Workload Evaluation of the Modified Unit Dose System in Inpatient Pharmacy: A Study at Queen Elizabeth Hospital

Nadia Mohd Khairudin[1*], Daphne Lo[1], Ee Wern Chu[1], Jerry Ee Siung Liew[1], Fairenna Fairuz[1], Oganeswary Kobi[1], Yun Lun Lai[1]

[1]*Pharmacy Department, Queen Elizabeth Hospital, Kota Kinabalu, Sabah, Malaysia*

Correspondence to: Nadia Mohd Khairudin (nadiakhairudin@gmail.com)

Accepted: 23 July 2024

ABSTRACT

Introduction:

Inpatient pharmacy services provided specialized medication distribution tailored to the needs of hospitalized patients. Typically, hospitals under the Malaysian Ministry of Health implemented either unit-of-use (UOU) or unit-of-dose (UOD) dispensing systems. However, many pharmacy departments lacked the resources to operate seven days a week. To address these limitations, our institution adopted a modified unit-of-dose system (MUDS). This study aimed to evaluate the workload associated with MUDS in the inpatient pharmacy unit and to analyze the volume of items and time required for processing returned medications.

Methods:

A 62-day cross-sectional study was conducted at the satellite pharmacies of Queen Elizabeth Hospital. Data were collected on working days. The total preparation time for each medication trolley, from check-in to completion, was recorded, along with the time required to return unused drugs to the satellite pharmacies. The total duration needed for returning these items was also documented. All data were analyzed using descriptive statistics.

Results:

The study involved 12 pharmacists and 14 pharmacy assistants across six satellite pharmacies, who prepared a total of 968 medication trolleys. The mean time required to complete the preparation of a medication trolley was 105.6 ± 40.0 minutes. Of the total items, 32,902 (9.2%) were returned, with the time required for returning these unused medications ranging from 85.0 to 1432.8 minutes.

Conclusion:

MUDS imposes a significant workload on both pharmacists and pharmacy assistants, as evidenced by the preparation of medication trolleys and the time required for returning medications. These findings highlight the necessity for further investigation into optimizing dispensing systems to improve efficiency and reduce the burden on pharmacy personnel.

Keywords:

Unit of use, unit of dose, modified unit of dose, returned drugs, reuse of medication

INTRODUCTION

In a modern hospital, the pharmacy fulfills numerous tasks related to the medical activities of the institution. Inpatient pharmacy services support wards, clinics, and other units through various drug distribution methods.[1,2] Satellite pharmacy units work closely with the central inpatient pharmacy, relying on administrative support, staffing, and drug procurement to supply medications primarily for hospitalized patients.

Drug distribution within these satellite pharmacies typically follows two main approaches: the floor stock method and the patient prescription protocol. The floor stock system involves storing a quantity of commonly used drugs directly within patient care areas, allowing healthcare providers to access medications immediately without individual prescriptions. In contrast, the patient prescription protocol involves supplying medications to patients based on their prescriptions.

Pharmacy drug supply systems are generally categorized into the UOD and UOU.[2] UDS is often recommended for inpatient settings because it allows the pharmacy to coordinate, control, and efficiently manage pharmaceutical care and drug supply. Most Ministry of Health hospitals practice a combination of these methods, but the floor stock method is increasingly discouraged due to high medication wastage and error risks.

The UOU system provides medications in quantities intended for direct dispensing to patients with a prescription label.[3] Increasing the use of UOU packaging could potentially reduce pharmacy workload by decreasing the time spent on dispensing activities and reducing counting errors.[4] Conversely, UDS medications are prepared in single-unit packages and dispensed in ready-to-administer form for up to 24 hours. While UDS is effective in ensuring medication readiness, it involves higher running costs due to the need for additional equipment, specialized medication forms, and increased labor for preparation, screening, and handling of individual doses and returns.

To address these issues, our setting has implemented MUDS, which supplies medications in unit doses over a period of up to three working days.[2] Although there is substantial evidence on the workload and time associated with UDS and UOU, there is limited research on the use of MUDS.

This study aims to quantify the workload associated with MUDS, focusing on the time required to complete medication trolley preparation and the time spent processing returned medications.

METHODS

Study Design

This cross-sectional study was conducted to evaluate the MUDS in the inpatient pharmacy of Queen Elizabeth Hospital over a three-month period (August – October 2017). The inpatient pharmacy comprises six satellite pharmacies operating from 8 am to 5 pm, serving 28 wards, with an average of four wards per satellite pharmacy. Each ward is equipped with one or two medication trolleys, depending on the patient load. The study encompassed workload data from all satellite pharmacies and drug orders processed during office hours. Drug orders placed after working hours, on public holidays, and stat-dose orders were excluded from the analysis.

Outcome Measurement

The primary outcome of the study was the workload, specifically measured by the number of prescriptions handled per pharmacy staff member within the MUDS at the satellite pharmacies. The total number of staff, including pharmacists and pharmacy assistants, was considered to assess the workload across each satellite pharmacy. Secondary outcomes included the number of items and the time required to process returned medications under MUDS. The total preparation time for each medication trolley was recorded from the time of check-in to completion. Preparation time was classified based on compliance with the hospital's key performance indicator for medication trolley preparation: compliance (less than 120 minutes) and non-compliance (more than 120 minutes). Additionally, the total number of items returned to the satellite pharmacy and the time required to process these returns were documented.

Data Collection

A standardized data collection form was developed to capture key variables of interest. Information collected included details on medication trolleys, the number of patients, prescriptions received, the number of items supplied, and the preparation time for each medication trolley from the pharmacist-in-charge at each satellite pharmacy. This data was reported daily to the study investigators. For the primary outcome, monthly workload statistics were extracted for each satellite pharmacy. A one-week trial run was conducted to ensure the data collection procedures were effective and to assess the practicality of the data collection form. Data were collected over three months, encompassing a total of 62 evaluation days. Data relevant to the primary outcomes were collected on working days.

Statistical Analysis

All data were recorded in Microsoft Excel and analyzed using STATA/SE 12.0 (StataCorp, College Station, TX, USA). Descriptive statistics were employed for the analysis. Data normality was assessed using histograms and Q-Q plots. Continuous variables were summarized as means with standard deviations (SD), while categorical data were presented as frequencies and percentages.

RESULTS

MUDS Workload

During the study period, a total of 968 medication trolleys were received and prepared, serving 14,759 patients, with 91,846 prescriptions and 358,783 supplied items. Approximately 70.1% of the trolleys met the hospital's key performance index for medication trolley preparation time, with an average preparation time of 86.1 ± 26.7 minutes. However, 289 medication trolleys took more than 120 minutes to prepare, with an average preparation time of 151.4 ± 26.5 minutes. The overall average preparation time for all trolleys was 105.6 ± 40.0 minutes.

The study involved 26 personnel, comprising 12 pharmacists and 14 pharmacy assistants. On average, each staff managed 15.3 patients, 40.1 charts, 94.9 prescriptions, and 370.6 items per medication trolley, handling approximately 2.6 trolleys per day. Pharmacists screened an average of 247.5 items daily, while pharmacy assistants processed an average of 174.9 items per day. Additionally, MUDS required approximately 56 minutes to process 50 prescriptions.

Return of Unused MUDS Medication

In this study, approximately 9.2% of the total items, amounting to 32,903, were returned to their respective satellite pharmacies. Notably, Satellite Pharmacy 1 had the highest return percentage at 15.4%, totaling 10,998 items, while Satellite Pharmacy 6 had the lowest at 1.9%, with 1,168 items returned. The time required to return unused medications varied between 85.0 and 1432.8 minutes. Satellite 6 and Satellite Hillside had the shortest return times, whereas Satellite 4 had the longest. Satellite 1 received the highest number of returned items, representing 15.3% of the total items supplied, with a return time of 921.20 minutes. Of the returned drugs, only 66.0% were deemed reusable. The remaining items were non-reusable due to hygiene concerns, unclear or destroyed labels, compromised packaging, poor condition, or expiration. The findings are summarized in Table 1.

DISCUSSION

MUDS Workload

This study provided insights into the workload of inpatient pharmacy with the implementation of MUDS. According to Liwposki, UOU allowed the first and second teams to complete prescription preparation in 19.5 and 20.5 minutes for 50 prescriptions, respectively. In contrast, bulk packaging took longer, with the first and second teams requiring 45.0 and 41.5 minutes, respectively, for the same number of prescriptions.[3] Our study found that MUDS takes approximately 56.0 minutes for 50 prescriptions, indicating a need for more time to complete prescription preparation. This extended duration may result in the pharmacy not meeting the standards set by the customer charter.[5]

Table 1. Workload of medication supply and return in satellite pharmacies

Satellite Pharmacy	1	3	4	5	6	Hillside
Total number of items supplied	71743	69991	80751	41413	61921	32964
Total number of items returned	10998	6731	8593	4089	1168	1324
Percentage of items returned (%)	15.3	9.6	10.6	9.9	1.9	4.0
Total number of medication return sessions	14	11	18	6	2	2
Time spent to return items per session (min)	65.8	73.1	79.6	60.1	100.1	42.5
Total time spent for medication return (min)	921.2	804.1	1432.8	360.6	200.2	85.0

This study revealed that pharmacists at Queen Elizabeth Hospital handle an average of 247.5 inpatient prescriptions daily, which is significantly higher than the recommended 52 ± 3 prescriptions per pharmacist per working day.[6,7] In comparison, a similar study in Japan reported a maximum of 40 prescriptions per day per pharmacist,[8] highlighting the higher dispensing burden faced by pharmacists at Queen Elizabeth Hospital. This increased workload underscores the need to evaluate and potentially adjust the services provided by inpatient pharmacists. Pharmacists are crucial in ensuring appropriate medication use and identifying drug-related issues, such as drug allergies, drug-drug interactions, and medication errors, which can lead to adverse treatment outcomes or mortality. Research has shown that 37.5% of medication errors are associated with high pharmacist workload, insufficient staffing, and inadequate technological support.[8] Therefore, the increased workload may adversely impact the quality of pharmacy services.[6,7]

Return of Unused MUDS Medication

The standard functions and operations of the pharmacy are often disrupted due to the return of medications from wards, which increases the burden on pharmacy personnel and affects routine services. The primary reasons for returned medications include changes in treatment regimens, excessive quantities dispensed, and medication discontinuations by physicians.[9] The current study indicates that 9.2% of items are returned to the pharmacy. Castro et al. reported a return rate of 25.2%, while earlier studies noted rates of 4.30% and 6.7%.[10-12] Additionally, Alshehri's study found that approximately 6.4% of dispensed medications were returned daily from various hospital wards, with 4,410 returned medicines over 28 days, averaging 141 per day.[13] Improper use and disposal of medications lead to economic losses and environmental damage, highlighting the need for strategies to minimize waste.[14] Pharmacy staff must assess the suitability of returned medications for reuse, with expired or unsuitable medications being discarded.[15]

In our study, only 66.0% of returned drugs were deemed reusable, in contrast to Castro et al.'s finding that 98.6% of returned drugs could be reused.[10] Pharmacy personnel have implemented interventions to recover non-reusable drugs, which adds to their workload.[16] To mitigate drug accumulation and expiration in wards, unused drugs should be promptly returned to the pharmacy, and nurses should be reminded daily to do so to ensure optimal drug use.[17] Understanding the reasons for medication returns is crucial, though our study did not assess this aspect. Hashmi et al. found a direct correlation between medication returns and the incidence of medication errors, suggesting that increasing floor stock could reduce returns and alleviate the workload on nurses and pharmacists.[7]

This study also highlights that processing returned medications is labor-intensive and can interfere with the medication supply process, potentially leading to medication errors. Improving communication between doctors, nurses, and pharmacy personnel could help reduce drug returns.[14]

Study Limitations

Several limitations affect this study. First, the findings are specific to the study site and the three-month study period, which may not be generalizable to other settings or times. Various confounding factors, such as the experience levels of pharmacists and pharmacy assistants at the study site, could influence the results. Additionally, data on UDS and UOU medications prior to the study were not collected, preventing a comparison of the time required for UDS, UOU, and MUDS implementation. Despite these limitations, the study offers preliminary insights into the practicality and efficiency of MUDS, which can inform future research.

CONCLUSION

It was observed that the implementation of MUDS could extend the time required to prepare medication trolleys, potentially causing the pharmacy to fall short of the standards set by the customer charter. Furthermore, handling returned medications emerged as a significant challenge, adding to the workload and stress experienced by pharmacy personnel.

ACKNOWLEDGEMENT

The authors wish to express their deepest gratitude to the Director General of Health Malaysia for granting permission to publish this article. They also extend their thanks to Dr. William Gotulis, Director of Queen Elizabeth Hospital, and Ms. Fanny for their invaluable guidance and support throughout this research project. Additionally, the authors are grateful to all pharmacists and pharmacy assistants at Queen Elizabeth Hospital for their dedicated attention and contributions to improving the Pharmacy Delivery System.

CONFLICT OF INTEREST

The authors declare no conflict of interests.

FUNDING

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

ETHICAL APPROVAL

This research has obtained approval from the Medical Research Ethics Committee, National Institute of Health, Malaysia (NMRR-17-1468-36835).

REFERENCES

1. Wylegała K, Religioni U, Czech M. The Impact of Hospital Pharmacy Operation on the Quality of Patient Care. Int J of Env Res and Pub Heal. 2023;20(5):4137.
2. Ministry of Health. Garis Panduan Pembekalan Ubat Farmasi Pesakit Dalam [Internet]. 2019 [Cited 2024 Jul 19]. Available from: https://pharmacy.moh.gov.my/sites/default/files/document-upload/garis-panduan-pembekalan-ubat-pesakit-dalam-edisi-ke-3-final-latest-version-4.3.2019.pdf
3. Lipowski EE, Campbell DE, Brushwood DB, Wilson D. Time Savings Associated with Dispensing Unit-of-Use Packages. J of the Amer Phar Ass. 2002;42(4):577–81.
4. Kobayashi D, Sakamaki H, Komatsu R, Iijima T, Iijima Y, Ootsuga H, et al. A study of the pharmacist work changes associated with dispensing unit-of-use packaging in community pharmacies. Yak Zas. 2014;134(7):823–8.
5. Hospital Pharmacy Europe. Unit dose versus one stop dispensing [Internet]. 2014 [Cited 2024 Feb 12]. Available from: https://hospitalpharmacyeurope.com/news/editors-pick/unit-dose-versus-one-stop-dispensing/
6. Shao SC, Chan YY, Lin SJ, Li CY, Kao Yang YH, Chen YH, et al. Workload of pharmacists and the performance of pharmacy services. PLoS ONE. 2020;15(4):e0231482.
7. Hashmi Y, Khaliq A, Sultana J. Medicine Returns from Wards to Pharmacies in Tertiary Care Hospital Setting of Karachi: Factor Analysis and its Effect on Pharmacy Services. Isra Med J. 2017;9(3):157–60.
8. Akaho E, MacLaughlin EJ, Takeuchi Y. Comparison of prescription reimbursement methodologies in Japan and the United States. J of the Amer Phar Ass. 2003;43(4):519–26.
9. Sim SJ, Ching CS, Chua ATT, Ha CHH, Kong SL, Brandon AJ, et al. A Study on Medication Return by Patients as an Estimation of Medication Wastage in Bintulu Hospital. Sar J of Phar. 2019;5(2):32-45.
10. Castro J, Couto S, Dias M, Couto C, Fonseca A, Cruz A, et al. Analysis of Drugs Returned by Inpatient Services after Unit Dose Distribution in a Portuguese Public Hospital. Phar Pag. 2021; 1(1):1.
11. Perez-Cebrian M, Font-Noguera I, Domenech-Moral L, Bosó-Ribelles V, Romero-Boyero P, Poveda-Andrés JL. Monitoring medication errors in personalised dispensing using the Sentinel Surveillance System method. Farm Hosp. 2011;35(4):180-8.
12. Max BE, Itokazu G, Danziger LH, Weinstein RA. Assessing unit dose system discrepancies. Amer J of Hea-Sys Phar. 2002;59(9): 856-8.
13. Alshehri AA, Athar A, Nami HA, Cara AK, Fasih MJ, Maqsood M. Evaluation of medicine return from wards to inpatient pharmacy in tertiary care hospital. Lat Amer J of Phar. 2019;38(4):712–8.
14. Chong KM, Rajiah K, Chong D, Maharajan MK. Management of Medicines Wastage, Returned Medicines and Safe Disposal in Malaysian Community Pharmacies: A Qualitative Study. Fron in Med. 2022;9:884482.
15. Ebrahim AJ, Teni FS, Yimenu DK. Unused and Expired Medications: Are They a Threat? A Facility-Based Cross-Sectional Study. J of Pri Car & Com Hea. 2019;10:2150132719847857.
16. Pérez-Cebrián M, Font-Noguera I, Doménech-Moral L, Bosó-Ribelles V, Romero-Boyero P, Poveda-Andrés JL. Monitoring medication errors in personalised dispensing using the Sentinel Surveillance System method. Farm Hosp. 2011;35(4):180–8.
17. Max BE, Itokazu G, Danziger LH, Weinstein RA. Assessing unit dose system discrepancies. Amer J of Hea-Sys Phar. 2002;59(9):856–8.