Prevalence and Causes of Wrong Time Medication Administration Errors, Experience at a Tertiary Care Hospital, Karachi, Pakistan

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Abstract

Purpose: Wrong-time medication administration error (WTMAE) is a high risk to patient safety. It can result in severe harm, death or fatal consequences. Through this study we investigated the prevalence of WTMAEs via electronic medical administration record (eMAR) and explore the contributing factors associated with WTMAEs.

Study design: A descriptive study design with quantitative research approach.

Setting: Data was gathered from a private tertiary care university hospital in Karachi, Pakistan.

Outcome: Determine the prevalence and causes for WTMAEs.

Findings: 250,213 doses were observed, out of which 231,380 (92.5%) doses were administered and 18,833 (7.5%) doses were identified as missed doses. Administered doses (n= 231,380) were further analyzed for on-time administration (n=191,994; 83%) and wrong-time administration (n=39,386; 17%). Study showed high percentage of WTMAE's during the night shift. Upon further exploration of WTMAEs multiple reasons for late and early medication administration were identified.

Implications: Medication administration is a complex process, and WTMAE is a major area to focus for improving the accuracy of medication administration recording. The study highlights the frequency of WTMAEs and provides opportunities for improvement in nursing practices by elaborating multiple reasons for WTMAEs.

Value: Technology used innovatively in the form of eMAR can significantly help in identifying medication administration errors (MAE). The study also highlights major issues of MAE requiring intervention.

Keywords: Medication errors, Technology, Medication administration.

Introduction

Patient safety issues related to medication administration are critical on a day by day basis. Among all types of clinical errors, medication administration errors (MAEs) are reported as the second most frequent cause of injury. Therefore research needs to be done to identify different types of medication administration errors such as, wrong patient, wrong dose, wrong route, wrong drug, wrong-time and many others. Identification and analysis of MAEs are highly important for process improvement and patient safety. According to Koppel, Wetterneck, Telles, and Karsh (2008) "The Institute of Medicine (IOM) estimates that, on average, a hospitalized patient is subject to one medication administration error (MAEs) per day… In hospitals, the medication administration stage accounts for 26% to 32% of adult patient's medication errors" (p. 408).

Studies have been conducted to identify MAEs and wrong-time medication administration error (WTMAE) as high risk to patient safety. The National Patient Safety Agency (NPSA) News (2007) reported that WTMAE is the second largest category of medication error reported worldwide and has resulted in death or serious harm to patients. A review of the literature suggested that observational study for wrong time (WT) errors conducted by different methods, showed variation ranging from 10% to 42% at several healthcare institutions (Balas, Scott & Rogers, 2004, Barker, Flynn & Pepper, 2002, Colen, Neef and Schuring, 2003, Prot et al., 2005). In addition Fitzhenry et al., (2007) reported wide disparity in wrong-time error rates, ranging from 0.5% to 35.7%. He defined WT errors as "dose administered > 60 minutes before or after scheduled time" (p.760). Khowaja *et al.,* (2008) highlighted that 26.4% of medication errors are due to delayed dispensation of drug from pharmacy. Allan and Barker (1990) suggested that wrong-time errors were defined as deviations from hospital policy.

The purpose of this study was to investigate the prevalence of WTMAE with the help of technology and to explore factors contributing to WTMAE. This study compared actual versus expected medication administration time, captured from an electronic medication administration recording system (eMAR). The study was conducted at a tertiary care hospital in Pakistan where the electronic medication administration record (eMAR) was used at all inpatient locations. The study findings provide an opportunity to decrease patient care risk and assist in development of different strategies for system improvement to ensure safe practices.

Literature review

A literature review was done using different search engines such as Pub-Med, EBSCO host CINAHL Plus and Cochrane Database of Systematic Reviews. Attempts were made to find the literature from the primary source library and some of the literature was explored through secondary sources (University of Sheffield) library. All electronic databases were searched for references with key terms such as medication error, medication administration error and wrong-time medication administration errors. The search was limited to literature available from January 2000 to December 2011. Pub-Med search revealed 1642 articles, EBSCO host CINAHL Plus provided 220 and the Cochrane database revealed 1551 full text articles with search term: "medication error". The search was narrowed to search term "wrong-time medication

administration error" which revealed limited full text articles. Leading studies are summarized in Table I.

Table

Study Design

A quantitative descriptive study design was used. Data for this study was gathered through the eMAR system, which identified the dose timing (actual verses expected) with reasons for early or late administration.

Setting

The study was conducted at a private tertiary care university hospital in Karachi, Pakistan. It serves over 600,000 out-patients and 50,000 inpatients annually. This study included five in-patient locations; i.e., medical, surgical, coronary care, intensive care and pediatric units (37% of total inpatient beds). These units were chosen to cover most of the specialty areas for adult and pediatric patients with medical and surgical conditions. Approval for data collection was requested from relevant departmental heads and the hospital Ethical Review cCmmittee (ERC).

Sampling

A universal sampling technique was used to capture all the medication doses prescribed for the 3-month period from February 10, 2012 to May 9, 2012. This activity was initiated only after getting approval from hospital departmental heads and the ERC.

Data collection

The data for this study was gathered through the eMAR system from designated locations. All medication administered daily from 00:00 hours to 23:59 hours for 3 consecutive months were included in the study. The information was then exported to Microsoft Excel for analysis.

Data analysis

Data received from the eMAR was coded for different variables and analyzed in SPSS version 19. Additionally Chi-square test was used to analyze data for differences between wrong-time administration verses on-time administration at different locations and shifts, to identify any significance difference**.** Lastly data was analyzed to identify the reasons for any WTMAEs.

Results

The results illustrate that, overall 250,213 doses were prescribed for all of the five selected inpatient locations during the study period of 90 days. The finding indicates that out of 250,213 prescribed doses 231,380 doses were administered whereas 18,833 doses were not administered (see Table 2).

Table

Subsequently data from the total number of administered doses (n=231,380; 100%) were analyzed to obtain the on-time administrated doses (n= 191,994; 83.0%) and wrong-time administrated doses (n=39,386; 17.0%). The data showed 17% prevalence of WTMAEs at the tertiary care university hospital in Karachi, Pakistan. Findings of this analysis are presented in Figure 1.

Figure

Figure 2 summarizes the percentage of on-time and wrong-time medication administration record by locations.

Figure

Data was also analyzed to measure WTMAEs in different shifts to identify the impact of shifts on WT errors. This hospital has nursing staff working three eight hour shifts. The highest number of medication administration was reported in the evening shift; whereas the highest percentage of WT administrations was reported in the night shift; i.e., 21.22% (see Figure 3).

Figure

The eMAR system was programed to allow nurses to administer a medication dose 60 minutes prior or later to its scheduled time only after giving a short reason. This systemic intervention helped us to identify many reasons for early or late medication administration errors. These reasons were further grouped to list 35 reasons (Table 3) for late administration and eight reasons (Table 4) for early administration. Figures 4 and 5 depict the top five reasons for late and top three reasons of early administration.

Figure 4 and 5

Discussion

The data on WT medication administration errors illustrates that error identification from electronic system helps to give accurate number of errors and avoid Hawthorne effect on the study; whereas literature search revealed that most of the previous studies used observational method to achieve medication administration error (Bates *et al.,* 2000). Our study results showed total of (n=39,386; 17%) doses in error due to WT administration in 3 month time. The data also displays how timings errors are not considered as a major issue and has been given less attention. It has been mentioned by Fitzhenry *et al.,* (2007) *"The effects of timing errors and errors of omission were rarely recognized clinically"* (p. 762). Our study is first from a third world country showing 17% WTMAE. Many studies conducted internationally on medication errors presents WTMAE in ranges from 3% to 45% (Bemt *et al.,* 2007; Szczepura *et al.,* 2011).

Conclusion

Medication administration is a complex process. The most important contribution of this study was the focus on wrong-time medication administration errors and its contributing factors. The study shows that innovation of technology and its role in identification of MAE and WTMAE are imperative and well supported by literature. Electronic medication administration record system acts as a great tool to capture the administration record in a timely manner and to help to correctly estimate the prevalence of WTMAE and the reasons behind the wrong-time administration.

Recommendations

Available literature on WTMAEs via electronic data base is limited. International studies conducted on wrong time error were reported using observational and chat review method via manual medication administration record. Conducting a study in a developing nation through eMAR is a new experience. This study finding recommends that staff members ought to be sensitized on the importance of on-time medication administration, which requires strong enforcement by the management in the form of institutional policy. Also regular audits of medication administration record of eMAR should be done to check for WTMAE. The senior management must also be apprised of the fact that to create a culture of patient safety, correct nurse patient ratio is important to curtail WTMAE.

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As a System Analyst, I am involved in the planning, development and implementation of different clinical systems to enhance technology in nurses. Currently as a Lead Analyst Nurse working with EHR Core Committee for selection of suitable software for Electronic Health Record for all the Aga Khan Hospitals in Asia & Africa.

Acknowledgement

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My special thanks to my supervisor Dr. Peter Bath, for his ongoing encouragement and continue guidance.

Table I: International studies on medication administration errors

Author	*Title*	*Country*	*Setting*	*Method*	*Outcome*	*Recommendation*
Barker *et al* (2002)	Medication Errors Observed in 36 Health Care Facilities	Atlanta, USA	18 facilities randomly selected; 6 accredited, 6 non-accredited hospitals and 6 skilled nursing facilities	Direct Observation Method	19%MAE including 43%wrong time, 30% omission, 17%wrong dose and 4% unauthorized drug.	Systems should be designed to eliminate threats of MAE.
Van Den Bemt *et al*. (2002)	Frequency and determinants of drug administration errors in the intensive care unit.	Netherland	2 ICU of Dutch hospitals	Disguised-Observation Technique	44.6% MAE including 10.6% wrong time error and 33% other MAE errors	Nurses need to be educated on use of medication administration protocol.
Calabrese *et al* (2001)	Medication administration errors in adult patients in the ICU	USA	5 ICU of USA hospitals	Observation Method	3.3% MAE includes; 40.1%wrong infusion rate, 14.4% dose omission, 13.9% wrong time and 11.1% improper dose	Wrong infusion rates should be considered as potential areas for improvement.
Fitzhenry *et al* (2007)	Medication Administration Discrepancies Persist Despite Electronic Ordering	Tennessee, USA	Adult patients in sub-acute, acute, and critical care units	Retrospective manual chart audits	16.9% wrong time MAE, while12.6% were dose omission errors.	Future study on medication administration processes to determine, a classification of medications based on "timing criticality"
Nelson *et al.* (2005)	Detection and prevention of medication errors; using real-time	USA	Two 40-bed surgical units	Review of Medication event report and charting	Real-time charting rate were improved from 59% to 75%	A future study that may target interventions separately

	bedside nurse charting			process of medication		
Author	*Title*	*Country*	*Setting*	*Method*	*Outcome*	*Recommendation*
Van Den Bemt *et al* (2007)	Drug administration errors in an institution for individuals with intellectual disability: an observational study	Netherland	Five units from five different towns/villages were selected. consists of both day care and living units	Observation study	Frequency of drug administration errors were 25.4% including WT error and 22.4% excluding WT error. This shows only 3% WT errors out of 25.4%	Focus on identified determinants for future improvements.
Szczepura , Wild and Nelson (2011)	Medication administration errors for older people in long-term residential care	UK	13 care homes (9 residential and 4 nursing homes)	Three months data gathered from central system	2,289 potential MAEs recorded, out of which 45% were WTMAE	Implement barcode medication administration systems
DeYoung *et al*. (2009)	Effect of barcode assisted medication administration on medication error rates in an adult medical intensive care unit.	USA	Medical ICU	Direct observation technique	After implementation of barcode medication administration system, MAE rate reduced from 19.7% to 8.7% and WT error rate reduced from 18.8% to 7.5%.	Utilizes automated dispensing cabinets for eMAR to reduce transcription, dispensation and administration errors.
Tissot *et al* (2003)	Observational study of potential risk factors of medication administration Errors	France	Geriatric Unit (GU) and Cardiovascular-Thoracic Surgery Unit	Observational study	14.9% MAE include: 41% dose error, 26% wrong time, 19% wrong rate errors, 4% preparation errors and 10% no potential fatal errors	Institutions need to have computerized physician order entry, unit-dose drug distribution system and pharmacist as a member on the patient care team to cut errors

Buckley *et al* (2007)	Direct observation approach for detecting medication errors and adverse drug events in a pediatric intensive care unit	USA	pediatric intensive care unit	Direct observation	17% preventable errors including; 29.7% wrong dose, 26.7% wrong time, 20%wrong tech and 26.7% extra doses.	Future studies are needed to evaluate the effects of medication use process to observe chances of medication errors in PICU.

Table 2: Prescribed, administered and missed doses

	Total Prescribed Doses	Total Administered Doses	Missing Doses
N Valid %	250,213 (100%)	231,380 (92.5%)	18,833 (7.5 %)

Figure 1: On-time verses wrong-time doses

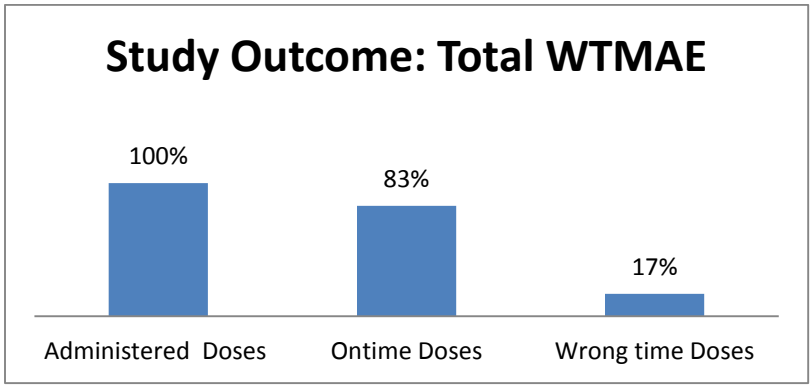


Figure 2: On-time and wrong-time medication administration record by different locations.

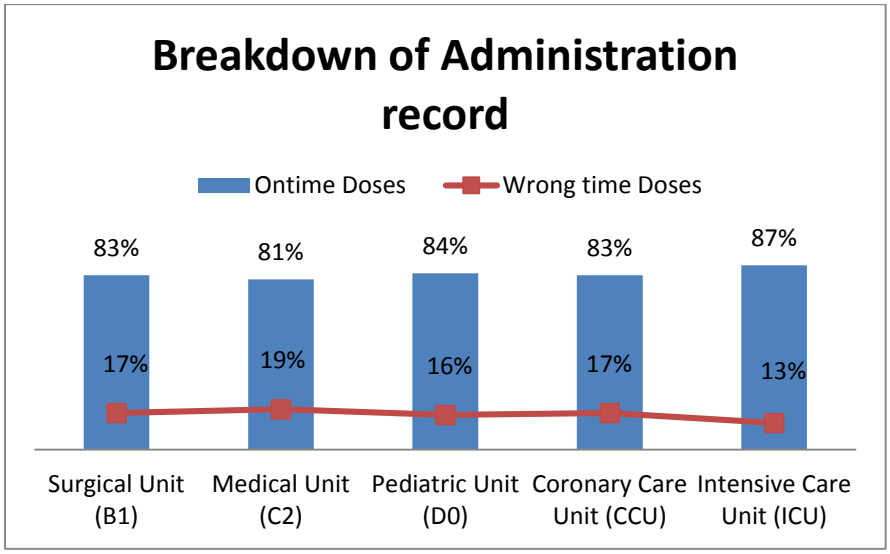


Figure 3: On-time and wrong-time medication administration by shift

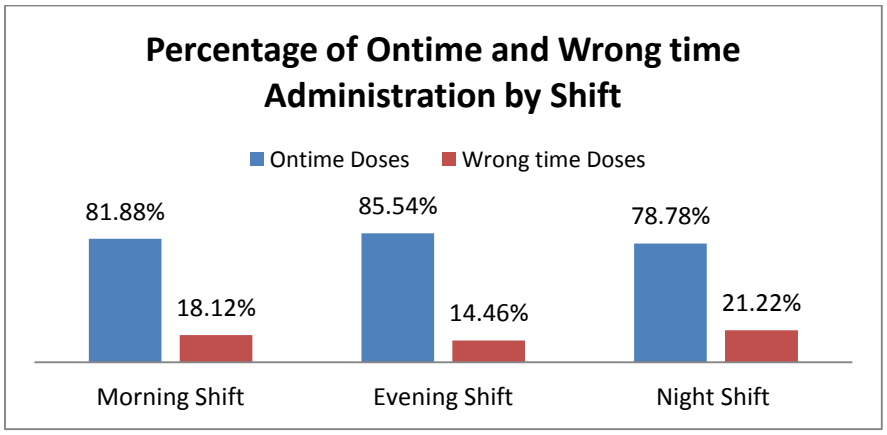


Figure 4: Early administration – main reasons

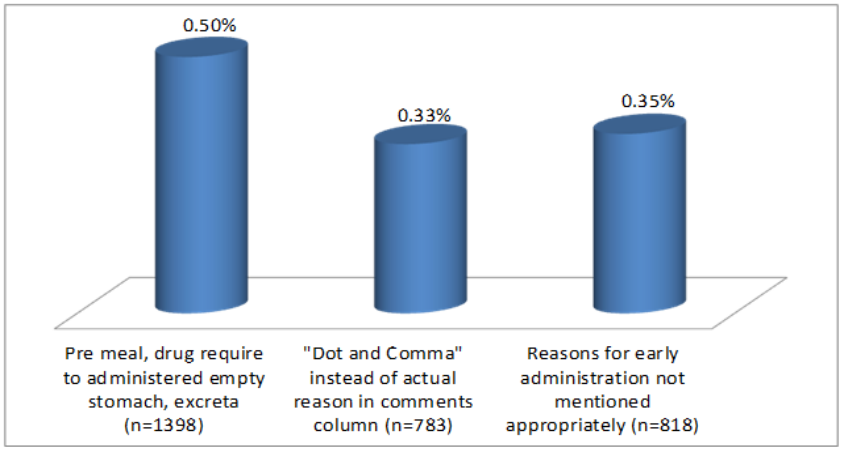
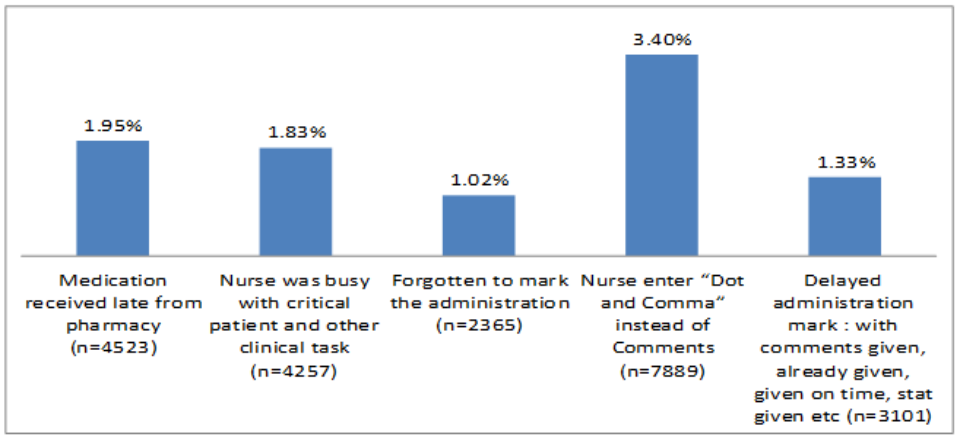


Figure 5: Delayed administration – main reasons



Appendix 1: Reasons for delayed medication administration

Category	*Nos*	*Reasons*	*Number (%)*
Pharmacy Related	1.	Medication received late from pharmacy	4523 (12.2)
Nursing Related	2.	Nurse was busy; • handling a critical patient • doing patient handover • shifting of patient to another care level • in-appropriate nurse patient ratio	4257 (11.5)
	3.	Nurse forgot to record medication administration on-time	2365 (6.4)
	4.	Data showed that nursing staff skipped the mandatory field of reason for delay by entering symbols such as comma or dot.	7889 (21.4)
	5.	Dose administered on-time but updated in the system late	3101 (8.4)
	6.	Medication administration not signed by previous shift staff at different patient care location	614 (1.6)
	7.	Dose skipped as patient did not require medication	157 (0.4)
	8.	Medication administration done by doctors and trainee nurses were later signed in eMAR by registered nurses	157 (0.4)
	9.	Medication delayed to adjust regular dose time after stat dose.	69 (0.1)
	10.	Medication misplaced	13 (0.03)
	11.	Delayed order review by nursing staff	3 (0.008)
	12.	Medication administration delayed as feeding tube not in place	61 (0.1)
	13.	Unclear statements mentioned by nursing staff for delayed medication administration	1108 (2.9)
Patient Related	14.	Patient was not on bed at the time of dose administration	300 (0.8)
	15.	Patient intravenous line not accessible	294 (0.7)
	16.	Patient was sleeping	1353 (3.6)
	17.	Patient or attendant refusal	1098 (2.9)
	18.	Delayed administration as patient is having meal, taking bath or changing clothes	115 (0.2)
	19.	Patient allowed to bring their own medication. Delay occurs when these are not brought to hospital in time.	19 (0.05)

	20.	Patient had gone for a procedure	1069 (2.9)
System Related	21.	Missing appropriate consent for a specific medication.	270 (0.7)
	22.	Medication administration time was dependent on procedure time (e.g. blood transfusion, renal dialysis, CT scan, tracheal suction for secretions etc.)	1547 (4.2)
	23.	Medication administered during emergency are used from floor stock and later re-furbished from pharmacy	875 (2.3)
	24.	Administration delayed due to physician's verbal order	112 (0.3)
	25.	Pre-meal doses depend on meal arrival time	353 (0.9)
	26.	Orders for temporary suspension of doses by physician	341 (0.9)
	27.	Administration delayed as patient in operating room and in operating room recovery area	292 (0.7)
	28.	Medication frequency changed and not updated in system.	265 (0.7)
	29.	Medication ordered for patient on NPO (Nothing per oral)	195 (0.5)
	30.	Medication administration dependent on laboratory result	20 (0.05)
	31.	Patient on non-invasive ventilator (BIPAP)	117 (0.3)
	32.	Delay due to change in patient condition such as: altered blood sugar, altered blood pressure, nausea and vomiting etc.	49 (0.1)
	33.	Multiple I/V medications at same time	1429 (3.8)
Technical and other	34.	Technical issue • User log-in issues • Computer hardware issues • Wifi connectivity issues	1371 (3.7)
	35.	Other miscellaneous comments	1017 (2.6)

Appendix 2: Reasons for early medication administration

Category	*Nos.*	*Reasons*	*Number (%- reduced to one decimal)*
Nursing related	1	Data showed that nursing staff skipped the mandatory field of reason for early administration by entering symbols such as comma or dot.	783 (30.4)
	2	Unclear statements mentioned by nursing staff for early medication administration	818 (31.8)
Patient related	3	Early administration done in view of patient's condition such shortness of breath, increase heart rate, pain, fever, alter blood pressure, nausea, vomiting excreta	142 (5.6)
	4	Patient wish to sleep early	21 (0.8)
System related	5	Medication administered early as pre-meal requirement.	1398 (54.4)
	6	Medication administered before schedule time owing to planned procedure	50 (1.9)
	7	Early administration done as per doctors order	27 (1.05)
Other	8	Other miscellaneous comments	111 (4.3)