

Effect of Remedial Measures on Incidence and Awareness about Medication Errors in an Indian Tertiary Care Hospital

Vivek Ratnamraju, Priti Dhande*

Department of Pharmacology, Bharati Vidyapeeth (Deemed to be University) Medical College, Dhankawadi, Pune, Maharashtra, INDIA.

ABSTRACT

Background: Any medication reaching a patient has tendency to face errors, from point of procurement to its consumption. Often health-care professionals, being human, are inevitably bound to commit errors potentially causing medications to be fatal or ineffective to patients, unless they are made aware about them. **Objectives:** To assess the knowledge, attitude and practices of health-care personnel, identify and evaluate medication errors and also analyse effect of remedial measures on the same. **Materials and Methods:** Prospective interventional study involving 151 Resident doctors, 112 Nursing staff and 15 Pharmacists. Their knowledge, attitude and practices regarding medication errors was assessed using a pre-tested questionnaire before and after interventions. Medication errors were identified at all patient-care levels with simultaneous remedial measures for reducing them. Data was analysed using Chi-square test. **Results:** Knowledge about medication errors and practice of reporting them was significantly better among nurses as compared to resident doctors and pharmacists ($p < 0.001$) where unawareness was a significant reason ($p < 0.001$) behind under-reporting. Remedial measures were effective as evident by increased awareness of participants ($p < 0.001$) and reduced number of medication errors in the hospital. **Conclusion:** Poor awareness went hand in hand with the number of medication errors identified in study population which improved after remedial measures.

Key words: Medication errors, Knowledge, Attitude, Practice, Intervention, Awareness, Reporting.

INTRODUCTION

Drugs that have to reach patients may face errors, right from their procurement to storage in pharmacy stores, prescription by a physician, transcription by fellow clinician/subordinate, dispensing by pharmacist, administration by a nurse, counselling by a clinical pharmacist or consumption by patient themselves. Furthermore, medications, when given inappropriately to patients, may either be detrimental or ineffective for them. The National Coordinating Council for Medication Error Reporting and Prevention, founded by the United States Pharmacopoeia Convention in 1995, defines a medication error as “any preventable event that may cause or lead to inappropriate medication use or patient harm, while the medication is in control of the health-care professional, patient or consumer.”¹

As human beings, we are inevitably bound to commit errors. But, eventually, as the number of such errors increase in medical institutions, patients will ultimately lose faith and confidence in the health-care system. The above mentioned definition of medication errors suggests that it is a preventable event. Since human life is at stake, it is necessary to take appropriate steps to identify these errors, analyse the different levels at which they occur and provide correction to the different types of medication errors so as to prevent further occurrences of such errors and improve the quality of health-care.

Currently in India, even though most of medication errors remain unreported in many health care setups, we are still known to report 5.2 million injuries related to medication errors and adverse drug reactions

DOI: 10.5530/ijopp.14.2.20

Address for correspondence:

Dr. Priti Dhande,
Department of Pharmacology,
Bharati Vidyapeeth (Deemed to be University) Medical College,
Dhankawadi, Pune-411043,
Maharashtra, INDIA.
Phone no: +91 9922426840
Email id: pritidhande76@gmail.com



www.ijopp.org

annually.² Studies in developing countries have shown that basic knowledge among healthcare professionals, about fundamentals of medication errors and a system to report them, was evidently low.^{3,4} It goes without saying that a person's belief motivates his/her behaviour and this behaviour dictates their actions. Same can be applied to the act of medication error reporting. Knowledge or awareness about the concept of medication errors is very necessary to understand its prevention and contribute in its reporting.

Medication Errors are not reported by health-care professionals, either due to lack of awareness, fear of litigation, fear of harming their own reputation or fear of harming the patient's relationship with the health-care institution.⁵ The knowledge-attitude-behaviour model modifies human health-related behaviours by dividing changes into three continuous processes: knowledge acquisition, belief generation and behaviour formation.⁶ Creating awareness or imparting knowledge about a subject enhances the positive generation of belief towards it and modifies the behaviour of an individual favourably for it. This concept was taken as a model for the present study to generate a positive change in the medication error reporting system.

So far, studies abroad and in India regarding medication errors, were found to be focused on the identification of medication errors mainly in a single speciality department in a hospital or individual category of medication error like administration or prescribing, etc.⁷⁻⁹ Moreover, studies trying to improve the scenario of medication errors throughout the hospital by intervening in all these process were scarcely reported.¹⁰⁻¹² Hence, we had planned this study to assess the knowledge, attitude and practices of health-care personnel, identify and evaluate medication errors by health-care personnel and also analyse effect of remedial training pertaining to various medication errors on the same.

MATERIALS AND METHODS

This was a prospective interventional study conducted from December 2016 to June 2018 at a tertiary care teaching hospital (Bharati Hospital and Research Centre, Pune) involving resident doctors, nursing staff and pharmacists. The study had 3 phases: pre-intervention questionnaire, intervention and collection of medication errors followed by post-intervention questionnaire phase. After sample size calculation,¹³ a total of 151 resident doctors, 112 nurses and 15 pharmacists were included in the study. A pre-tested questionnaire was given to all groups of all healthcare professionals (during December'16 - February'17) after a brief information

about the study and their willingness to participate in the assessment. This questionnaire was adopted from a previous study⁴ and comprised a composite of 17 questions – 9 questions based on knowledge about medication errors, 5 questions based on attitude towards medication errors, 3 questions based on practice to identify and report medication errors.

Medication errors were identified in the above mentioned tertiary care teaching hospital for a period of 13 months (March'17 – March'18), at all patient-care levels by visiting wards, intensive and critical care units, internal and external hospital pharmacies, etc. Data were collected by clinical pharmacists of the study site hospital (independent observers) by reviewing case records of in-patients which included prescriptions, case history, physician daily progress notes, medication charts, nursing administration sheets, indent orders, medication requisition orders, etc. Data from the identified medication errors were entered into medication error reporting tool devised by the department of Pharmacology of our institute. These errors were further analysed, categorized into types and assessed for their level of severity, using medication error index provided by the NCCMERP.¹⁴

Interventions were tailored after obtaining the primary information of participants' knowledge, attitude and practice about medication errors and its reporting system. These were as follows:

1. Conducting training sessions separately for individual populations such as resident doctors, nurses and pharmacists targeted towards knowledge about medication errors, types of such errors and various causes which may lead to these errors. Each intervention was a 45 min' session using power point presentations for each healthcare group separately.
2. Furthermore, attempts were made to impart preventive measures for reducing the occurrences of medication errors through informative charts for preventing prescription, administration and dispensing errors for doctors, nurses and pharmacists respectively.
3. Lists of special category drugs (look-alike, sound-alike, high risk and emergency, refrigerated) was also displayed in all patient care areas for the doctors and nurses to refer and not get involved in medication errors while using these drugs.
4. The study participants were also given training to report medication errors for improving culture of reporting so that these errors can be analysed and

their cause identified to act upon.

- Hospital wide policies for safe prescribing, administration, monitoring after drug administration and dispensing were framed to prevent further occurrences of medication errors. These policies were communicated to the respective healthcare professional groups through successive training sessions.

The knowledge, attitude and practices about medication errors was re-evaluated using the same questionnaire, which was given to all the groups of health-care professionals during the period of April'18 to June'18 (post-intervention phase).

Statistical Analysis

Results were expressed in frequencies and percentages. Statistical analysis was performed using SPSS software, version 21. Chi-square test was used for categorical variables. Correlation analysis was performed using Spearman's rho between knowledge, attitude and practice scores independently for pre and post intervention data set.

RESULTS

An attempt has been made in this study to analyze the baseline awareness about medication errors and the attitude and practices to report them, using a questionnaire. This questionnaire was filled up by 278 participants, including resident doctors, nurses and pharmacists.

Table 1 shows that majority of the resident doctors (92.7 %) and almost all the nurses (98.3 %) were aware of the term medication errors as compared to pharmacists (46.7 %) but the relevance of the term was found to be significantly lower ($p < 0.001$) amongst resident doctors (68.2 %) and pharmacists (0 %), as compared to nurses (94.6 %). The resident doctors had significantly ($p < 0.001$) poor knowledge about categories (16.6 %) and a reporting system (19.9 %) for medication errors when compared to nurses, whereas the pharmacists were completely unaware (0%) about these aspects.

Table 2 shows that more than half of the doctor (51%) and pharmacist population (60%) did not report medication errors due to lack of awareness. Fear of litigation or a busy workload were not found to be the reasons for under-reporting. Collectively, 87 (31.3%) of the 278 study participants believed that reporting an error would hamper their image in their workplace.

Table 1: Knowledge of study participants about medication errors (pre-intervention).

Knowledge about:	Resident Doctors (n=151)	Nurses (n=112)	Pharmacists (n=15)	Chi ² value
Medication errors	140 (92.7 %)	110 (98.3 %)	7 (46.7 %)	50.37 $p < 0.001^{***}$
Relevance of the term medication error	103 (68.2 %)	106 (94.6 %)	0 (0.0 %)	72.10 $p < 0.001^{***}$
Categories of medication errors	25 (16.6 %)	93 (83.0 %)	0 (0.0 %)	128.0 $p < 0.001^{***}$
Reporting system	30 (19.9 %)	90 (80.4 %)	0 (0.0 %)	107.9 $p < 0.001^{***}$
Interventions to prevent medication errors	38 (25.2 %)	97 (86.6 %)	1 (6.7 %)	108.5 $p < 0.001^{***}$
How to proceed after medication error occurs	62 (41.1 %)	92 (82.1 %)	0 (0.0 %)	63.62 $p < 0.001^{***}$

*P-value was calculated after comparing difference in proportions across the groups by using chi-square test with degree of freedom 2; *** $p < 0.001$*

Table 2: Attitude of study participants towards reporting medication errors (pre-intervention).

Did not inform medication errors due to:	Resident Doctors (n=151)	Nurses (n=112)	Pharmacists (n=15)	Chi ² value
Fear of legal consequences	30 (19.9 %)	25 (22.3 %)	4 (26.7 %)	0.51 $p = 0.774$
Busy schedule	18 (11.9 %)	13 (11.6 %)	3 (20.0 %)	0.89 $p = 0.638$
Unawareness about whom to inform	77 (51.0 %)	20 (17.9 %)	9 (60.0 %)	33.14 $p < 0.001^{***}$
Fear of image getting affected	44 (29.1 %)	37 (33.0 %)	6 (40.0 %)	1.01 $p = 0.603$

*P-value was calculated after comparing difference in proportions across the groups by using chi-square test with degree of freedom 2; *** $p < 0.001$*

Table 3 shows that practice of reporting medication errors was found to be significantly lower ($p < 0.001$) among doctors and pharmacists than that of nurses (40.0 %). However, around 79% of the resident doctors intervened to rectify the errors, which was significantly more ($p < 0.001$) than that of nurses (67%) and pharmacists (26.7%). On an average, more than half ($n=154$; 55.4%) of the study participants, had identified medication errors by other healthcare personnel.

Figure 1 shows a downward trend in the incidences on medication errors amongst doctors and nurses, over the study period. Identification of medication errors was done over a period of 13 months from March 2017 to March 2018, by visiting wards, intensive and critical care units, hospital pharmacies. Most commonly encountered categories of medication errors have been compared in the graph (Figure 2) at the initiation and end of intervention period which clearly shows a decrease in all these medication errors due to interventions.

Of the various outcomes of medication errors (Figure 3), most of them collected during the study period were potentially harmful events where the error was committed but no harm was done to the patient. No cases resulting in death due to medication errors were encountered during the study period.

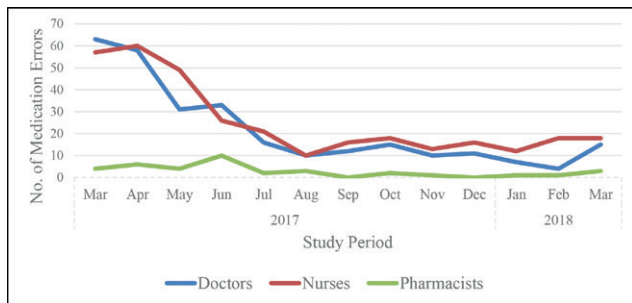


Figure 1: Incidences of medication errors caused by health-care professionals during study period.

Tables 4 and 5 indicate the comparison of pre and post-intervention knowledge and attitude parameters of the questionnaire at one glance so that it becomes easy to understand the influence of interventions on these parameters. Table 4 reveals that in the post-intervention period, there was a significant improvement in the knowledge about medication errors amongst resident doctors and pharmacists as compared to the pre-intervention phase ($p < 0.001$). As a result of remedial training, 12 (80%) of the pharmacists became aware that they may be involved in causing medication errors which was known by only 1 (6.7%) out of the 15 pharmacists initially.

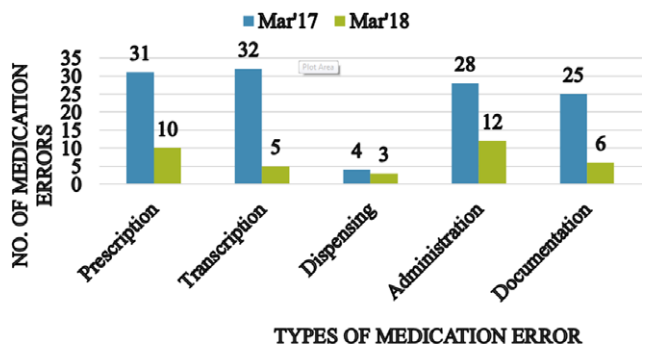


Figure 2: Types of medication errors collected at the initiation and end of intervention.

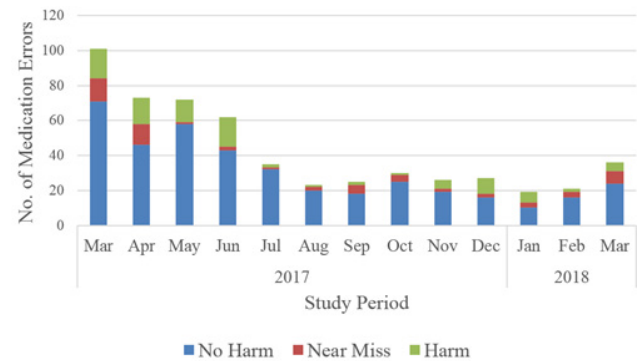


Figure 3: Outcome of medication errors during the study period.

Table 3: Practices of study participants regarding medication errors (pre-intervention)				
Did you ever:	Resident Doctors (n=151)	Nurses (n=112)	Pharmacists (n=15)	Chi ² value
Report an error	4 (2.6 %)	46 (40.0 %)	0 (0.0 %)	67.83 p < 0.001***
Intervene to rectify an error	119 (78.8 %)	75 (67.0 %)	4 (26.7 %)	19.76 p < 0.001***
Identified errors by other healthcare professionals	74 (49.0 %)	70 (62.5 %)	10 (66.7 %)	5.55 p = 0.062

P-value was calculated after comparing difference in proportions across the groups by using chi-square test with degree of freedom 2; *** p < 0.001

It was found that 86% of the study participants, in the post intervention period, were imbued with the proper approach to report a medication error (filling an incident report form) which was a significant improvement as compared to the pre-intervention phase (30.9%). This is a cumulative observation of all 3 groups and hence has not been included in the results Table. With regards to attitude towards reporting errors (Table 5), unawareness being the reason for underreporting was statistically

seen to be lessened in the post-intervention phase as compared to the pre-intervention phase amongst all the study participants ($p < 0.05$), more significantly amongst resident doctors and pharmacists ($p < 0.001$).

Correlation analysis was performed using Spearman's rho between knowledge, attitude and practice score independently for pre and post intervention data set which revealed that the knowledge scores were significantly associated with attitude and practice scores (Table 6).

Table 4: Effect of interventions on knowledge of participants about medication errors

Knowledge about:	Resident Doctors (n=151)		Nurses (n=112)		Pharmacists (n=15)	
	Pre	Post	Pre	Post	Pre	Post
Medication errors	140 (92.7 %)	151*** (100.0 %)	110 (98.3 %)	110 (98.3 %)	7 (46.7 %)	15*** (100 %)
Relevance of the term medication error	103 (68.2 %)	149*** (98.7 %)	106 (94.6 %)	108 (96.4 %)	0 (0.0 %)	15*** (100 %)
Categories of medication errors	25 (16.6 %)	123*** (81.5 %)	93 (83.0 %)	93 (83.0 %)	0 (0.0 %)	11*** (73.0 %)
Reporting system	30 (19.9 %)	147*** (97.4 %)	90 (80.4 %)	91 (81.3 %)	0 (0.0 %)	14*** (93.3 %)
Interventions to prevent medication errors	38 (25.2 %)	130*** (86.1 %)	97 (86.6 %)	90 (80.4 %)	1 (6.7 %)	11*** (73.3 %)
How to proceed after medication error occurs	62 (41.1 %)	143*** (94.7 %)	92 (82.1 %)	91 (81.3 %)	0 (0.0 %)	9*** (60.0 %)

P-value was calculated after comparing pre and post intervention values in respective healthcare professional groups by using chi-square test with degree of freedom 1; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 5: Effect of interventions on attitude of study participants towards reporting medication errors.

Did not inform medication errors due to:	Resident Doctors (n=151)		Nurses (n=112)		Pharmacists (n=15)	
	Pre	Post	Pre	Post	Pre	Post
Fear of legal consequences	30 (19.9 %)	14** (9.3 %)	25 (22.3 %)	14 (12.5 %)	4 (26.7 %)	3 (20.0 %)
Busy schedule	18 (11.9 %)	14 (9.3 %)	13 (11.6 %)	7 (6.3 %)	3 (20.0 %)	1 (6.7 %)
Unawareness about whom to inform	77 (51.0 %)	7*** (4.6 %)	20 (17.9 %)	10* (8.9 %)	9 (60.0 %)	0*** (0.0 %)
Fear of image getting affected	44 (29.1 %)	14*** (9.3 %)	37 (33.0 %)	8*** (7.1 %)	6 (40.0 %)	3 (20.0 %)

P-value was calculated after comparing pre and post intervention values in respective healthcare professional groups by using chi-square test with degree of freedom 1; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 6: Correlation between knowledge attitude and practices of study participants.

Knowledge		Pre-intervention			Post-intervention		
		Attitude	Practice	Knowledge	Attitude	Practice	Knowledge
Knowledge	Correlation Coefficient	1.000	0.248**	0.353**	1.000	0.222**	0.239**
	Sig. (2-tailed)	-	0.000	0.000	-	0.000	0.000
Attitude	Correlation Coefficient	0.248**	1.000	0.061	0.222**	1.000	0.071
	Sig. (2-tailed)	0.000	-	0.315	0.000	-	0.235
Practice	Correlation Coefficient	0.353**	0.061	1.000	0.239**	0.071	1.000
	Sig. (2-tailed)	0.000	0.315	-	0.000	0.235	-

** Correlation is significant at the 0.01 level (2-tailed)

DISCUSSION

The medication process involves team work of many healthcare professionals and is at a risk of errors at various levels. Recognizing and analysing these medication errors for their cause becomes a very important tool to develop strategies for future prevention of these errors. Another important aspect in establishing a safe medication process is to improve the awareness of all healthcare professionals regarding this concept and its preventive strategies.

An attempt was made in this study to evaluate the awareness of resident doctors, nurses and pharmacists about medication errors and to identify and analyse the errors caused by them to develop intervention tools for their training. Results of this study indicate that nurses at the study site had significantly better ($p < 0.001$) awareness about the concept of medication errors, its categories and its relevance as compared to the resident doctors and pharmacists (Table 1).

If collectively considered, the study participants believed that medication errors were predominantly caused by doctors (75.5%) and nurses (71.6%) and hence the common types of errors which they knew were of prescription (73.4%) and administration (66.2%) categories. This finding is similar to that reported by Abdel-Latif in a study to assess the knowledge of healthcare professionals about medication errors in hospitals of Saudi Arabia³ and also found in another study conducted in North India by Kumar *et al.*¹⁵ The nurses responded that they were significantly better oriented towards the procedure on recognizing a medication error and measures to prevent such errors when compared to doctors and pharmacists ($p < 0.001$). This is in contrast to a study conducted by Abdel-Latif in Saudi Arabia³ where it was found that all the 3 population of healthcare professionals had similar knowledge about the reporting system. It is understood that nurses are obligated to improve medication administration and minimize errors and mistakes as they would be blamed individually for committing such errors. Similar was the opinion expressed by participants of a study conducted to investigate the occurrence and reporting of medication errors by nurses in Iranian hospitals.¹⁶

Majority of the study participants were practically unaware of any method to report an error. This finding is similar to that by Abdel-Latif from Saudi Arabia where > 50% of the healthcare professionals were unaware of how and where to report such errors. In spite of having a sound knowledge and appropriate attitude about the medication error reporting system, only 40% of nurses in the present study had reported an error (Table 3) which was significantly better than that of the other

study groups (Resident doctors and pharmacists) ($p < 0.001$). Poor knowledge about the reporting system has been quoted as a reason by many researchers for under-reporting of adverse drug reactions which can also be extrapolated in this aspect.¹⁷⁻²⁰ Fear of litigation or a busy workload or hampering their image at workplace were not found to be the significant reasons for non-reporting (Table 2). Authors have previously mentioned fear of punishment or medical lawsuits or professional repercussions as factors responsible for under-reporting of errors.²¹

In the initial study period, a high number of medication errors were collected in the hospital. Majority of these were errors committed by doctors (prescription and transcribing errors) and by nurses (administration and documentation errors). Kumar *et al.* has reported a similar trend of errors in his study where he found prescription errors the maximum followed by administration and transcription errors.¹⁵

Despite a significant lack of awareness about medication errors amongst pharmacists, dispensing errors were seen to be very extremely low throughout the study period. In our study, the low number of dispensing errors may be attributed to the errors being mutually rectified at the pharmacists' level when alerted by the nurses or clinical pharmacists, without being reported by anyone. Whichever dispensing errors were found reported had been raised by the clinical pharmacists. Dispensing errors were also the least encountered in the study by Kumar *et al.*¹⁵ and Karna *et al.*¹⁰ In a systematic review done by Olaniyan *et al.*²² the author has also found a low rate of dispensing errors across various countries around the globe. They have mentioned that if directly observed, the rate of dispensing errors was found higher than those through incident reporting or reported as "near misses".

Medication errors were analysed collectively to plan hospital wide remedial measures to prevent medication errors. Apart from the individual group interventions like training sessions, preventive measures of medication errors, other initiatives were carried out to develop a health-care team committed to patient safety; encourage reporting of all types of errors including near-misses; a feedback mechanism on analysis of the errors, follow up actions and improvements to prevent future errors; simplify error reporting etc. Such suggestions were also given by authors who evaluated the awareness about medication errors amongst health-care personnel representing North, East and West Regions of India.⁴ The effectiveness of various forms of interventions carried out, was evident by the low occurrences of medication errors over the following months, till the end of the study.

In this study, authors have made an attempt to assess the effect of various remedial measures on the incidences and the knowledge, attitude and practices of healthcare professionals about medication errors throughout the hospital and not in individualized units like that found in other studies mentioned in the introduction section.

In the post-intervention period, there was a significant improvement in the knowledge about medication errors amongst resident doctors and pharmacists as compared to the pre-intervention phase ($p < 0.001$) which included clarity on the concept of medication errors, relevance of this term, levels and categories of such errors, their reporting system and how to handle such errors (Table 4). The study participants were oriented towards the medication error reporting system and had started reporting such errors. They had started implementing the preventive strategies for medication errors and promoting patient safety.

Studies have shown that to maintain consistency of such strategies or improvements among healthcare professionals, frequent repetition of educational interventions or continuous interventions of different types are needed.^{17,23,24} Authors have also mentioned about the fading of the effectiveness of such interventions eventually over time.^{25,26}

We not only recommend continuous series of interventions but also suggest that the healthcare professionals should be themselves involved in the process by inviting their suggestions, appreciation on contributing to such improvements, auditing for implementation of medication management strategies in routine practice and last but not the least to avoid the “blame game” in such system. To achieve and sustain a good culture of medication error identification and reporting, interventions should not just focus on improving individuals’ knowledge; there should be a continual commitment by all stakeholders- from the institutional head, managers, policy makers to all healthcare professionals and support workers.²⁷

The study data revealed a positive correlation between knowledge attitude and practice about medication error recognition or reporting in both the pre-intervention as well as post-intervention period among the healthcare professionals (Table 6). The pre-interventional correlation between knowledge, attitude and practice about medication errors suggests that inadequate or incomplete awareness will lead to a casual attitude and a lack of appropriate practice regarding the same.

In a study conducted in Pakistan by ul Haq, the author quotes that a person’s intention to a specific behaviour is

a function of his/her attitude towards that behaviour and furthermore, this attitude is determined by the person’s belief/ knowledge that a given outcome will occur if he/she will perform the behaviour.²⁸ To improve safety of medication use, we must imbibe a culture of accepting the fact that errors happen in such a course and these should be reported and remedies found to build a tolerant system which protects both staff and patients.²⁹

CONCLUSION

Various interventions done to improve the culture of healthcare professionals regarding patient safety were effective as seen by the increased awareness of these participants and reduced number of medication errors in the hospital. A positive correlation was found between knowledge about medication errors and attitude and practice of medication error reporting in both pre and post-intervention periods.

ACKNOWLEDGEMENT

We thank the study participants for filling the questionnaire and clinical pharmacists and nurses for reporting medication errors which were analysed in this study.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

NCCMERP: National Coordinating Council for Medication Error Reporting and Prevention.

SUMMARY

In this prospective interventional study involving 151 Resident doctors, 112 Nursing staff and 15 Pharmacists we found that knowledge about medication errors and practice of reporting them was significantly better among nurses as compared to resident doctors and pharmacists ($p < 0.001$) where unawareness was a significant reason ($p < 0.001$) behind under-reporting. Medication errors were identified at all patient-care levels with simultaneous remedial measures for reducing them. This increased awareness of participants ($p < 0.001$) and reduced number of medication errors in the hospital.

REFERENCES

1. Definition of Medication Error, National Coordinating Council for Medication Error Reporting and Prevention. 2020. www.nccmerp.org/about-medication-errors.

2. Sinha K. India records 5.2 million medical injuries a year. The Times of India. 2013. Available from: <http://www.timesofindia.indiatimes.com/india/India-records-5-2-million-medical-injuries-a-year/articleshow/22832260.cms?referral=PM>. Accessed on 21.7.18.
3. Abdel-Latif MM. Knowledge of healthcare professionals about medication errors in hospitals. *J Basic Clin Pharma*. 2016;7(3):87-92.
4. Sewal R, Singh P, Prakash A, Kumar B, Medhi B. A prospective study to evaluate awareness about medication errors amongst healthcare personnel representing North, East, West Regions of India. *Int J Appl Basic Med Res*. 2014;4(1):43-6.
5. Wu AW. Medical Error: The second victim: the doctor who makes the mistake needs help too. *BMJ*. 2000;320:726-7.
6. Bettinghaus EP. Health promotion and the knowledge-attitude-behavior continuum. *Prev Med*. 1986;15(5):475-91.
7. Croskerry P, Shapiro M, Campbell S, LeBlanc C, Sinclair D, Wren P, *et al*. Profiles in patient safety: medication errors in the emergency department. *Acad Emerg Med*. 2004;11(3):289-99.
8. Sara BCL, Larry LYL, Richard SDY, Jimmy TSC. A continuous quality improvement project to reduce medication error in the emergency department. *World J Emerg Med*. 2013;4(3):179-82.
9. Subramanyam R, Mahmoud M, Buck D, *et al*. Infusion Medication Error Reduction by Two-Person Verification: A Quality Improvement Initiative. *Pediatrics*. 2016;138(6):e20154413
10. Karna K, Sharma S, Inamdar S, Bhandari A. Study and Evaluation of Medication Errors in a Tertiary Care Teaching Hospital: A Baseline Study. *Int J Pharm Pharm Sci*. 2012;4(5):587-93.
11. Sinha G, Acharya L, Thunga G, Mathews T. A Study Of Medication Errors in General Medicine Wards of the South Indian Tertiary Care Hospital. *Asian J Pharm Clin Res*. 2016;9(4):196-200
12. Wang HF, Jin HF, Feng XQ, Xin H, Zhu LL, Zhao XY, *et al*. Quality improvements in decreasing medication administration errors made by nursing staff in an academic medical center hospital: A trend analysis during the journey to Joint Commission International accreditation and in the post-accreditation era. *Ther Clin Risk Manag*. 2015;11:393-406.
13. Abramson JH, Abramson ZH. *Survey Methods in Community Medicine*, 5th Ed. Churchill Livingstone. 1999;102.
14. Index for categorizing Medication Errors, National Coordinating Council for Medication Error Reporting and Prevention. 2020. at www.nccmerp.org/sites/default/files/indexColor2001-06-12.pdf.
15. Kumar S, Madhwar A, Pathak AK, Saikia D. Learning from error: Identification and analysis of causative factors leading to medication error in an inpatient hospital setting. *Int J Basic Clin Pharmacol*. 2016;5(3):999-1005.
16. Ebrahimipour H, Hosseini SE, Haghighi H, Tabatabaee SS, Badiie SH, Vafaee NA, *et al*. Evaluation of Medication Errors by Nurses in Hospitals Affiliated with Mashhad University of Medical Sciences, Mashhad, Iran. *Patient Saf Qual Improv*. 2016;4(3):400-4.
17. Sanghavi DR, Dhande PP, Karandikar YS, Sahasrabudhe RA, Pandit VA. Impact of series of interventions on clinicians' awareness about pharmacovigilance system in western India. *Asian J Pharm Clin Res*. 2014;7(3):14-20.
18. Sanghavi DR, Dhande PP, Pandit VA. Perception of pharmacovigilance among doctors in a tertiary care hospital: Influence of an interventional lecture. *Int J Risk Saf Med* 2013;25(4):197-204.
19. Desai CK, Iyer G, Panchal J, Shah S, Dikshit RK. An evaluation of knowledge, attitude and practice of adverse drug reaction reporting among prescribers at a tertiary care hospital. *Perspect Clin Res*. 2011;2(4):129-36.
20. Kamtane R, Jayawardhani V. Knowledge, attitude and perception of physicians towards adverse drug reaction (ADR) reporting: A pharmacoepidemiological study. *Asian J Pharm Clin Res*. 2012;5(3):210-4.
21. Wolf ZR, Hughes RG. *Error Reporting and Disclosure. Patient Safety and Quality: An Evidence-Based Handbook for Nurses*. Rockville (MD): Agency for Healthcare Research and Quality (US). 2008. Chapter 35. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK2652>
22. Olaniyan JO, Ghaleb M, Dhillon S, Robinson P. Safety of medication use in primary care. *Int J Pharm Pract*. 2015;23(1):3-20.
23. Figueiras A, Herdeiro MT, Polónia J, Gestal-Otero JJ. An educational intervention to improve physician reporting of adverse drug reactions: A cluster-randomized controlled trial. *JAMA*. 2006;296(9):1086-93.
24. Bracchi RC, Houghton J, Woods FJ, Thomas S, Smail SA, Routledge PA. A distance-learning programme in pharmacovigilance linked to educational credits is associated with improved reporting of suspected adverse drug reactions via the UK yellow card scheme. *Br J Clin Pharmacol*. 2005;60(2):221-3.
25. Rehan HS, Sah RK, Chopra D. Comparison of knowledge, attitude and practices of resident doctors and nurses on adverse drug reaction monitoring and reporting in a tertiary care hospital. *Indian J Pharmacol*. 2012;44(6):699-703.
26. Tabali M, Jeschke E, Bockelbrink A, Witt CM, Willich SN, Ostermann T, *et al*. Educational intervention to improve physician reporting of adverse drug reactions (ADRs) in a primary care setting in complementary and alternative medicine. *BMC Public Health*. 2009;9(1):274.
27. Stewart D, Thomas B, MacLure K, Wilbur K, Wilby K, Pallivalapila A, *et al*. Exploring facilitators and barriers to medication error reporting among healthcare professionals in Qatar using the theoretical domains framework: A mixed-methods approach. *PLoS One*. 2018;13(10):e0204987.
28. Ul HN, Hassali MA, Shafie AA, Saleem F, Farooqui M, Haseeb A, *et al*. A cross-sectional assessment of knowledge, attitude and practice among Hepatitis-B patients in Quetta, Pakistan. *BMC Public Health*. 2013;12(1):692.
29. Hemphill RR. Medications and the culture of safety: conference title: At the precipice of quality health care: The role of the toxicologist in enhancing patient and medication safety venue ACMT pre-meeting symposium, 2014 North American Congress of Clinical Toxicology, New Orleans, LA. *J Med Toxicol*. 2015;11(2):253-6.