Impact of Pharmacist-Directed Medication Reconciliation in Reducing Medication Discrepancies: A Randomized Controlled Trial

Khawla Abu Hammour, Rana Abu Farha, Rawan Ya'acoub, Zeinab Salman, and Iman Basheti

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ABSTRACT

Background: In hospital surgical wards, patients are at higher risk for medication errors, in part because physicians may not consider themselves sufficiently trained to prescribe medications. Hence, collaborative teamwork involving the pharmacist is needed.

Objectives: To assess the impact of medication reconciliation directed by pharmacists on decreasing medication discrepancies after discharge from the surgical ward.

Methods: Patients admitted to the surgical unit at a tertiary teaching hospital in Amman, Jordan, between July 2017 and July 2018 were selected and randomly assigned to either the control or the intervention group. Upon admission, the number and kinds of unintentional medication discrepancies were determined for both groups. Medication reconciliation was then provided to patients in the intervention group. The number of unintentional discrepancies was re-evaluated upon discharge for both groups. To assess differences between the control and intervention groups, the χ^2 or Fisher exact test was used for categorical variables and an independent-sample *t* test for continuous data. A paired *t* test was conducted to determine whether the number of medication discrepancies was reduced as a result of pharmacists' recommendations.

Results: A total of 123 patients met the inclusion criteria, 61 in the intervention group and 62 in the control group. Discrepancies of omission and wrong dose constituted 41 (77%) of the 53 discrepancies in the intervention group and 25 (76%) of the 33 discrepancies in the control group. The number of unintentional discrepancies was significantly reduced from admission to discharge in both the intervention group ($p = 0.002$) and the control group ($p = 0.007$). Of 53 recommendations made by pharmacists, 20 (38%) were accepted by the treating physician, and all of these discrepancies were resolved.

Conclusions: This study sheds light on the existence of unintentional medication discrepancies upon admission for surgical patients, which may expose the patients to potential harm upon discharge from hospital. Additional studies with a larger sample size are needed to gain further insights on pharmacists' role in implementing medication reconciliation for surgical patients.

Keywords: medication reconciliation, discrepancies, surgery, pharmacists

Trial Registration: ClinicalTrials.gov NCT03928106

RÉSUMÉ

Contexte : Dans les services chirurgicaux des hôpitaux, les patients sont exposés à un risque d'erreurs de médication plus élevé, en partie parce que les médecins ne se considèrent pas suffisamment formés pour prescrire des médicaments. Par conséquent, un travail d'équipe collaboratif impliquant le pharmacien est nécessaire.

Objectifs : Évaluer l'impact du bilan comparatif des médicaments dirigé par les pharmaciens sur la diminution des écarts médicamenteux après la sortie du service de chirurgie.

Méthodes : Les patients admis à l'unité chirurgicale d'un hôpital d'enseignement tertiaire à Amman, en Jordanie, entre juillet 2017 et juillet 2018 ont été sélectionnés et affectés au hasard au groupe témoin ou au groupe d'intervention. Lors de l'admission, le nombre et les types de divergences médicamenteuses non intentionnelles ont été définis pour les deux groupes. Le bilan comparatif des médicaments a ensuite été fourni aux patients du groupe d'intervention. Le nombre d'écarts non intentionnels a été réévalué à la sortie pour les deux groupes. Pour évaluer les différences entre le groupe témoin et le groupe d'intervention, le test χ^2 ou le test exact de Fisher a été utilisé pour les variables catégorielles et un test *t* pour échantillon indépendant, pour les données continues. Un test *t* apparié a été effectué pour déterminer si le nombre d'écarts de médicaments a été réduit à la suite des recommandations des pharmaciens.

Résultats : Au total, 123 patients répondaient aux critères d'inclusion : 61 dans le groupe d'intervention et 62 dans le groupe témoin. Les divergences d'omission et de mauvaise dose constituaient 41 (77 %) des 53 divergences dans le groupe d'intervention et 25 (76 %) des 33 divergences dans le groupe témoin. Le nombre d'écarts non intentionnels a été significativement réduit de l'admission à la sortie à la fois dans le groupe d'intervention ($p = 0{,}002$) et dans le groupe témoin ($p = 0{,}007$). Sur 53 recommandations émises par des pharmaciens, 20 (38 %) ont été acceptées par le médecin traitant et toutes ces divergences ont été résolues.

Conclusions : Cette étude met en lumière l'existence d'écarts médicamenteux non intentionnels lors de l'admission des patients chirurgicaux, ce qui peut exposer les patients à des risques au moment de leur sortie de l'hôpital. D'autres études avec un échantillon plus important sont nécessaires pour mieux comprendre le rôle des pharmaciens dans la mise en œuvre du bilan comparatif des médicaments pour les patients chirurgicaux.

Mots-clés : bilan comparatif des médicaments, divergences, chirurgie, pharmaciens

Enregistrement de l'essai : ClinicalTrials.gov NCT03928106

INTRODUCTION

Medication reconciliation is a practice whereby health care workers cooperate with patients, their family members, and other health care workers to ensure that precise, complete drug information is transferred consistently through transitions of care.[1] It requires an extensive review of preadmission medications for each patient and comparison with current (in-hospital) medications to ensure that any added, changed, or discontinued medications are carefully checked.[2-4] Hence, medication reconciliation is an established practice to verify the use of medications, to identify and resolve harmful unintended discrepancies, and thus to decrease medication errors during transitions in patient care.[3,5,6]

Medication reconciliation must be performed at each transition of care, especially when new medications are ordered or existing orders are renewed.[2] An accurate medication list (with drug names, dosages, frequencies, and routes of administration) is prepared at the time of hospital admission to evaluate and manage avoidable medication errors, such as duplication of therapy, dosage errors, omission (without clinical justification) of drugs for which the patient has preadmission indications, errors of commission, and drug–drug interactions during the hospital stay (on admission and transfer) and after patient discharge.[2,6-8] Identified discrepancies can be classified as intentional (documentation errors) or unintentional.[9]

Pharmacists have become more active in providing patient care services, including medication reconciliation.[9] These health care providers represent a cornerstone in the provision of essential information about the safe and effective use of medications, and their engagement in patient care during hospital rounds has been essential in improving medication safety.[10] Because pharmacists are specialists in drug use, their involvement in obtaining patient drug histories has led to lower rates of medication discrepancies and has improved the effectiveness of identifying and resolving these discrepancies, relative to histories obtained by other health care providers.[6] Inaccurate reconciliation and medication history-taking can lead to medication errors.[8] As one of the main causes of morbidity in inpatient settings, medication errors must be prevented through all available means, starting with pharmacist involvement.[3,9]

Compared with internal medicine wards, the surgical wards in hospitals present greater risks of medication errors for patients.[11] Only a few studies have investigated medication discrepancies among surgical patients, and these have revealed high discrepancy rates.[12,13] For example, a study conducted in surgical intensive care units found a total of 325 discrepancies for 45 patients (average of 7.2 discrepancies per patient).[12] Another study, involving patients who had undergone gastrointestinal surgery, found an average of 3.4 discrepancies per patient. [13] Patients in the surgical ward have greater need for medications to control pain, such as opioids, as well as for antibiotics, antithrombotic drugs, and cardiovascular drugs.[14,15] The care of these patients is usually delivered by junior physicians, who are not yet adequately trained in the prescription of medications and are usually supervised by specialists who may have inadequate experience in complex pharmacotherapy.[16,17] Hence, collaborative teamwork involving clinical pharmacists in the surgical wards is needed.[18,19]

Pharmacists have an important role in reviewing preoperative medications, before their administration, to ensure appropriate selection, recognition of drug–drug interactions and drug allergies, and weight-based hepatic or renal dosage adjustments to reduce complications related to surgical procedures.[20] Only one previous study has investigated the impact of pharmacist-led medication reconciliation on reducing discrepancies for surgical patients; the study found no significant change in medication errors before and after the intervention.[21] Thus, further studies are needed to examine the effectiveness of implementing pharmacist-led medication reconciliation among surgical patients.

The aim of the current study was to evaluate the frequency and types of medication discrepancies identified by clinical pharmacists in the surgical ward of a teaching hospital in Amman, Jordan, and to determine the effect of a medication reconciliation service delivered by clinical pharmacists in reducing the medication discrepancies that were identified.

METHODS

Study Design, Participants, and Clinical Setting

This single-blind randomized controlled trial took place at Jordan University Hospital (JUH) over the period July 2017 to July 2018. JUH is a 600-bed tertiary teaching hospital located in Amman, Jordan.

Two hundred patients admitted to the surgical department were approached and screened for inclusion. Patients were included in the study if they were at least 18 years old, were using at least 4 long-term medications regularly before admission, spoke Arabic, were expected to stay in hospital for at least 48 hours, and did not have any cognitive impairment. Patients who were in isolation, those who discharged themselves against medical advice, and those who refused to provide written informed consent were excluded.

The study was registered with clinicalTrials.gov (registration identifier NCT03928106), and ethics approval was obtained from the Institutional Review Board at the JUH (reference number 65/2017).

Sample Size Calculation

The sample size was estimated according to outcomes of a previous study by the same research team, which assessed the impact of medication reconciliation performed by pharmacists on the number of medication discrepancies

for internal medicine patients.[22] In that study, the pooled standard deviation (SD) for the number of unintentional discrepancies for the intervention and control groups was 0.92. To determine the necessary sample size, with α set at 0.05 and power of 80% (the most commonly used values for these parameters),[23] the following equation was used:

$$N = 2\,\sigma^2\,(Z_{\text{Critical}} + Z_{\text{Power}})^2/D^2$$

where N is the sample size, σ is the pooled SD for the 2 groups, ZC_{ritical} is 1.96 for the 0.05 significance level, Z_{Power} is 0.842 for 80% statistical power, and D is the minimum expected difference between the 2 means (set at 0.5).

According to this equation, the minimum required sample size to obtain a significant difference was calculated as 53 participants per group. We assumed a potential 20% attrition rate, and aimed to recruit 11 more participants for each group to compensate for any possible attrition. Therefore, a sample of 64 patients was to be recruited for each group.

Randomization, Data Collection, and Identification of Medication Discrepancies

Patients who met the inclusion criteria were informed about the purpose of the research, were told that participation was voluntary and that responses would be kept anonymous, and were asked to provide written informed consent.

Data were collected by 2 clinical pharmacist preceptors at JUH (R.Y., Z.S.). These pharmacists were well trained in data collection and in identifying and resolving medication discrepancies in a standardized, systematic manner. The training included a didactic lecture, followed by a simulation training session.

All of the patients were recruited in the JUH surgical ward after undergoing their scheduled surgeries. Following recruitment, the patients were randomly assigned to the intervention or the control group, according to a random number table generated by the Statistical Package for the Social Sciences (SPSS), version 22 (IBM SPSS Statistics). A specific data collection form was used to gather patient-specific information, including sociodemographic data (age, sex, marital status, educational level, monthly income, smoking status, and nationality), medical data (admission date, intended length of stay, acute and chronic medical conditions, current admission medications, preadmission medication history [i.e., best possible medication history or BPMH], and discharge date). Various sources were used to obtain the BPMH, including patient and caregiver interviews, medical records, and physician interviews. Patients' 10-year mortality rate was predicted from the Charlson comorbidity index,[24] as calculated by the researchers. A flowchart for data collection is presented in Figure 1.

Medication discrepancies were identified for each patient in both groups by comparing the patient's current (in-hospital) medication order with their BPMH. The discrepancies were categorized as intentional undocumented or unintentional. Unintentional discrepancies were reported as "medication errors", and intentional discrepancies were recorded as "documentation errors". To ensure consistency in identifying medication discrepancies, some cases from each of the clinical pharmacists were re-evaluated independently by another researcher (R.A.); no differences were found.

Unintentional discrepancies were further categorized into different types, including addition, duplication, omission, wrong drug, wrong dose, and wrong frequency. They were also classified according to the seriousness levels defined by Cornish and others[25]: "Class 1 discrepancies were those unlikely to cause patient discomfort or clinical deterioration. Class 2 discrepancies were those with the potential to cause moderate discomfort or clinical deterioration, and class 3 discrepancies were those with the potential to cause severe discomfort or clinical deterioration."

Pharmacist-Delivered Intervention

For patients in the intervention group, pharmacists discussed the discrepancies identified and provided their recommendations to the responsible clinicians using a consult form. If the clinicians accepted the recommendation, it was documented as an "accepted recommendation". Finally, upon discharge the number of medication discrepancies was assessed for each patient in both groups.

Statistical Analysis

SPSS software, version 22, was used to analyze the data. Normality was checked with the Shapiro–Wilk test. Descriptive analysis was based on means and SDs for continuous variables and percentages for categorical variables.

The χ^2 or Fisher exact test was used to assess differences between the control and intervention groups for categorical variables, and an independent-sample t test was used for continuous data. A paired t test was conducted to determine whether the number of medication discrepancies was reduced as a result of the pharmacists' recommendations. A p value of less than 0.05 was considered statistically significant with 2-tailed tests.

RESULTS

During the study period, a total of 200 patients were screened, of whom 123 matched the study inclusion criteria; all of these patients agreed to participate (100% participation rate). Of the 123 participants, 61 (49.6%) were assigned to the intervention group, and the remaining 62 (50.4%) were assigned to the control group.

The average age of the study population was 61.9 years (SD 10.0). Men represented slightly more than half of the patients (n = 63, 51.2%). Most of the participants were married (n = 104, 84.6%), most did not smoke (n = 95, 77.2%), and the level of education was a postsecondary diploma or higher for 20.3% (n = 25) (Table 1).

Medical characteristics and administrative data are displayed in Table 2, which shows that the 2 groups did not differ significantly with regard to intended length of stay in hospital, number of medical conditions, number of current or home medications, number of documentation errors, actual length of hospital stay, Charlson comorbidity index, or number of prescribed medications upon discharge ($p \geq 0.05$ for all).

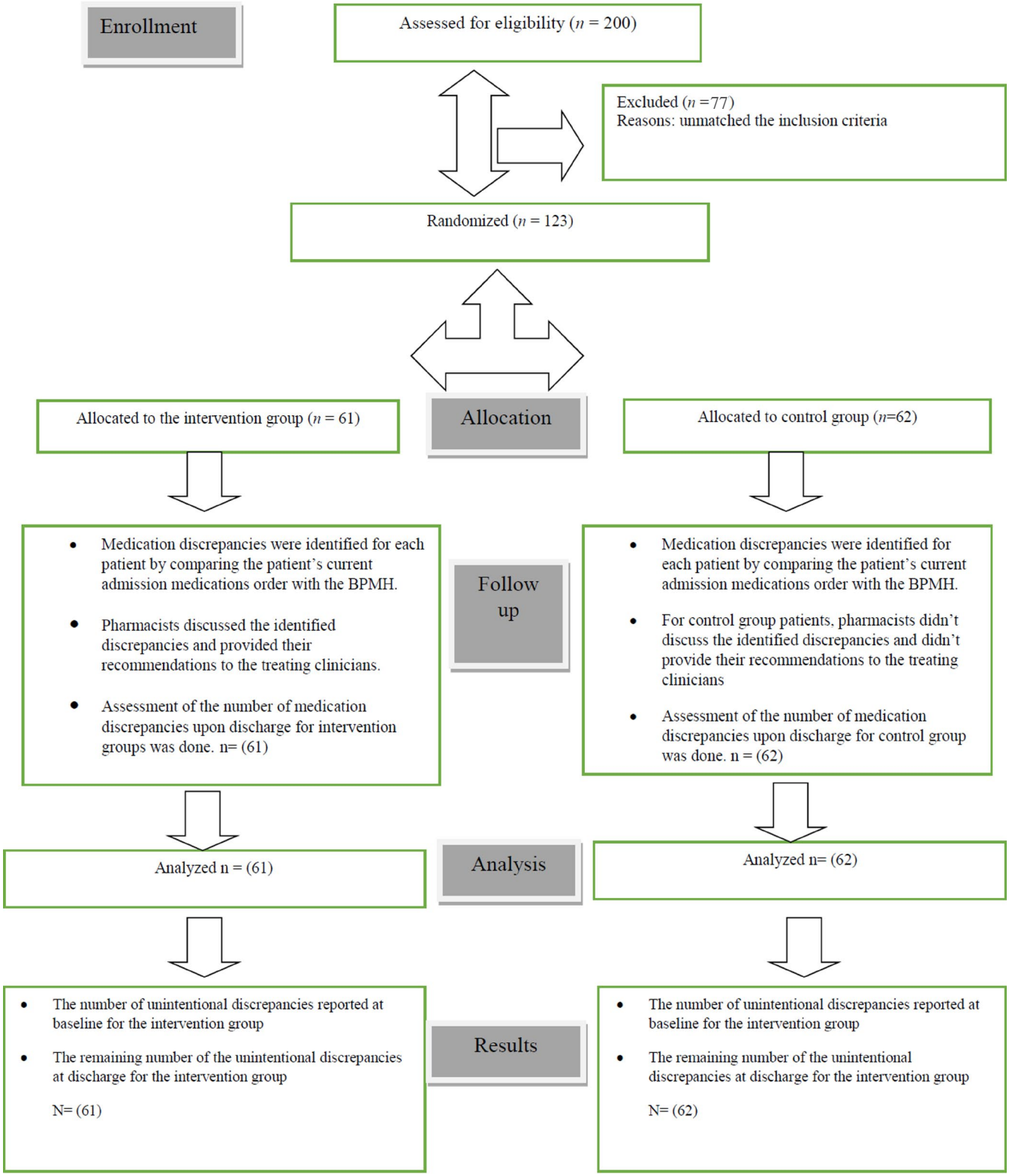

FIGURE 1. Flowchart for data collection. Patients were assessed for eligibility and recruited for study participation after undergoing scheduled surgery. BPMH = best possible medication history.

Table 3 classifies the type and prevalence of unintentional discrepancies (medication errors) detected for both groups, along with their clinical seriousness. The total number of discrepancies was 86, of which 53 (62%) occurred in the intervention group and 33 (38%) in the control group.

With regard to the types of medication discrepancies detected in the intervention group, the most common was omission ($n = 32$, 60%) followed by wrong dose ($n = 9$, 17%). The same pattern was observed for the control group, for which omissions represented the more than half of the discrepancies ($n = 18$, 55%), followed by wrong dose ($n = 7$, 21%). Overall, discrepancies of omission and wrong dose constituted 41 (77%) of the 53 discrepancies in the intervention group and 25 (76%) of the 33 discrepancies in the control group. Among the 53 medication discrepancies in the intervention group, moderate to severe harmful discrepancies (classes 2 and 3) accounted for 30 (57%). Among the 33 medication discrepancies in the control group, 16 (48%) were classified as moderate to severe harmful discrepancies. This difference was not statistically or clinically significant ($p = 0.35$).

Table 4 shows the number of unintentional discrepancies reported at baseline (i.e., at time of admission) and the number of unintentional discrepancies remaining at discharge for the intervention and control groups. In terms of unintentional discrepancies recorded at baseline, the average number was greater in the interventional group (0.86, SD 1.40) than in the control group (0.53, SD 0.65). This observed difference in the average number of unintentional discrepancies was not statistically significant ($p = 0.09$).

The average number of unintentional discrepancies remaining at discharge was 0.68 (SD 1.35) in the intervention

TABLE 1. Demographic Characteristics of Study Sample at Baseline

Characteristic	Group; No. (%) of Patients[a] Intervention ($n = 61$)	Control ($n = 62$)	Total ($n = 123$)	p Value[b]
Age (mean ± SD	62.1 ± 8.6	61.8 ± 11.3	61.9 ± 10.0	0.87[c]
Sex				
Women	29 (47.5)	31 (50.0)	60 (48.8)	0.78
Men	32 (52.5)	31 (50.0)	63 (51.2)	
Marital status				0.022
Single	2 (3.3)	6 (9.7)	8 (6.5)	
Married	53 (86.9)	51 (82.3)	104 (84.6)	
Divorced	0 (0)	4 (6.5)	4 (3.3)	
Widowed	6 (9.8)	1 (1.6)	7 (5.7)	
Education				0.232
None	6 (9.8)	5 (8.1)	11 (8.9)	
Primary/high school	38 (62.3)	44 (71.0)	82 (66.7)	
Diploma/bachelor's degree	15 (24.6)	8 (12.9)	23 (18.7)	
PhD	2 (3.3)	0 (0.0)	2 (1.6)	
Missing data	0 (0.0)	5 (8.1)	5 (4.1)	
Monthly income (JOD)				0.67
1–250	56 (91.8)	55 (88.7)	111 (91.2)	
251–500	3 (4.9)	5 (8.1)	8 (6.5)	
501–750	0 (0.0)	0 (0.0)	0 (0.0)	
751–1000	1 (1.6)	2 (3.2)	3 (2.4)	
Missing data	1 (1.6)	0 (0.0)	1 (0.8)	
Smoking				0.21
Yes	11 (18.0)	17 (27.4)	28 (22.8)	
No	50 (82.0)	45 (72.6)	95 (77.2)	
Nationality				0.30
Jordanian	58 (95.1)	61 (98.4)	119 (96.7)	
Other	3 (4.9)	1 (1.6)	4 (3.3)	

JOD = Jordanian dinars, SD = standard deviation.
[a]Except where indicated otherwise.
[b]Pearson χ^2 test, except where indicated otherwise.
[c]Independent-sample t test.

group compared with 0.41 (SD 0.62) in the control group. This difference was also statistically nonsignificant ($p = 0.16$).

When the number of unintentional discrepancies at baseline was compared with the number of unintentional discrepancies remaining at discharge, the results revealed statistically significant reductions for both groups ($p = 0.002$ for the intervention group; $p = 0.007$ for the control group). However, the extent of the reduction was not significantly different between the intervention and control groups ($p = 0.33$) (Table 4).

TABLE 2. Medical History and Administrative Data at Baseline

	Group; Mean ± SD			
Variable	**Intervention (*n* = 61)**	**Control (*n* = 62)**	**Total (*n* = 123)**	***p* Value[a]**
Intended length of stay (days)	5.0 ± 5.4	4.1 ± 2.1	4.5 ± 4.1	0.26
No. of medical conditions	3.6 ± 1.4	3.3 ± 1.5	3.4 ± 1.4	0.24
No. of current medications	8.6 ± 3.1	7.9 ± 2.8	8.2 ± 3.0	0.15
No. of home medications	7.2 ± 3.0	6.6 ± 2.3	6.9 ± 2.7	0.22
No. of documentation errors	2.5 ± 1.7	2.0 ± 1.7	2.3 ± 1.7	0.15
Length of stay (days)	9.6 ± 11.0	6.7 ± 5.4	8.1 ± 8.7	0.07
Charlson comorbidity index score	3.5 ± 1.7	3.2 ± 1.7	3.3 ± 1.7	0.41
No. of discharge medications	7.1 ± 3.0	6.7 ± 2.5	6.9 ± 2.8	0.40

SD = standard deviation.
[a]Independent-sample *t* test.

TABLE 3. Types and Clinical Seriousness of Unintentional Medication Discrepancies at Baseline

	Group; No. (%) of Patients		
Variable	**Intervention (*n* = 53)**	**Control (*n* = 33)**	***p* Value[a]**
Type of discrepancy			0.14
Wrong drug	3 (6)	0 (0)	
Wrong dose	9 (17)	7 (21)	
Wrong frequency	1 (2)	5 (15)	
Omission	32 (60)	18 (55)	
Addition	7 (13)	3 (9)	
Duplication	1 (2)	0 (0)	
Seriousness of error			0.35
Class 1	23 (43)	17 (52)	
Class 2	28 (53)	16 (48)	
Class 3	2 (4)	0 (0)	

[a]Fisher exact test.

TABLE 4. Unintentional Discrepancies at Baseline and at Discharge

	No. of Unintentional Discrepancies (Mean ± SD)			
Variable	**Baseline**	**Discharge**	**Reduction**	***p* Value[a]**
Intervention group (*n* = 61)	0.86 ± 1.40	0.68 ± 1.35	0.18 ± 0.43	0.002
Control group (*n* = 62)	0.53 ± 0.65	0.41 ± 0.62	0.11 ± 0.32	0.007
p value comparing the 2 groups[b]	0.09	0.16	0.33	–

SD = standard deviation.
[a]Paired sample *t* test.
[b]Independent-sample *t* test.

Among the submitted recommendations, 20 out of 53 (38%) were accepted by the treating physician, and all of them led to resolution of the medication discrepancy. It should be noted that in this study, the clinical pharmacists were instructed to not intervene to resolve unintentional discrepancies in the control group, unless the discrepancies were classified as severe (class 3). No class 3 discrepancies were identified in the control group, so the clinical pharmacists performed no interventions for patients in this group.

DISCUSSION

To the authors' knowledge, this study was the first randomized controlled trial in Jordan to assess the impact of providing medication reconciliation services to patients in surgical wards.

During the study period, a total of 86 discrepancies were identified in the 2 groups combined, with an overall average of 0.7 discrepancies per patient. The overall average of medication discrepancies has varied across previous studies.[7,9,26,27] A recent study conducted at JUH reported a similar average of 0.72 unintentional discrepancies per patient.[9] Other studies have reported higher rates of unintentional discrepancies, from 1.5 to 2.3 per patient.[7,26,27] This variation could be due to differences in the evaluation and identification of medication discrepancies among the researchers. Another factor may be that JUH is accredited by the Joint Commission International, which requires fulfilment of various standards that may reduce the incidence of medication discrepancies.

The results of the present study revealed that unintentional discrepancies were reduced from admission to discharge in both the intervention group (p = 0.002) and the control group (p = 0.007). This might be because the implementation of medication reconciliation services has increased awareness about detecting medication errors, which will be reflected across the entire patient population. Other studies have revealed significant improvements in patient safety as a result of the involvement of pharmacists as active health care providers, specifically in terms of reducing medication discrepancies.[5,6,28]

Discrepancies involving omissions and wrong doses represented the majority of unintentional discrepancies detected in both groups. This is a worrisome finding and is comparable to the results of previous studies, in which researchers reported that drug omissions were the most important type of error detected, followed by wrong doses.[29,30]

The seriousness of the recognized discrepancies was also assessed. About half of the reported unintentional discrepancies in both groups were deemed moderate to severe (57% in the intervention group, 48% in the control group), as they had the potential to cause harm or worsening of the patient's condition. Similar findings have been reported from Canada and Saudi Arabia, with most of the reported discrepancies being classified as serious.[31,32] However, other studies in Ireland and France categorized the majority of the discrepancies as having minor to moderate seriousness.[33,34] The potentially serious nature of the majority of discrepancies means that medication reconciliation services should start from the time of admission to prevent patient harm.

For the intervention group, discussion with the responsible physician was based on written forms documenting the reported unintentional discrepancies. Of the 53 interventions recommended to physicians, 20 (38%) were accepted and the discrepancy was resolved. This result was lower than those of previous research (93%[3] and 72%[35]). Nonetheless, despite the modest acceptance of pharmacists' recommendations in the present study, the number of unintentional discrepancies for the intervention group was significantly reduced upon discharge relative to the number of unintentional discrepancies at baseline.

The outcomes of this study will be added to existing research in this field, assessing the importance of the pharmacist in identifying medication discrepancies and in avoiding medication errors in the hospital setting.[9,36,37] In Jordan and neighbouring countries, previous studies have shown readiness among health care teams to interact with pharmacists to provide a medication reconciliation service.[38]

Limitations

This study had several limitations. It was conducted in a single teaching hospital, which might affect the generalizability of the results. Other studies in different hospitals throughout the country are needed. The detection of unintentional discrepancies and classification of their severity was completed by only 2 pharmacists and relied on the researchers' subjective judgment, which may raise concerns about bias. There was also a possibility of the Hawthorne effect, whereby clinicians' knowledge that their work was being observed might have caused a reduction in the number of unintentional medication discrepancies in both groups. This could be considered as a limitation of the validity of some of the assessed outcomes. Finally, the clinical pharmacists were not blinded to the randomization table, which leads to the possibility of selection bias.

CONCLUSION

This study sheds light on the presence of unintentional medication discrepancies among surgical patients upon their admission to hospital, which might expose them to harm upon discharge. Moreover, the study highlighted a significant reduction, from admission to discharge, in the number of medication discrepancies for both the intervention and control groups. It also showed that clinical pharmacists had a positive impact in resolving unintentional discrepancies. Further studies with larger sample sizes are needed to gain

better insight into the pharmacist's role in implementing medication reconciliation for surgical patients.

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Khawla Abu Hammour, PhD, is an Associate Professor in the Department of Biopharmaceutics and Clinical Pharmacy, Faculty of Pharmacy, University of Jordan, and Head of the Pharmacy Department and Pharmaceutical Care Unit, Jordan University Hospital, Amman, Jordan.

Rana Abu Farha, PhD, is an Associate Professor in Pharmacology and Pharmacotherapy, Department of Clinical Pharmacy and Therapeutics, Faculty of Pharmacy, Applied Science Private University, Amman, Jordan.

Rawan Ya'acoub, PharmD, is a Lecturer with the Faculty of Pharmacy, University of Jordan, Amman, Jordan.

Zeinab Salman, PharmD, is a Lecturer with the Faculty of Pharmacy, University of Jordan, Amman, Jordan.

Iman Basheti, PhD, is Vice President and Dean of the Faculty of Pharmacy, Applied Science Private University, and Head of the Pharmaceutical Care Unit, Ibn Al-Haytham Hospital, Amman, Jordan. He is also Honorary Professor with the Faculty of Pharmacy, University of Sydney, Sydney, Australia.

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Address correspondence to:
Dr Khawla Abu Hammour
Department of Biopharmaceutics and Clinical Pharmacy
Faculty of Pharmacy
University of Jordan
Amman, Jordan

email: k.hammour@ju.edu.jo

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