

# Drug Utilization Evaluation Study in a Tertiary Care Hospital

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## ABSTRACT

**Background:** Not administering medicines as per the prescribed guidelines can result in subtherapeutic or toxic effects by taking dose too early or too late. It could have a negative impact on the patient or resulting in an additional financial burden. **Materials and Methods:** A Prospective observational study was carried out in the inpatients of tertiary care hospital. Total 400 patients and 1050 medication administrations were studied over a period of 6 month for timely medication administration. The error was assessed using ISMP (Institute for Safe Medication Practices) guidelines. **Results:** The numbers of females were 146 and 254 males forming total 400 patients. Total 1050 medication administrations were evaluated, 681 time critical and 369 medication administrations were non-time critical. Before awareness program, out of 515 medication administrations 263 were on time (51.07%), while 252 administrations deviated from the scheduled time (48.93%). After awareness program, out of 535 medication administrations, 413 were on time (77.20%), while 122 administrations deviated from the scheduled time (22.80%). Difference in scheduled time and administration time for time critical medication administrations, was reduced by 22 min 33 sec ± 11 min 58 sec after the awareness program, while for non-time critical medication administrations the time was reduced by 12 min 14 sec ± 9 min 87 sec, after the awareness program. **Conclusion:** Timely administration of medications is crucial to prevent harm and therapeutic failure. Educating nursing staff can help prevent errors improve patient care.

**Keywords:** Heavy patient load, ISMP guidelines, Time critical medications, Timely medication administration.

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**Received:** 06-03-2024;

**Revised:** 10-04-2024;

**Accepted:** 01-05-2024.

## INTRODUCTION

Drug usage is a complicated process, and there are many challenges related to drug therapy at various levels, including patients, doctors, pharmacists and nurses.<sup>1</sup> Currently, main problem in health care is increase in occurrences of medication error which can happen at any of the three steps of medication use process i.e., prescribing, administration and dispensing.<sup>2</sup>

Medication administration error is defined as any diversions from the physician's medication order as written on patient's treatment chart during medication administration to the patient.<sup>3</sup> Maintenance of the therapeutic level in the patient's systemic circulation, required medication administrations at predetermined periods. Time-critical medications are those that

may harm the patient or compromise the therapeutic efficacy, leading to poor therapeutic outcome, if administered sooner or later than the recommended time by more than 30 min. The majority of medicines used in hospitals are not time-critical. For such medications, the administration either 60 min before or after scheduled time can be considered for those with the frequency more than OD but less than QID. For the medicines which are not administered frequently (OD or more), the administration can be done within 2 hrs before/after scheduled time according to ISMP (Institute of Safe Medication Practice) guidelines.<sup>4-5</sup>

Nurses have a unique role and responsibility in medication administration in that they are the final individual to inspect the medication prescribed and dispensed before administration. A guiding principle of the 'right administration' is that medication should be administered as closely to the time as feasible and nurses should not deviate from this time by more than half an hour in case of time critical medications to avoid outcomes like altered bioavailability.<sup>6</sup>



DOI: 10.5530/ijopp.17.3.35

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## MATERIALS AND METHODS

The study was carried out in a tertiary care hospital over a period of six months in both critical (ICU and Private wards) and non-critical (General ward) areas. All age group inpatients were included in study. Outpatient and one day treatment patients were not included in study. An awareness program was conducted to discuss the root causes of early or late drug administrations and their minimization measures. Errors were assessed by Institute for Safe Medication Practices (ISMP) guidelines.

## RESULTS

A total 400 patients were included in the study. Out of the 400 patients, 254 were males and 146 were female. Total 1050 medication administrations were evaluated, in which 681 medication administrations were time critical and 369 medication administrations were non-time critical. The most common time critical medication administrations belonged to ATC class J (Anti-Infectives for Systemic Use) (33.77%), while non-time critical scheduled medication administrations belonged to ATC class A (Alimentary Tract and Metabolism) (57.45%) class (Table 1).

The data was divided in two segments, data collected before the awareness program and data collected after the awareness program.

Before awareness program, total 515 medication administrations were examined, in which 335 were time critical and 180 were non-time critical. 535 medication administrations assessed after the awareness session contained 346-time critical administrations and 189 non-time critical administrations (Figure 1).

Before awareness program, out of 515 medication administrations 263 were on time (51.07%), while 252 administrations deviated

from the scheduled time (48.93%) accounting for 20 (7.94%) administrations being early and 218 (86.51%) administrations being late whereas 14 (5.55%) administrations were not administered (Figure 2).

For the analysis which was done after the awareness program, out of 535 medication administrations, 413 were on time (77.20%), while 122 administrations deviated from the scheduled time (22.80%) accounting for 28 (22.95%) administrations being early and 94 (77.05%) administrations being late (Figure 3).

Similarly, compliance and non-compliance also vary for the critical areas (ICU and Private wards) and non-critical area (General ward). When comparing critical areas versus non-critical areas, before awareness program, medications administered in the former (74.69%) were more compliant than latter (29.63%) (Figure 4).

Similarly, for the analysis after awareness program, when comparing critical areas versus non-critical areas, medications administered in the former were more compliant (86.09%) than latter (71.67%) (Figure 5).

Common causes of not administering medications in timely manner before the awareness program include heavy patient load (70.23%), shift issues (7.94%) and Nurses being busy in other work (7.54%). After the awareness program common causes for early/late administrations were same as before but frequency was decreased (Table 2).

Mean difference in scheduled time and administration time before the awareness program for time critical medication administrations was 49 min 66 sec $\pm$ 34 min 94 sec, while 41 min 24 sec $\pm$ 31 min 86 sec for non-time critical medication administrations.

**Table 1: ATC Classification of drug administration.**

ATC Class	Time Critical	Non-Time Critical	Total
J: Anti-Infectives for Systemic Use	230	0	230
C: Cardiovascular System	154	0	154
N: Nervous System	94	74	168
B: Blood and Blood Forming Organs	85	23	108
A: Alimentary Tract and Metabolism	43	212	255
M: Musculo-Skeletal System	29	10	39
H: Systemic Hormonal Preparations, Excl. Sex Hormones and Insulins	24	1	25
R: Respiratory System	10	27	37
L: Antineoplastic and Immunomodulating Agents	6	0	6
G: Genito Urinary System and Sex Hormones	4	2	6
V: Various	2	17	19
D: Dermatological	0	2	2
S: Sensory Organs	0	1	1

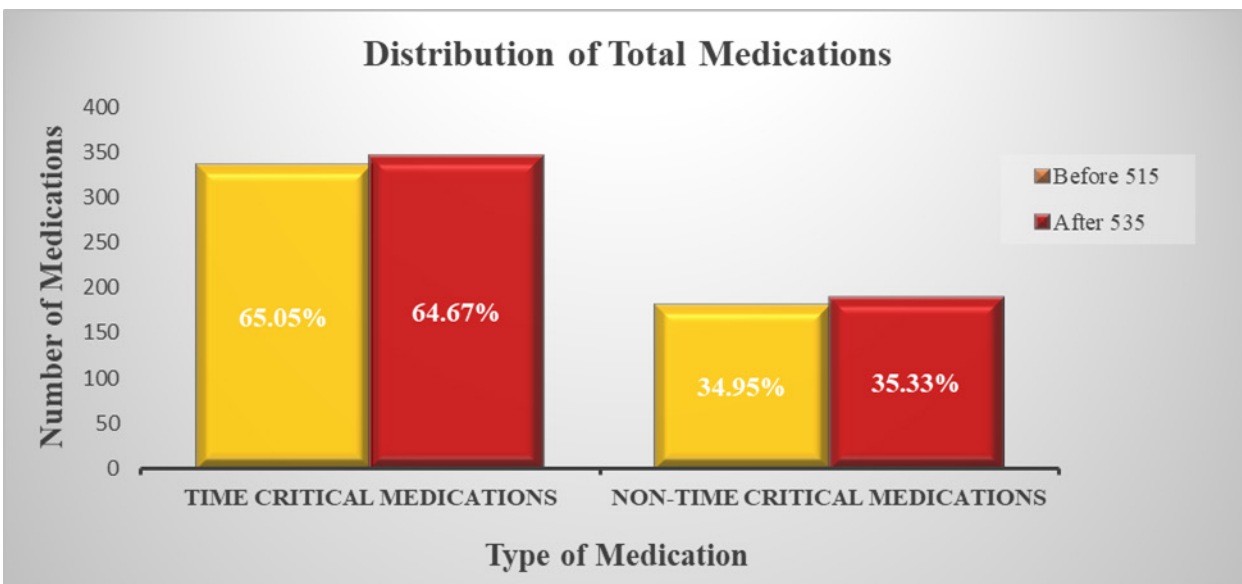


Figure 1: Drug Distribution of Total Medication Administrations.

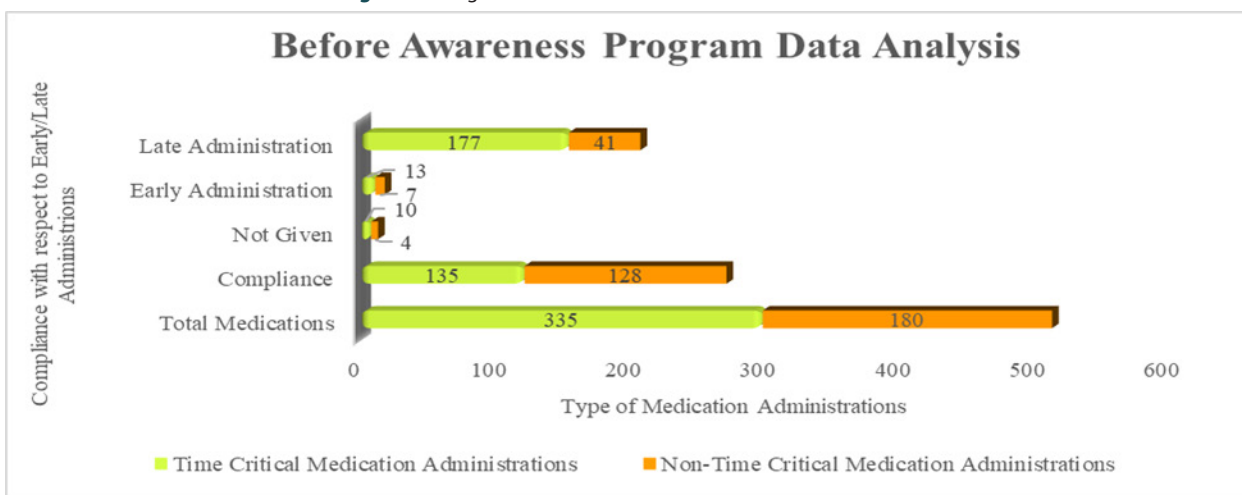


Figure 2: Before Awareness Program Data Analysis.

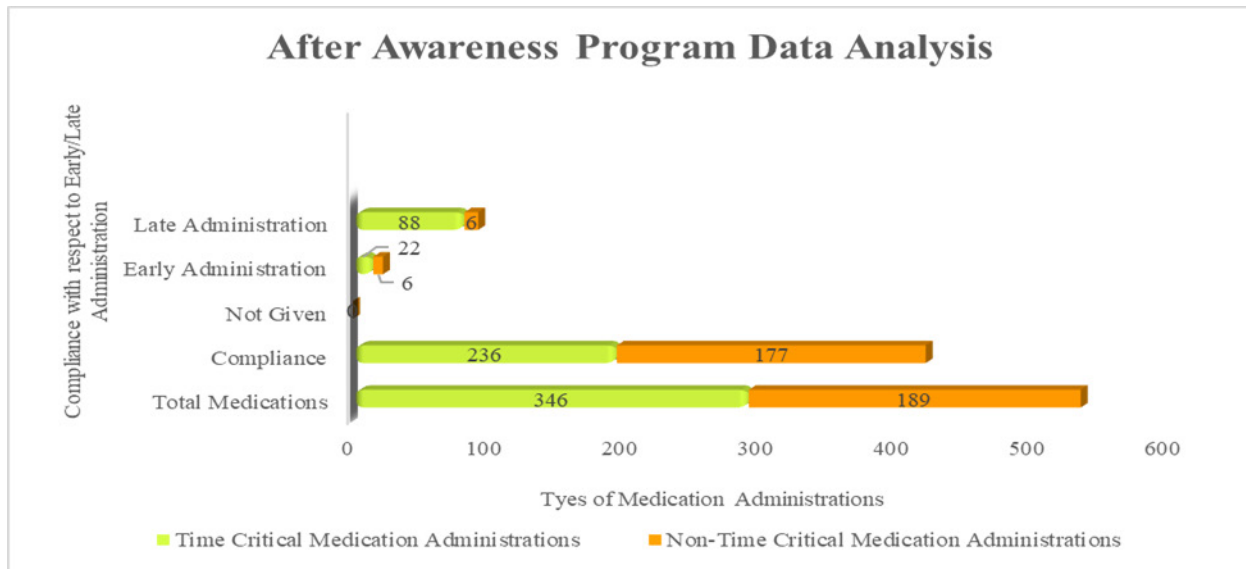
Mean difference in scheduled time and administration time after the awareness program for time critical medication administrations was 27 min 33 sec±23 min 36 sec, while 29 min 10 sec±21 min 99 sec for non-time critical medication administrations.

When the findings before the awareness program were compared with the findings after the awareness program, they showed 26.13% increase in on time drug administration. The difference in scheduled time and administration time for all medication administrations (time critical and non-time critical) after the awareness session was 27 min 96 sec±22 min 84 sec which indicated significant improvement after the awareness session in terms of medication administration.

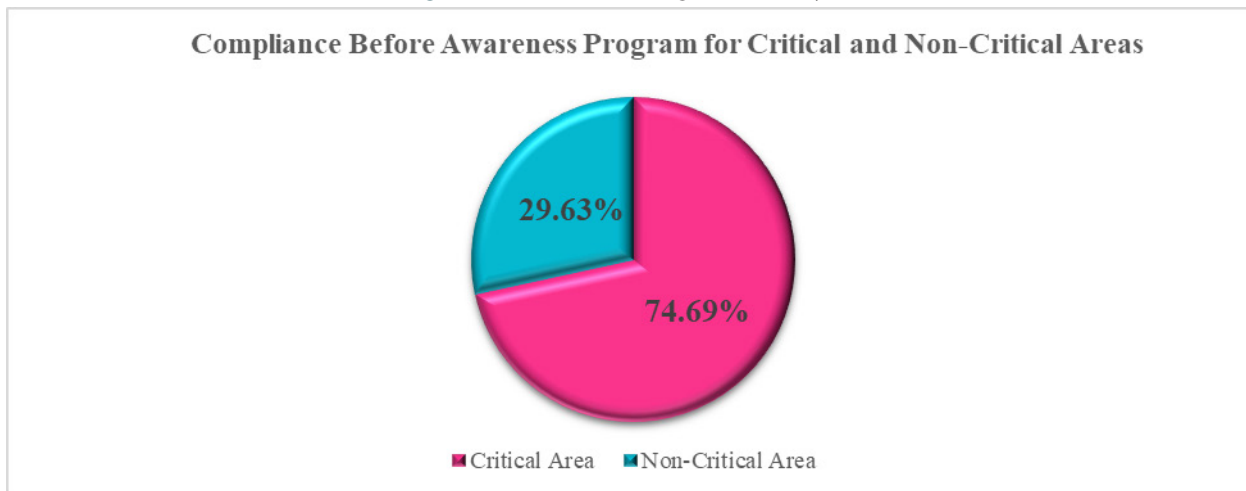
Compliance was also checked for parameters other than timing of administration of medicines. The observations were as follows (Table 3).

### DISCUSSION

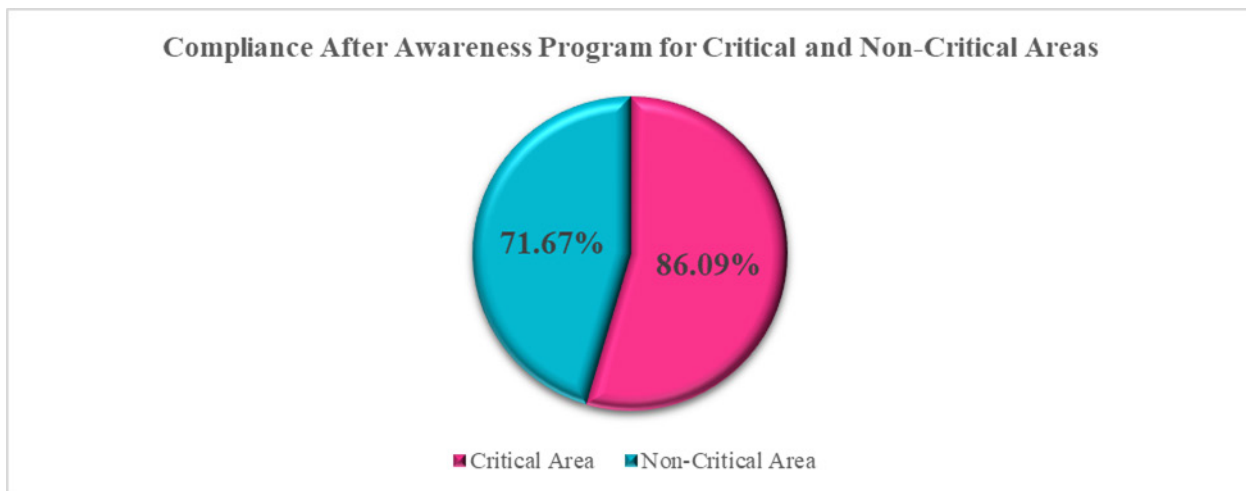
This study was undertaken to examine timely administration of time critical medications and non-time critical medications. This prospective observational study was conducted in tertiary care hospital with 400 (254 Males and 146 female) inpatients with 1050 medication administrations, in which 681 medication administrations were time critical and 369 medication administrations were non-time critical. The most common time critical medication administrations belonged to ATC class of Anti-Infective for Systemic Use (33.77%), while non-time critical



**Figure 3:** After Awareness Program Data Analysis.



**Figure 4:** Compliance before Awareness Program for Critical and Non-Critical Areas.



**Figure 5:** Compliance after Awareness Program for Critical and Non-Critical Areas.

scheduled medication administrations belonged to ATC class of Alimentary Tract and Metabolism (57.45%).

The study conducted by Craig Furnish *et al.*<sup>7</sup> had total of 69,794 medication administrations in which 389 were time-critical and 69,405 were non-time critical. They had more non time critical medication administrations than time critical medication administrations whereas we had a greater number of time critical medication administrations. Another study conducted by Sarah Berdot *et al.*<sup>1</sup> had most frequently administered drugs belonging

to the ATC class of cardiovascular drugs (28.3%), the central nervous system drugs (18.6%), followed by the gastrointestinal drugs (18.0%).

Before awareness programme 515 number of medication administrations were observed, in which 335 medication administrations were time critical and 180 medication administrations were non time critical. Out of 515 medication administrations, 263 were on time (51.07%) while 252 medications deviated from the schedule time (48.93%) accounting for 20 (7.94%) administrations being early and 218 (5.55%) administrations being late and 14 (5.55%) were not administer.

The study by Arun Kumar K S *et al.*<sup>8</sup> had 218 medications administration errors in 167 patients in which on time drug administration errors was 12.84%. The study focused on all medication error which included omission error, improper dose, wrong strength, wrong time, wrong route besides error in time of administrations whereas our study focused specifically on timely administrations of medicines. Jyhong Gabriel Hou, *et al.*<sup>9</sup> completed one of the larger trials looking at medication timeliness in 89 patients with Parkinson's Disease. They evaluated 3,873 administrations of anti-Parkinson medications in an inpatient setting and found that 675 of the 3,873 administrations were incorrect (17.4%). Although their study involved Parkinson's Disease and anti-Parkinson medicines, in our study we evaluated time critical and non-time critical medicines irrespective of diagnosis.

After awareness programme out of 535 medication administrations, in which 346 were time critical medication administrations and 189 were non time critical medication administrations. Out of total medication administrations, 413 were on time (77.20%), while 122 administrations deviated from the scheduled time (22.80%) accounting for 28 (22.95%) administrations being early and 94 (7.05%) administration is being late.

**Table 2: Causes of Early/Late Drug Administration.**

Possible causes of Early/Late administration of drug.	Count of Possible causes of Early/Late administration of drug (Before Awareness Program) (%)	Count of Possible causes of Early/Late administration of drug (After Awareness Program) (%)
Heavy patient load.	177 (70.23)	82 (67.21)
Shift issues.	20 (7.94)	28 (22.95)
Nurse was busy in other work.	19 (7.54)	9 (7.38)
Patient was not on floor.	11 (4.37)	0 (0)
Order placed late.	4 (1.59)	0 (0)
Patient was on another IV.	4 (1.59)	3 (2.46)
Changed medication order was not mentioned on medication chart.	1 (0.40)	0 (0)
Late from pharmacy.	1 (0.40)	0 (0)
Outside pharmacy. Relative brought medicine late.	1 (0.40)	0 (0)

**Table 3: Analysis of Parameters other than timing of medication administration.**

Parameters	Number of cases before awareness program (%)	Number of cases after awareness program (%)	% Change
Document's initials and signature on drug chart along with emp id were legible.	501 (97.28)	535 (100.00)	2.72%
The medications prepared at the time of administration by using medicinal tray.	165 (32.04)	188 (35.14)	3.1%
Nurses wash or sanitize hands prior to the drug administration.	91 (17.67)	241 (45.05)	27.38%
The medicines get crosschecked with the senior nurse or nurse in charge.	25 (4.85)	66 (12.34)	7.49%
The signature was done before the drug administration.	7 (1.36)	8 (1.50)	0.14%
The medications administrations done without documentations.	6 (1.17)	3 (0.56)	0.61%

The study conducted by Craig Furnish *et al.*<sup>7</sup> out of total 69,794 medication administrations, in which 58,369 medication administrations were on time (83.62%), while 11,427 administrations being late or early (16.37%). These findings were similar to our study. We also find out on time and late or early medication administrations.

Compliance and non-compliance also vary for the critical areas (ICU and Private wards) and non-critical area (General ward). Before awareness programme, when comparing critical areas versus non-critical areas, medications administered in the former (74.69%) were more compliant than latter (29.63%) and after the awareness programme; the compliance was improved with similar results. For critical area, compliance can be more because the patients in these areas are usually serious and need more care and supervision with respect to their physical health and medications. Total number of patients in critical area is usually less. If we consider non-critical area, numbers of patients are more and number of nurses available can be less which makes the process of achieving compliance more difficult.

Mean difference in scheduled time and administration time before awareness program for time-critical medications was 49 min 66 sec  $\pm$  34 min 94 sec which reduced to 27 min 33 sec  $\pm$  23 min 36 sec after the program, whereas for non-time-critical medications the mean difference was 41 min 24 sec  $\pm$  31 min 86 sec which later reduced to 29 min 10 sec  $\pm$  21 min 99 sec. The % increase in on-time administrations was observed to be 26.13, after the awareness programme.

The reduction in mean time of administrations can be linked to the awareness programme designed for the nursing staff in which identified errors were discussed along with root causes of administration errors. Significance of timely administrations was explained further extending the session on how to reduce the risk of errors that lead to early or delayed administrations such as managing the IV, giving priority to time-critical infusions, preparing list of time-critical and non-time-critical medications, checking availability of medications, before the scheduled time of medication administration, using colour code for time-critical medications for easy recognition and so on. The root causes found in the study for non-compliance included heavy patient load (70.23%), shift issues (7.94%), nurse was busy in other work (7.54%), patient was not on floor (4.37%), patient was on another IV (4.37%), order placed late (1.59%), incomplete documentations such as changed medication order was not mentioned on medication chart (0.40%), outside pharmacy (longer retrieval time by the relative) (0.40%), and late from pharmacy (0.40%).

The study conducted by Erika Sharpnack Elganzouri *et al.*<sup>10</sup> Had a longer medication retrieval time, possibly because of staff mixing, longer time to resolve the nurse queries, storage of medicines away from patient bedside, stored on different locations. Differences in causes can be because of different hospital system being followed.

Another study performed by Arun Kumar K S *et al.*<sup>8</sup> Reported human factors responsible for medication administration errors like performance deficit (42.20%), stress (21.10%), fatigue and lack of sleep (8.71%). These findings were similar to our study.

Some of the other parameters also improved significantly after the session as mentioned below.

Initials, signature and employee identification on documents were 100% legible after the programme was enhanced.

The usage of medicinal tray at the time of administration after the programme increased to 35.14%.

In 45.05% cases nurses were observed to wash or sanitize their hands before the drug administrations.

Cross-checking of medications with the senior nurse was increased to 12.34%.

The percentage of drug delivery without proper documentation was reduced to 0.56%.

Study conducted by Samantha P *et al.*<sup>11</sup> had checked for errors in medication verification and reported error in 77.8% cases. Our study observed that medication verification occur in 4.85%.

## CONCLUSION

Timely administration of medications is crucial to prevent harm and therapeutic failure. Educating nursing staff and other healthcare professionals can help prevent errors and improve patient care. Despite factors like heavy patient load or shift issues, efforts can be made to improve the compliance by prioritizing medication and understanding the consequences of deviations in time of administration.

## ACKNOWLEDGEMENT

I extend my sincere gratitude to all staff of hospital for their cooperation. I thank my guide without whom this paper is not possible.

## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

## ABBREVIATIONS

**Emp:** Employee; **ICU:** Intensive Care Unit; **ISMP:** Institute for Safe Medication Practices; **OD:** Once daily; **QID:** Quatre in die (four times a day).

## SUMMARY

Not administering medicines as per the prescribed guidelines can result in subtherapeutic or toxic effects by taking dose too early or too late. It could have a negative impact on the patient or resulting in an additional financial burden.

A Prospective observational study was carried out in the inpatients of tertiary care hospital. Total 400 patients and 1050 medication administrations were studied over a period of 6 month for timely medication administration. The error was assessed using ISMP (Institute for Safe Medication Practices) guidelines.

The numbers of females were 146 and 254 males forming total 400 patients. Total 1050 medication administrations were evaluated, 681 time critical and 369 medication administrations were non-time critical. Before awareness program, out of 515 medication administrations 263 were on time (51.07%), while 252 administrations deviated from the scheduled time (48.93%). After awareness program, out of 535 medication administrations, 413 were on time (77.20%), while 122 administrations deviated from the scheduled time (22.80%). Difference in scheduled time and administration time for time critical medication administrations, was reduced by 22 min 33 sec  $\pm$  11 min 58 sec after the awareness program, while for non-time critical medication administrations the time was reduced by 12 min 14 sec  $\pm$  9 min 87 sec, after the awareness program.

Timely administration of medications is crucial to prevent harm and therapeutic failure. Educating nursing staff can help prevent errors improve patient care.

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**Cite this article:** Ubhe T, Dokh R, Bhujbal S, Joshi N, Tuse T, Pisure M. Drug Utilization Evaluation Study in a Tertiary Care Hospital. *Indian J Pharmacy Practice*. 2024;17(3):213-9.