



Impact of Medication Reconciliation by Clinical Pharmacist during Hospital Admission of Patients with Chronic Kidney Disease (CKD) Stage IV-V in Hospital Raub, Pahang

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ABSTRACT

Medication errors are more likely to occur during patient's transition of care. There was very little information about impact of medication reconciliation activities done for patients with chronic kidney disease (CKD) Stage IV-V during admission stage in Malaysian Primary Hospitals. The objective of this study is to evaluate the impact of clinical pharmacist's medication reconciliation activities during hospital admission of patients with CKD stage IV-V. This cross-sectional study was carried out in two multidisciplinary wards (male & female ward) in Hospital Raub, Pahang over 12 months with ethical approval. A clinical pharmacist was assigned to enroll potential study subjects in both wards. Patients over 18 years old who had previous history of CKD Stage IV-V were included in the study after obtaining informed consent. Medication reconciliation was carried out by the clinical pharmacist within 24 working hours during the admission of study subjects. All detected medication discrepancies were further classified as "intended" or "unintended" after discussion with the prescribing medical officer. The Severity Level of each unintended medication discrepancy was rated by a visiting medical specialist. Twelve patients with CKD stage V were recruited to the study. A total of 49 medication discrepancies were identified and most (89.8%) were found to be unintended. The most common unintended medication discrepancy identified was omission error. Most of the unintended medication discrepancies (59.1%) was rated as "No potential harm", while 40.9% were rated as "Potential for monitoring and/or Intervention to preclude harm". None of the unintended medication discrepancy was rated as "Potential harm". In conclusion, medication discrepancies were common during admission of patients with late-stage chronic kidney disease in a primary hospital. Medication reconciliation performed by clinical pharmacist during admission has a potential role in preventing potential harms that may arise from unintentional medication discrepancies.

INTRODUCTION

Chronic Kidney Disease (CKD) is indicated as gradual deterioration of renal function over time and CKD can cause major health complications [1]. It was reported that 10-13% of the population in China, Taiwan, and Japan have CKD [2]. Besides, Asian population has a higher prevalence of CKD as compared to American population [3].

According to a nationwide population-based cross-sectional study conducted by Saminathan et al. [4] from September 2017 to June 2018, the prevalence of respondents with stage I, stage II, stage III, stage IV and stage V CKD in Malaysia were

3.85%, 4.82%, 6.48%, 0.25% and 0.08% respectively in 2018 [4], as compared to 4.16%, 2.05%, 2.26%, 0.24% and 0.36% respectively from a similar study which included only respondents from West Malaysia in 2011 [5]. Saminathan et al. stated that out of all respondents with CKD, only 5% of them were aware of their diagnosis [4].

Patients with CKD are considered as a complex population. According to study conducted by Manley et al., patients with end stage renal failure undergoing haemodialysis were prescribed an average of 12 medications [6]. Medication errors are more likely to occur during patient's transition of care [7]. Besides, incidence of adverse drug reactions increases with

increasing number of medications used and worsening of renal function [8].

Medication reconciliation is defined as the process of comparing a patient's medication list ordered by prescriber to patient's previous medications during transition of care [9]. Based on data from Buckley et al., medication discrepancies during hospital admission are common and accounted for up to 67% of all hospitalised patients [10]. An unintentional medication discrepancy occurs when prescribers omitted, changed, or added a medication unintentionally [11]. Any unintentional medication discrepancy has the potential to become a medication error and cause patient harm [11].

A systematic review from Tam et al. showed that inaccurate or incomplete medication orders during patient's admission accounted for 27% of total hospital medication errors [12]. Obtaining accurate medication histories during patient's admission is crucial to improve medication safety as errors in medication history taking may lead to inappropriate drug therapy for hospitalised patients [12].

Based on a study conducted by Hassali et al., 90.1% of respondents consisting of 86 General Practitioners in the Penang State agreed that medication reconciliation can be a practical strategy in improving medication safety [13]. Medication Reconciliation was announced as 2005 National Patient Safety Goal #8 by the Joint Commission [9]. According to the safety goal, medication reconciliation should be implemented in all patient care settings [9].

There was only one similar study in Malaysia done by Islahudin et al. for medication reconciliation during admission of patients to healthcare facilities [14]. The study found out that medication reconciliation tool identified more medication discrepancies than standard medication history taking during patient admissions in a tertiary hospital [14].

The objective of this study was to evaluate the impact of clinical pharmacist's medication reconciliation activities during hospital admission of patients with CKD stage IV-V. To date there was very little information about impact of medication reconciliation activities done for specific populations (eg. Late-Stage CKD patients) during admission stage in Malaysian Primary Hospitals. The primary outcome of this study was the number of medication discrepancies detected during the admission of patients with CKD stage IV-V over the study period. As compared to the similar study conducted by Islahudin et al. [14], we also evaluated the "severity level of each unintended medication discrepancy if left undetected", which was the secondary outcome of this study.

METHOD

This was a cross-sectional study to determine the number of unintended medication discrepancies identified through medication reconciliation activities performed by a clinical pharmacist during admission of patient with CKD stage IV-V in multidisciplinary wards.

This study was carried out in two multidisciplinary wards (male & female ward) in Hospital Raub over a period of 12 months from 24th May 2018 to 23rd May 2019. Hospital Raub is a primary hospital with 89 beds and multidisciplinary wards comprise 56 beds. This study protocol was approved by the Medical Research and Ethics Committee (MREC), Ministry of Health Malaysia [Reference numbers: KKM.NIHSEC.P18-469(5) for initial ethical approval and KKM.NIHSEC/P18-469(9) for subsequent annual ethical renewal].

The mean of total admission of patients to these multidisciplinary wards in Hospital Raub from 2015-2017 were 3569 patients. As there was no study regarding prevalence of CKD patients admitted to ward, prevalence data from the study conducted by Hooi et al. [5] was used as it was the first study showing prevalence of CKD by stages in Malaysia, and newer prevalence data was yet to be reported in early 2018, when this study was initiated. According to Hooi et al., total percentage of noninstitutionalized adult patients with CKD stage IV-V in West Malaysia in 2011 was 0.60% [5].

The sample size of this study was calculated using the "Sample Size for Frequency" calculator from openepi.com [15]. After entering population size as 100,000 people, anticipated frequency (in percentage) is calculated as 0.60%, confidence limits as 5%, and design effect as 1. A sample size of 12 study subjects was required for 97% confidence level [15]. Convenient sampling method was used to recruit study subjects.

Patients over 18 years old who had previous history of CKD and with estimated Glomerular Filtration Rate (eGFR) of less than 30ml/min/1.73m² upon admission were included in our study. On the other hand, patients/caregivers who were unresponsive or unwilling to communicate with clinical pharmacist were excluded from this study. Besides, patients who were diagnosed as having Acute Kidney Injury (AKI) by ward Medical Officer (MO) during the time of admission were also excluded. Acute Kidney Injury is diagnosed when Serum Creatinine (SCr) level increases ≥ 26.5 $\mu\text{mol/l}$ from baseline value or patient's urine output is < 0.5 ml/kg/h for 6 hours [16].

The Modification of Diet in Renal Disease (MDRD) formula was used in estimating Glomerular Filtration Rate (GFR) for renal function assessment and drug dosage adjustment in this

Table I: Severity Level Ratings for Medication Discrepancies

Severity Level of Medication Discrepancy [19]	Definition [20] *	Category of Medication Errors [20] involved in each Level*
Level 1	No Potential harm	Category C: An error reached the patient but did not result in patient harm
Level 2	Potential for monitoring and/or Intervention to preclude harm	Category D: An error reached the patient, monitoring and/or intervention is required to preclude harm.
Level 3	Potential harm	Category E: An error reached the patient and may have caused temporary harm to the patient, intervention is required. Category F: An error reached the patient and may have caused temporary harm to the patient and may necessitate initial or prolonged hospitalization.

*Adapted from the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) (www.nccmerp.org)

study. The eGFR Calculator mobile app (version 2.3) from the National Kidney Foundation (NKF) was used to calculate estimated GFR for each study subject [17].

This study focused on medication reconciliation activities conducted by a clinical pharmacist in detecting and resolving any unintended medication discrepancies within 24 hours post-admission of Late-Stage CKD patients. Patients that were admitted on weekends or public holidays were reviewed within 24 hours on the subsequent first working day. A clinical pharmacist (also as the investigator in this study) was assigned to cover both multidisciplinary ward on working days to screen each newly admitted patient to determine potential participant for this study. The clinical pharmacist informed each eligible patient that there would be no harm to participate in this study, as no invasive procedure or interventional product was to be introduced to him/her. Each participant was informed that he or she would not be reimbursed for participation in the study. Every eligible patient who agreed to take part in the study was required to complete the patient information leaflet/informed consent form.

After the patient or caregiver had completed the consent form, the clinical pharmacist determined the patient's actual stage of CKD by entering the patient's age, gender, and serum creatinine level in the "MDRD Study Equation" section of the eGFR Calculator mobile app [17]. Patients with an estimated GFR greater than 30ml/min/1.73m² were excluded from the study. After that, using a data collection form adapted from the Medication History Assessment Form (CP1) [18], the clinical pharmacist conducted an interview with the patient or caregiver to obtain the patient's demographic information, past medical history, history of drug allergy and past medication history. The list of medication history generated by the clinical pharmacist was used to compare to the list of medications prescribed during admission, and all medication discrepancies were documented.

The clinical pharmacist then contacted corresponding prescribing Medical Officer (MO) regarding the detected medication discrepancies and inquired whether each discrepancy was intended or unintended. Unintended medication discrepancy was determined when the MO indicated that the difference between the patients' previous medication list and the medication list prescribed at the time of patient admission was unintentional. Then, the clinical pharmacist requested ward MO to make corrections on ward medication chart if the medication discrepancies were found to be unintended or erroneous. The medication reconciliation process was considered complete once interventions were done for each unintended medication discrepancy.

In order to evaluate severity level of each unintended medication discrepancy if left undetected, a visiting medical specialist was invited to rate each medication discrepancy based on the 3 Severity levels (Table I). The severity levels ratings for medication discrepancies were adapted from the potential harm ratings from Gleason et al, 2010 [19]. The definition of each Severity Level and Categories of Medication Errors involved in each level were adapted from the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) *Index for Categorizing Medication Errors* [20].

The data collected was analysed descriptively with 'Statistical Package for the Social Sciences' (SPSS for Windows) version 21. For categorical variables, results were presented as frequency and its percentage whereas results for numerical variables were presented as Mean ± Standard Deviation (SD) or Median ± Interquartile Range (IQR). Only descriptive statistics were used in this study.

RESULT

Twelve patients with CKD stage IV-V were recruited to the study. Details of sociodemographic and baseline characteristics of the study population are summarized in Table II. All

recruited patients were evaluated as having CKD Stage V. Among all patients recruited, two patients (16.7%) had no medication discrepancies. This study identified a total of 49 medication discrepancies, and in which 44 (89.8%) discrepancies were found to be unintended. Details of different types of unintended medication discrepancies are shown in Table III.

Table II: Demographic Data of the Study Population (n = 12)

Characteristics	Value
Gender, number (%)	
Male	7 (58.3)
Female	5 (41.7)
Median age (years)	65.5 (10.8)
Stage of CKD, number (%)	
Stage IV	0 (0.0)
Stage V	12 (100.0)
Mean (SD) number of medications prescribed on admission	7.2 (3.8)
Mean (SD) number of regular medications before admission	9.0 (2.3)
§Source of medication history, number (%)	
Pharmacy Information System (PhIS) record	11 (91.7)
Patient's current outpatient prescription	6 (50.0)
Patient's own medication	4 (33.3)

§Cumulative percentage > 100% as some patients had >1 source of medication history.

Medications for Bone and Mineral Disease was found to be the most common medication class involved in unintended medication discrepancies during admission, followed by Vitamins/Iron supplements, Antihypertensives and Antidiabetic Agents (Table IV). Among all the unintentional

medication discrepancies, 59.1% were judged as Severity Level 1 (no potential harm if left undetected), while 40.9% were judged as Severity Level 2 (potential for monitoring and/or intervention to preclude harm if left undetected). No unintended medication discrepancy was classified as Severity Level 3 (potential harm to patient if left undetected).

Table III: Types of Unintended Medication Discrepancies Identified (n = 44)

Type of Discrepancy	Number (%) ^Δ
Omitted Drug	34 (77.3)
Wrong Dose	6 (13.6)
Wrong Frequency	2 (4.5)
Wrong Drug	2 (4.5)

^Δ Percentages may not add up to 100% due to rounding.

Table IV: Medication Class Involved in Unintended Medication Discrepancies (n = 44)

Medication Class	Number (%) ^Δ
Medications for Bone and Mineral Disease	11 (25.0)
Other (Vitamin/ Iron) Supplements	8 (18.2)
Antihypertensives	7 (15.9)
Antidiabetic Agents	6 (13.6)
Medications for Stress Ulcer Prophylaxis/ Gastritis	4 (9.1)
Cholesterol-Lowering Agents	3 (6.8)
Diuretics	2 (4.5)
Antiplatelets	2 (4.5)
Thyroid Replacement Medications	1 (2.3)

^Δ Percentages may not add up to 100% due to rounding.

DISCUSSION

None of the patient recruited in this study was classified under CKD Stage IV. This might be due to more patients with CKD Stage V were admitted during the study period. A study conducted by Go et al. found out that there was a graded association between lower levels of estimated GFR and the risks of hospitalization [21].

Most of the medication discrepancies were found to be unintended. The result in this study showed that the most common medication discrepancy identified during admission of patient was omission error, follow by wrong dose, and then by wrong frequency. This coincides with the similar study involving eligible patients admitted to the Orthopedic Service [22]. The most common interventions done in this study was addition of the omitted medications. This result is consistent

with the findings of other similar studies which also recruited patient from other disciplines [14,23–25].

Most of the unintended medication discrepancies (59.1%) was judged as Severity Level 1, which indicates that the discrepancies were unlikely to cause harm if left undetected. This result agrees with the findings from a similar study from Cornish et al., where eligible patients admitted to the general internal medicine clinical teaching units in a tertiary care teaching hospital were recruited [25]. The study found that 61.4% of the unintended medication discrepancies were considered as unlikely to cause harm [25].

Another finding from this study showed that 40.9% of the unintended medication discrepancies were deemed to have the potential to cause harm & monitoring and intervention may have been required to preclude harm (Severity Level 2). This

finding is in agreement with the systematic review conducted by Tam et al., where limited data suggested that 11-50% of medication history errors at admission to hospital were clinically important [12]. Besides that, this data also coincides with the findings from other studies, where more than 30% of the unintended medication discrepancies were deemed to have potential to cause moderate harm [23,25]. There is no medication discrepancy classified as Severity Level 3 in this study. On the contrary, the study from Cornish et al. revealed that 5.7% of the identified medication discrepancies were judged to have the potential to result in severe discomfort or clinical deterioration [25].

All recommendations proposed were accepted by the MO who did the admission with acceptance rate of 100%. Other studies involving medication reconciliation on admission also showed that most recommendations by pharmacy team regarding the unintended discrepancies were accepted [14,22,23].

In this study, more than 1 source of medication list were obtained from several patients as different sources of medication can be used to ensure the accuracy of patient's medication history [23]. This is important for those who are under follow up at different disciplines/facilities. The main source of medication list used in this study is the Pharmacy Information System (PhIS) [26].

Since 2016, PhIS had been implemented in most healthcare facilities in PAHANG State [26]. The PhIS system shows the complete current medication record for patients who are under follow up in Hospital Raub, including the regular medications from other Ministry of Health (MOH) facilities if patient opted the Integrated Drug Dispensing System (SPUB), a Value-Added Service (VAS) where patients can obtain the next drug supply of active prescriptions from any of the MOH health facilities listed in the MOH's SPUB Directory through a nationwide referral system [26,27].

PhIS system is accessible in emergency department and all wards in Hospital Raub. Patient's latest medication list from outpatient/ specialist clinics can be retrieved by clinical pharmacist from PhIS during ward round, thus improving the accuracy of the medication history taking as some patients might leave their regular medications at home while some might bring incomplete medication list to ward.

This study showed that PhIS system was underutilized among medical officers in Hospital Raub Emergency Department throughout the study period as most patients' complete medication lists were obtained from PhIS by the clinical pharmacist and yet the most common unintended discrepancy was omission of patient's regular medication. Further investigations are required to determine the root cause of PhIS

underutilization by medical officers during admission of patients in Hospital Raub.

Limitations

This study only involved small sample of patients from a primary hospital, so the result might not be generalized to other areas with bigger population. Besides, all recruited patients in this study were classified under CKD Stage V, thus the result might not be generalized to population with higher hospitalization rate of patients with CKD Stage IV. The potential harm of each unintended medication discrepancy was judged by only one visiting medical specialist, and there was possibility that other medical specialist might have different judgement on some of the medication discrepancies.

CONCLUSION

Medication discrepancies were common during admission of patients with late-stage chronic kidney disease in a primary hospital. Medication reconciliation performed by clinical pharmacist during admission has a potential role in preventing potential harms that may arise from unintentional medication discrepancies.

CONFLICT OF INTEREST

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