the participants had been working more than forty five hours per week, which is slightly different from the policy recommended by the human resource department of working 45 hours per week (Human Resource Policy Manual [17], p.1). The present study finding is contradicting the study findings of Stone., *et al*. [18] which reported nurses working 12 hours a day were more satisfied with their jobs, had decrease frustration, less absenteeism and decrease error rates [19].

Strengths and Limitations of the Study

The current study has a number of strengths and a few limitations:

1. The participants included doctors, pharmacists and nurses which provided a comprehensive understanding of the medication errors in the study setting.

2. Some of the participants of this study, in fact thanked the researcher for providing them the opportunity to verbalize their feelings. An open-ended question at the end of the structured questionnaire also provided an opportunity to those participants who did not want to reveal their identity, but were interested in ventilating their feelings in writing.

3. The researcher had intended to interview the participants within a week after the incident; but in two cases the time factor exceeded more than twenty days due to handling of incident by the managers. This was the major limitation faced by the researcher during data collection process.

4. Data was not collected on the designation of the health care professionals. Among those who were interviewed, a number of them were working in a supervisory capacity. Therefore, no conclusion could be made about the implications of this finding.

Conclusion

The study has provided information about the causes of medication errors. Recommendations provided in the light of this study may help to get information about the underlying factors of medication errors. The study findings will help the management to consider the assignment and modification in the work environment to prevent medication errors. This study was an opportunity to understand the underlying factors of medication error among physician, pharmacist and nurses that help in improving the system as a whole. Considering the gross difference of the error rates between the morning and other shifts, further exploration is needed. Moreover, a correlation study could be conducted to see the association of the staff workload and medication errors.

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