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Analysis of the Medication Turnaround Time in a Tertiary Government Hospital

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RESEARCH ARTICLE

Abstract

Background: Medication turnaround time (MTAT) is the time interval from the time a medication order is written to the time the medication was administered. Literature showed that delays in MTAT were found to cause medication errors which can result in patient harm. At present, there are limited studies conducted about MTAT in the Philippines.
Objectives: This study aimed to evaluate the MTAT of Medicine and Surgery Departments and dispensary turnover time of new and stat medication orders of the Central Block (CB) and Payward Pharmacies and identify the common factors associated with delays in MTAT and dispensary over time of the hospital.
Methods: MTAT was collected using MTAT forms distributed to the Medicine and Surgery Departments while time and motion logs were used for the dispensary turnover time of CB and Payward Pharmacies. Interviews with pharmacists and watchers were conducted to gain their insights on the factors and effects of MTAT delays.
Results: The MTAT in the Medicine and Surgery Departments were 303.53 and 114.35 minutes, respectively. Administrative, protocol-based and personal factors that led to delays were identified. The average dispensary turnover time of the CB pharmacy was 35.37 minutes while the dispensary turnover time for non-stat and stat medication orders of the Payward Pharmacy were 31.78 and 10.93 minutes, respectively.
Conclusion: Dispensary turnover time of both pharmacies were significantly different from the protocol times. The short range and low variability of the dispensary turnover time observed suggest that protocols can effectively reduce MTAT. Administrative, protocol-based and personal factors that led to delays were identified which could serve as possible targets for process improvement.

Keywords: *medication turnaround, MTAT, dispensary turnover, pharmacy*

Introduction

According to the Agency for Healthcare Research and Quality, medication turnaround time (MTAT) is defined as the interval from the time a medication order is written, manually or electronically, to the time the medication is administered [1]. It can be broken down into different phases, namely: (1) verification time, (2) dispensary turnover time, (3) delivery time, and (4) unit sit time [2]. Verification time is the time required to check and verify a medication order. Dispensary turnover time can be further subdivided into different steps to process the medication order received by the pharmacy. It starts from the receiving of the medication order to the dispensing of the medications. Delivery time is the period from the medication's release from the pharmacy until it reaches the unit of the patient. Unit sit time is the length of time that the medication waits at the unit until administration.

The major effect of delays in MTAT is the late delivery of medicine. Delays in medication turnaround were found to cause 9% of medication error reports. Approximately 23% of these errors result in patient harm [3]. One of the major events that can delay MTAT in any of the steps is staffing shortages that can be experienced by hospital pharmacies and other departments of the hospital [4]. Staffing shortages can lead to medications being delivered at an inappropriate time to the bedside of the patient and to personnel being assigned to another area at the start of the shift to fill in for an absent employee [2,5]. In turn, these staffing reallocations lead to further delays due to the build-up of medication orders that have to be prepared and delivered [2]. If fewer personnel are

working at a certain department of the hospital, they can be easily overworked and are more prone to fatigue which can lead to errors during medication order processing. Within the Pharmacy Department, it has been identified that a heavy workload on the staff affects their well-being and ultimately, the patient's safety. Also, a high dispensary workload increases the risk of dispensing errors [6]. There is frequent miscommunication between the Pharmacy and Nursing Departments. This leads to numerous reports of missing or duplicate medication orders [2]. Any delays in the points of transmission of medication order processing contribute to a prolonged MTAT. Also, physicians lengthen MTAT when their verbal orders are not transcribed correctly or they order medications that are restricted or unavailable in the hospital. An increase in patient mortality and morbidity can be directly or indirectly associated with delays in MTAT [7]. Moreover, prescribing and transcribing errors lead to a significant reduction in the probability of treatment being timely and effective [8]. There can be possible miscommunication between the Nursing and Pharmacy Departments that can lead to high stress and conflicts.

Studies on MTAT have been done in countries such as the USA and India [2,7]. Measurements of MTAT were conducted to re-evaluate the appropriateness of their existing protocols. Monitoring of the hospital's MTAT in the in-patient setting allowed the hospital to measure the impact of the efficiency of their patient care [7]. At present, there are no studies conducted about the MTAT and dispensary turnover time in the selected tertiary government hospital. Also, there are only a few existing studies on the factors that affect each step of the MTAT in Philippine hospitals. In this regard, the study aimed to evaluate the medication turnaround time of the Medicine and Surgery departments, and the dispensary turnover time of new and stat medication orders processed in the Central Block (CB) and Payward pharmacies of the hospital. Also, the study aimed to identify the common factors associated with delays in MTAT and dispensary turnover time of the hospital.

Methodology

This study was approved by the UP Manila Research Ethics Board (UPM REB) prior to implementation. The study employed a descriptive research design which employed both quantitative and qualitative modes of data collection.

The sources of data were MTAT forms, time and motion logs, and interviews with watchers and pharmacists. Data were collected from April 23 to May 7, 2016 and data

<table>
<tr><td colspan="3">MTAT Form Ward 1
DATE: MTAT form:
BED No.:
No. of Medications:

Encircle type of order: NEW STAT</td></tr>
<tr><td>Prescription of medication order/ Transcription</td><td>Medication order or RIV received by the pharmacy</td><td>Medications are dispensed by the pharmacy</td></tr>
<tr><td>TIME:</td><td>TIME:</td><td>TIME:</td></tr>
<tr><td>RIC/Nurse/Pharmacist:</td><td>Pharmacist/ Clerk:</td><td>Pharmacist/ Clerk:</td></tr>
<tr><td colspan="2">Medications are received in the ward</td><td>Medications are administered to the patient</td></tr>
<tr><td colspan="2">Time:</td><td>Medication Administered (1 only):</td></tr>
<tr><td colspan="2" rowspan="2">Nurse:</td><td>TIME:</td></tr>
<tr><td>Nurse:</td></tr>
</table>

***Figure 1**. MTAT forms distributed to the wards of the hospital and attached on the medication order forms.*

collection sites included Wards 2, 3, 4, and 6, and the Central Block and Payward Pharmacies.

There were three instruments used to collect data – MTAT forms, time and motion log, and interview guide. MTAT forms were developed to determine the medication turnaround time. This form (Figure 1) included the date of transcription, ward and bed number of the patient, number of medications in the order, and type of prescription (new or stat). There were blank spaces provided for the time of transcription of order, its arrival in the pharmacy and dispensing of the medications, arrival at the ward and administration to the patient. The signature or initials of the healthcare professional who recorded the time of each phase were written below the time. There were five time and motion log forms created (Figure 2) to facilitate simultaneous recording for the data collection of dispensary turnover time. The time and motion log forms included the date of data collection, number of interns present in the pharmacy during data collection, and columns for case number, type of medication order, line items, and the start time for each step of the dispensary turnover time. Finally, an interview guide was developed to gain a clear insight of the pharmacists' perception on the common factors that could affect MTAT and the effects of

Date:	Number of Interns:		
Case number	Stat?*	Start of Checking	Start of Encoding

Figure 2a. Form for the checking and encoding steps in CB and Payward Pharmacies.
* Column added during data collection at Payward Pharmacy to indicate if the order was stat or non-stat.

Date:	Number of Interns:		
Case number	Color of basket	Start of Unit Sit	Start of Filling

Figure 2b. Form for the filling unit sit time and filling step in CB Pharmacy.

Date:	Number of Interns:			
Case number	Line items	Color of basket	Start of Unit Sit	Start of Filling

Figure 2c. Form for the filling unit sit time and filling step in Payward Pharmacy.

Date:	Number of Interns:			
Case number	Line items	Start of Unit Sit	Start of Dispensing	End of Dispensing

Figure 2d. Form for the dispensing unit sit time and dispensing step in CB Pharmacy.

Date:	Number of Interns:		
Case number	Start of Unit Sit	Start of Dispensing	End of Dispensing

Figure 2e. Form for the dispensing unit sit time and dispensing step in Payward Pharmacy.

Figure 2. *Time and motion log. Different time and motion log forms were used to record the time for each phase of MTAT.*

delays in MTAT. The interview guide consisted of three parts. The first part explained the background of the study and a consent form. The second part consisted of close-ended questions to establish their length of employment in the hospital and assignment at the in-patient pharmacy. The last part consisted of open-ended questions to gain their insights on the factors that affect their efficiency or delay MTAT, the effects of the delays and their recommendations.

Another interview guide was developed which was used for the semi-structured interview with the watchers at the CB Pharmacy which also consisted of three parts. The first part explained the background of the study and a consent form. The second part consisted of close-ended questions to establish a relationship with the patient and the number of times they had obtained medications at CB Pharmacy. The last part consisted of open-ended questions asking about their perceptions on the efficiency of CB, factors that affect the service delivery of the pharmacy, the effects of the delays in the dispensing and recommendations for the pharmacy.

Data Collection Process

After obtaining the certificate of approval from the ethics committee of the hospital, MTAT forms were distributed to the wards of the Medicine and Surgery Departments served by the Central Block (CB) Pharmacy. These were attached to new medication orders for a patient. The process of filling out the forms was explained to the nurses. The time and motion log forms were used by three researchers simultaneously to record the time periods of the different steps of dispensary turnover time using digital clocks. Data collection was done for a period of two consecutive weeks.

Pharmacists who were available during data collection were interviewed while watchers were chosen based on the estimated waiting time before their orders were received or dispensed to allow adequate time for the interview. After explaining the background of the study to the interviewees, informed consent forms were given and explained before proceeding with the interview. Questions on the second and third part of the interview guide were asked chronologically to the respondents. The interviews were recorded digitally and manually by note-taking. Data collection was done until there was data saturation.

Analysis of Data

Data collected using the MTAT forms and time and motion logs were transferred to an electronic database using Microsoft® Excel 2013. The mean time and standard deviation of the four phases of MTAT and average MTAT were used to summarize the results. The mean time for each step of dispensary turnover time was computed.

Independent t-test using Stata 12® was done to determine if there was a significant difference between the MTAT of the Medicine and Surgery Departments. A t-test for one population mean was used to compare the actual times of each step of the dispensary turnover time with the available protocol.

All interviews conducted with the pharmacists, pharmacy assistants, and watchers were transcribed and summarized. Content analysis was then conducted to identify the factors and effects associated with MTAT delays in the two main pharmacies of the hospital.

Results

Medication Turnaround Time

Completed MTAT forms from the Medicine and Surgery Departments were 41 and 14, respectively, giving a total of 55 MTAT forms included in the study. Only the completely filled out MTAT forms were considered.

The average time for each phase in MTAT and the average MTAT of both departments are summarized in Table 1. The average medication turnaround time in the Medicine and Surgery Departments were 303.53 and 114.35 minutes, respectively. For both departments, unit sit time was the longest and most variable phase. Dispensary turnover time was the shortest in the Surgery Department. It had the shortest range and least variability in both departments. Verification time had the second longest time in both departments.

The average MTAT of the Surgery Department was significantly faster than the MTAT of the Medicine Department ($p<0.001$). The unit sit time of the Surgery Department was significantly shorter ($p<0.001$) than the Medicine Department.

Dispensary Turnover Time

Among the four steps of the MTAT process, the government hospital only has an existing protocol for the dispensing process. This led to the measurement of the dispensary turnover time of CB and Payward Pharmacies to compare with the available protocols.

Table 1. *Average MTAT of the Medicine and Surgery Departments*

MTAT Process					MTAT (mins)
	Verification Time (mins)	Dispensary Turnover Time (mins)	Delivery Time (mins)	Unit Sit Time (mins)	
	Mean (SD) [Range]	Mean (SD) [Range]	Mean (SD) [Range]	Mean (SD) [Range]	
Medicine (n=41)	34.38 (29.35) [1-150]	21.43 (15.98) [2-82]	20.20 (50.08) [2-324]	227.52 (119.70) [35-545]	303.53 (128.08) [90-730]
Surgery (n=14)	36.50 (44.30) [1-151]	17.78 (7.52) [6-32]	20.78 (21.82) [4-86]	69.28 (123.58) [0-425]	144.35 (150.13) [30-600]
p-value (95% CI)	0.839	0.416	0.967	$p < 0.001$	$p < 0.001$

Central Block Pharmacy

A total of 360 RIVs from the CB Pharmacy was included in the study. The mean checking time, encoding time, filling time, and dispensing time of an RIV were 0.47, 1.50, 5.52, and 1.13 minutes, respectively. On the average, it took 35.37 minutes before the watchers received the medications they ordered in the CB. A total of 26.75 minutes of the dispensary turnover time was observed to be spent on unit sit time. There was an average lag time of 18.87 minutes before the medication order was filled and 7.88 minutes before it was dispensed (Table 2). Of the 4 steps listed in the protocol, checking time was the fastest while filling time was the slowest.

Payward Pharmacy

A total of 189 non-stat medication orders and 90 stat medication orders were measured in the Payward Pharmacy. However, only 111 (58.7%) and 68 (75%) non stat and stat medication orders, respectively, had complete dispensary turnover times. A total of 153 (81%) non-stat and 72 (80%) stat medication orders had checking, encoding, and filling times recorded.

In general, the dispensary turnover time without unit sit time of non-stat and stat medication orders was significantly different from each other. Stat medication orders were processed and dispensed faster than non-stat medication orders. When sit times were considered in the dispensary turnover time, these were 31.78 minutes for non-stat and 10.93 minutes for stat medication orders (Table 3).

The actual time of the dispensary turnover steps found in the protocol for stat medication orders was extremely significantly higher than the protocol-prescribed times except for the dispensing time which was significantly lower. The protocol values were not consistent with the actual dispensary turnover times.

Factors Affecting Medication Turnaround Time

A total of nine 5 pharmacists were interviewed from CB and Payward Pharmacies. They were primarily females with a mean age of 26.25 years. CB pharmacists have been employed in the hospital for three years and assigned to CB for 2.36 years. Payward pharmacists have been employed in the hospital and assigned to the pharmacy for 2.31 years. As for the 20 watchers interviewed, most of them had their partners (spouse, live-in partner) as patients admitted to the hospital and obtained medications and supplies at CB at least three times.

Several factors for MTAT delay were identified by pharmacists of both pharmacies. The incorrect writing of prescription or unreadable penmanship increases MTAT because the watchers or nurses were required to have the prescription corrected prior to processing and dispensing. Also, frequent phone calls to inquire about the drug's availability or price affected the workflow and efficiency in the pharmacies. Furthermore, Payward pharmacists stated that the manual system of updating a patient's profile for each new medication order was time-consuming and had high risks for errors which can affect even the subsequent shifts in the pharmacy. Also, there were numerous instances when the “stat” status of a medication order was overused even in orders that were not urgently needed.

The watchers observed that one factor affecting MTAT was the skipping of the queue of the watchers who had their

Table 2. *Dispensary Turnover Time of the Central Block Pharmacy*

Medication Orders (n=360)					
Dispensary Turnover Time Process	Mean (mins)	SD (mins)	Range (mins)	Protocol Time	p-value (95% CI)
Checking Time	0.47	0.70	[0.03-5.22]	2.00	<0.05
Encoding Time	1.50	1.55	[0-9.9]	5.00	<0.05
Filling Unit Sit Time	18.87	14.68	[0-54.72]	-	-
Filling Time (per RIV)	5.52	4.82	[0.12-27.23]	-	-
Filling Time (per line item)	2.23	2.78	[0.03-27.23]	2.00	0.117
Dispensing Unit Sit Time	7.88	5.78	[0.43-62.43]	-	-
Dispensing Time	1.13	0.55	[128.28-524.65]	5.00	<0.05
Dispensary Turnover Time with Unit Sit Time	35.37	16.60	74.05	-	-
Dispensary Turn over Time without Unit Sit Time	8.62	5.40	27.21	-	-

prescriptions corrected. They observed that there were more encoding pharmacists than dispensing pharmacists which affected the process. As stated by some of the interviewed watchers, the effects of these delays in MTAT were delayed or skipped drug administration to the patients.

Both groups of respondents identified that most factors can be addressed by increasing the manpower proportional to the volume of prescriptions served in a shift. However, they indicated that this might be difficult to implement due to the budget constraints of the hospital. Adopting a unit dose drug distribution system was recommended by pharmacists of CB and Payward. This will ensure that one pharmacist is assigned to each ward which can reduce the delays and errors in medication orders. The problem of high frequency of phone calls can be addressed by providing a system containing drug information, such as availability and price at the nurses' station.

Discussion

The average MTAT of both Medicine and Surgery Departments was more than an hour. In comparison with a private general hospital in the Philippines which evaluated the MTAT pre- and post-computerized transcription system, the MTAT of both departments was longer compared with the pre-computerization transcription system MTAT of 97.92 minutes [10]. The difference in the average MTAT can be due to the presence of a standard protocol for medication order processing in the private general hospital which can assist the healthcare professionals in efficiently executing tasks for each phase. The protocol can also standardize the medication order processing for all wards served by the pharmacy by identifying who should be the involved healthcare professionals in the key steps [9].

The significant difference of MTAT in the Medicine and Surgery Department can be greatly attributed to their differences in unit sit time or the amount of time that medications stay at the bedside of the patient before administration. The unit sit time for orders from the Surgery Department were significantly lower due to the medications ordered near the time of their administration. This greatly reduced the MTAT for a medication order compared with orders transcribed several hours before the administration. This emphasizes the effect of the lack of a protocol that can standardize the medication order processing of the different wards of the hospital. Their usual practice of writing the prescriptions in bulk and giving these to the watchers contribute to the high volume of prescriptions that reach the pharmacy at once. Problems were encountered when those who need medications immediately had to wait in-line with watchers whose orders will only be necessary on the next shift. Also, during this period, there was a sudden increase in

Table 3. *Dispensary Turnover Time of the Payward Pharmacy*

	Non -Stat Medication Orders (n=153)	Stat Medication Orders (n=72)	p-value, 95% CI (non-stat vs stat)	Stat Protocol Time	p-value, 95% CI (stat vs protocol)
Checking Time (mins) Mean (SD) [Range]	0.78 (1.28) [0.08-4.68]	0.82 (1.27) [0.02-8.08]	0.827	0.17	<0.05
Encoding Time (mins) Mean (SD) [Range]	2.43 (3.93) [0.02-29.17]	1.22 (1.70) [0-12.53]	0.013	-	-
Filling Unit Sit Time (mins) Mean (SD) [Range]	0.72 (1.98) [0-14.1]	0.20 (0.73) [0-5.32]	0.016	-	-
Filling Time (mins) Mean (SD) [Range]	5.88 (9.82) [0.07-62.47]	4.25 (8.17) [0.22-43.9]	0.223	-	-
Encoding Time and Filling Time / Line Item (mins) Mean (SD)	-	4.42 (8.48)	-	1.00	<0.05
Dispensing Unit Sit Time (mins) Mean (SD) [Range]	20.88 (24.80)[a] [0-92.57]	4.65 (11.85)[b] [0-47.42]	<0.001	-	-
Dispensing Time (mins) Mean (SD) [Range]	0.60 (0.45)[a] [0.1-2.37]	0.52 (0.43)[b] [0-2.32]	0.242	-	-
Dispensing Time / Line Item (mins) Mean (SD)	-	0.38 (0.43)[b]	-	1.00	<0.05
Total Dispensary Turnover Time with Unit Sit Time (mins) Mean (SD) [Range]	31.78 (27.05)[a] [1.45-104.8]	10.93 (14.23)[b] [0.95-57.68]	<0.001	-	-
Total Dispensary Turnover Time without Unit Sit Time (mins) Mean (SD) [Range]	10.33 (11.68)[a] [1.45-64]	6.26 (7.67)[b] [0.95-45.48]	0.006	-	-

[a]n = 111
[b]n = 68
yellow cells: stat protocol steps

the volume of watchers making the number of pharmacy personnel present insufficient.

Dispensary turnover time had the shortest range and least variability among the four phases of MTAT. This can be attributed to the presence of protocol in the pharmacy that was being implemented and followed by the staff. However, the steps of the dispensary turnover time were still affected by several factors, such as the high frequency of incoming phone calls. A disadvantage of a paper-based system was answering the phone calls to track the status of a medication order or answer questions which were time-consuming and led to conflicts between the pharmacists and nurses [11]. Furthermore, frequent miscommunication between the Pharmacy and Nursing Departments led to missing or duplicate medication orders [2].

In the dispensing process of the Central Block pharmacy, filling took the longest time. This can be attributed to the manual protocols in the Pharmacy, such as the use of stock cards. Also, checking for the remaining stocks in the stock

area can consume a significant amount of time. Delays occur in delivering of medicines due to stock variability and availability [7]. Also, the time spent before a medication order is dispensed was considerably long. This can be attributed to the shortage of pharmacists and/or clerks per shift. On the other hand, the computerized profiling system of the pharmacy contributed to the significantly fast checking of medication orders. The actual mean checking, encoding, and dispensing times in the CB Pharmacy were significantly faster than the time stated in the protocol. The results show that the times in the protocol were overestimated, thus they can be adjusted with the inclusion of filling and dispensing unit sit times for a more accurate monitoring and evaluation of the process.

The time period spent in dispensing the medications was shortest in the Payward Pharmacy. Prior to dispensing, the pharmacist only checked the correctness of the filled order, but not common drug interactions. This can save time, but compromises patient safety. At present, there is no computerized database used to check for drug interactions in the Payward Pharmacy. The frequent overuse of the stat order status had been cited as a factor that affects the efficiency of the pharmacy to fill non-stat medication orders. It is important for a hospital to have standardized definitions or qualifications for urgent orders or stat orders to avoid affecting the MTAT of the hospital [12].

Delays in drug administration or skipped doses were the ultimate effect of long MTAT. This agrees with the observation of pharmacy personnel and watchers in both in-patient pharmacies. The efficacy of the drug was not maximized due to delays and it directly affected the quality of healthcare service delivered and received by the patients. Due to the frequent unavailability of certain drugs as well as long waiting lines, the family of the patient was obliged to buy outside the hospital which defeated the purpose of the government hospital to provide quality service to those who were classified as indigents by the medical social service.

Limitations of the Study

Even though the study provided good insights on the medication turnaround time and dispensary turnover time of the hospital, the data collection was greatly limited by time constraints. From the planned data collection of three months, it was reduced to two consecutive weeks. Furthermore, the reported MTATs will not be generalizable for the 16 wards served by CB, but only to the two departments that participated in the study.

Another limitation in the data collection was the Hawthorne effect. The pharmacists knew the objectives of the study and were aware that they were being observed. The population size considered in computing the sample size was limited to the number of days that data collection was done which was seven days per pharmacy. The number of interns present inside the pharmacies varies across days. This affected the efficiency and the speed of the services provided in the pharmacy, especially in the filling time recorded.

Conclusions

The MTAT of the tertiary government hospital varied from one department to another. The MTAT of Medicine and Surgery Departments was slower compared with a study on a private general hospital that developed protocols for the medication order processing. Unit sit time had the greatest variability among the four phases of MTAT. The short range and least variability of the dispensary turnover time suggests that protocols can be an effective tool in reducing process times. Several factors identified that contribute in the delays of MTAT included administrative, protocol-based and personal factors. Delays in MTAT affect drug administration which can lead to poor healthcare service delivery and patient harm.

Unit sit time encompassed the bulk of dispensary turnover time in both CB and Payward Pharmacies. Reducing unit sit times can be a possible target of the hospital for process improvement. The significant difference between the dispensary turnover time of stat and non-stat orders could be attributed to the protocol in place for processing stat medication orders. Compared to the hospital protocol, most of the steps in dispensary turnover time were either underestimated or overestimated. Updating the protocols is necessary to optimize dispensary turnover time and adapt with the changing needs of the hospital.

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