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Identification of medication discrepancies during hospital admission in Jordan: Prevalence and risk factors

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ABSTRACT

Objectives: Medication errors are considered among the most common causes of morbidity and mortality in hospital setting. Among these errors are discrepancies identified during transfer of patients from one care unit to another, from one physician care to another, or upon patient discharge. Thus, the aims of this study were to identify the prevalence and types of medication discrepancies at the time of hospital admission to a tertiary care teaching hospital in Jordan and to identify risk factors affecting the occurrence of these discrepancies.

Methods: A three months prospective observational study was conducted at the department of internal medicine at Jordan university hospital. During the study period, 200 patients were selected using convenience sampling, and a pre-prepared data collection form was used for data collection. Later, a comparison between the pre-admission and admission medication was conducted to identify any possible discrepancies, and all of these discrepancies were discussed with the responsible resident to classify them into intentional (documentation errors) or unintentional. Linear regression analysis was performed to assess risk factors associated with the occurrence of unintentional discrepancies.

Results: A total of 412 medication discrepancies were identified at the time of hospital admission. Among them, 144 (35%) were identified as unintentional while the remaining 268 (65%) were identified as intentional discrepancies. Ninety-four patients (47%) were found to have at least one unintentional discrepancy and 92 patients (46%) had at least one documentation error. Among the unintentional discrepancies, 97 (67%) were found to be associated with a potential harm/deterioration to the patients. Increasing patients' age (beta = 0.195, p-value = .013) and being treated by female residents (beta = 0.139, p-value = .045) were significantly associated with higher number of discrepancies.

Conclusion: The prevalence of unintentional discrepancies at the time of hospital admission was alarmingly high. Majority of these discrepancies were associated with a potential harm to the patients. These findings support the necessity for implementing the medication reconciliation service in the country, engaging healthcare providers in the process of identification and resolution of medication discrepancies.

1. Introduction

Medication errors are ranked the seventh cause of death worldwide (Stelfox et al., 2006), and are considered among the most common causes of morbidity and mortality in the hospital setting (Poornima et al., 2015). Medication error is generally defined as "a failure in the treatment process that leads to, or has the potential to harm the patient" (Aronson, 2009).

Medication errors are classified into three categories: errors of omission, where the drug was completely not given, errors of commission, where the drug was given incorrectly, and discrepancies, reporting differences between medications taken by the patient prior to hospital admission and medications ordered in the hospital (Ferner and Aronson, 2006). Discrepancies have been previously identified during transfer of patients from one care unit to another, from one physician care to another, or upon patient discharge (Mueller et al., 2012; Poornima et al., 2015; Rozich and Resar, 2001). Changing a medication dose, removal or addition of a medication during hospital admission without a justification are

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common examples on discrepancies (Mueller et al., 2012; Quelennec et al., 2013). In addition, medication discrepancies have been identified as either intentional or unintentional (Kwan et al., 2013).

Over the years, pharmacists have become more active in delivery of medicines and patient care in hospitals (Calvert, 1999; Sulaiman et al., 2017). Moreover, the role of pharmacist in providing effective medication reconciliation interventions is becoming more effective (Lo et al., 2013; Mueller et al., 2012). Pharmacists are in a pivotal position to identify discrepancies (Kraus et al., 2017; Stewart and Lynch, 2014) by providing recommendations to physicians to optimize patient treatment (Fernandes and Shojania, 2012). The "process of obtaining a complete and accurate list of each patient's current home medications including name, dosage, frequency, and route of administration, and comparing the physician's admission, transfer, and/or discharge orders to that list (Wong et al., 2008) has been provided through a medication reconciliation service. The medication reconciliation service has been proven successful in revealing most of discrepancies and preventing harm from reaching the patient (Geurts et al., 2012; Kuo et al., 2013; Super et al., 2014; Vira et al., 2006).

The Joint Commission International (JCI) global organization recommends medication reconciliation to be applied accurately and completely at all care settings for all of its accredited hospitals (Alert, 2006). Accreditation by JCI is granted to hospitals after establishing high standards and policies of patient's care and safety. Among these standards is the application of medication reconciliation service (Alert, 2006). Healthcare providers working in hospitals need to be successfully involved in the reconciliation process to achieve optimal patient care (Geurts et al., 2012) and they are aware of the importance of providing such service (Hammour et al., 2016). However, JCI leaves each hospital the flexibility of determining the way to implement medication reconciliation and which healthcare provider(s) is/are responsible for its implementation (Alert, 2006).

Thus, the present study was conducted to identify the prevalence and types of medication discrepancies identified by pharmacists at the time of hospital admission of patients to a tertiary care teaching hospital in Amman, Jordan. Secondary aim involves the identification of risk factors for the occurrence of these discrepancies.

2. Methods

2.1. Study design, participants and clinical setting

This prospective observational study was conducted over three months (April-June 2017) at an internal medicine department at Jordan university hospital (JUH), a 550 beds tertiary care teaching hospital located in Amman, Jordan.

Patient inclusion criteria included: patients admitted to the hospital recently, whom age $\geq$18 years, using at least 4 regular prescription medications before admission, having an expected length of stay in the hospital (more than 48 h), speaking Arabic, have no apparent cognitive deficiency, and not involved in other clinical trials. Patients were excluded if they were placed in isolation (to avoid unnecessary contact between patients with infectious diseases and the study researcher), discharged within 48 h of hospital admission, discharged against medical advice, unable or unwilling to provide written informed consent.

2.2. Data collection

During each observational day (from 11 am to 5 pm for five days/week), patients' medical files were reviewed to assess patients eligibility for inclusion. Patients were recruited from all internal medicine department subdivisions which include: cardiology, respiratory, hematology/oncology, nephrology, neurology, infectious diseases, gastroenterology, endocrinology, and rheumatology. A written informed consent was obtained from each eligible patient who agreed to participate.

For each recruited patient, a pre-prepared data collection form was used for data collection. Data was collected from (1) the patient's medical records, (2) followed by interviewing the patient/caregiver and (3) interviewing the responsible resident (Fig. 1).

2.2.1. Medical record review

Patients' medical records were reviewed to obtain information regarding demographic data (patients age, gender, educational level, marital status and monthly income), admission data (date of admission, admission department, chief compliant), medical information (patients' acute and chronic medical condition), admission medications list (which includes: medication name (trade and generic), dose, frequency, dosage form, route of administration, time of administration, starting date and stop date), pre-admission medication list (if available), and discharge information (length of stay in hospital).

Based on patient's medical information, Charlson Comorbidity Index (CCI) was calculated for each patient. This index represents a tool that is used to predict the ten year mortality rate in individuals with comorbid conditions (Charlson et al., 1987).

2.2.2. Direct patient/caregiver interview

A comprehensive interview with the patient was conducted to obtain or to verify patient's pre-admission list (if it was obtained from the medical record). For patients who couldn't recall their medications, they or their caregivers were asked either to bring their pre-admission medications or the medications on the next visit, or to send photos of medications using a messaging application, e.g. WhatsApp. Information was requested for all medications including prescription, over the counter medications and herbal supplements.

2.2.3. Responsible resident interview

The characteristics pertinent to patients' responsible residents were obtained directly by interviewing the residents. This information included: residents' gender, years of practice at JUH and whether the resident received any medication reconciliation at JUH. Residents were also interviewed when needed to discuss patients' medication discrepancies as explained in the next section.

2.3. Identification of medication discrepancies

A comparison between patients' current admission and pre-admission medications was performed to identify any discrepancies between the two medication lists (pre-admission and admission lists). Identified discrepancies included, but not limited to, dosage discrepancies, frequency discrepancies, administration route discrepancies, dosage form discrepancies, addition of a drug not previously used, duplication of drugs, omission of a drug previously used, or substitution from one medication to another targeting the same treatment goals.

Identified discrepancies were evaluated by the pharmacists (study researchers LS and RA) to determine whether they were documented within the patients' medical files. All undocumented discrepancies were then reviewed and discussed with the responsible residents, and a clinical judgment was made to determine if there was a justified cause for such discrepancies (intentional discrepancies). Otherwise, discrepancies were reported as unintentional. Unintentional discrepancies were classified based on the

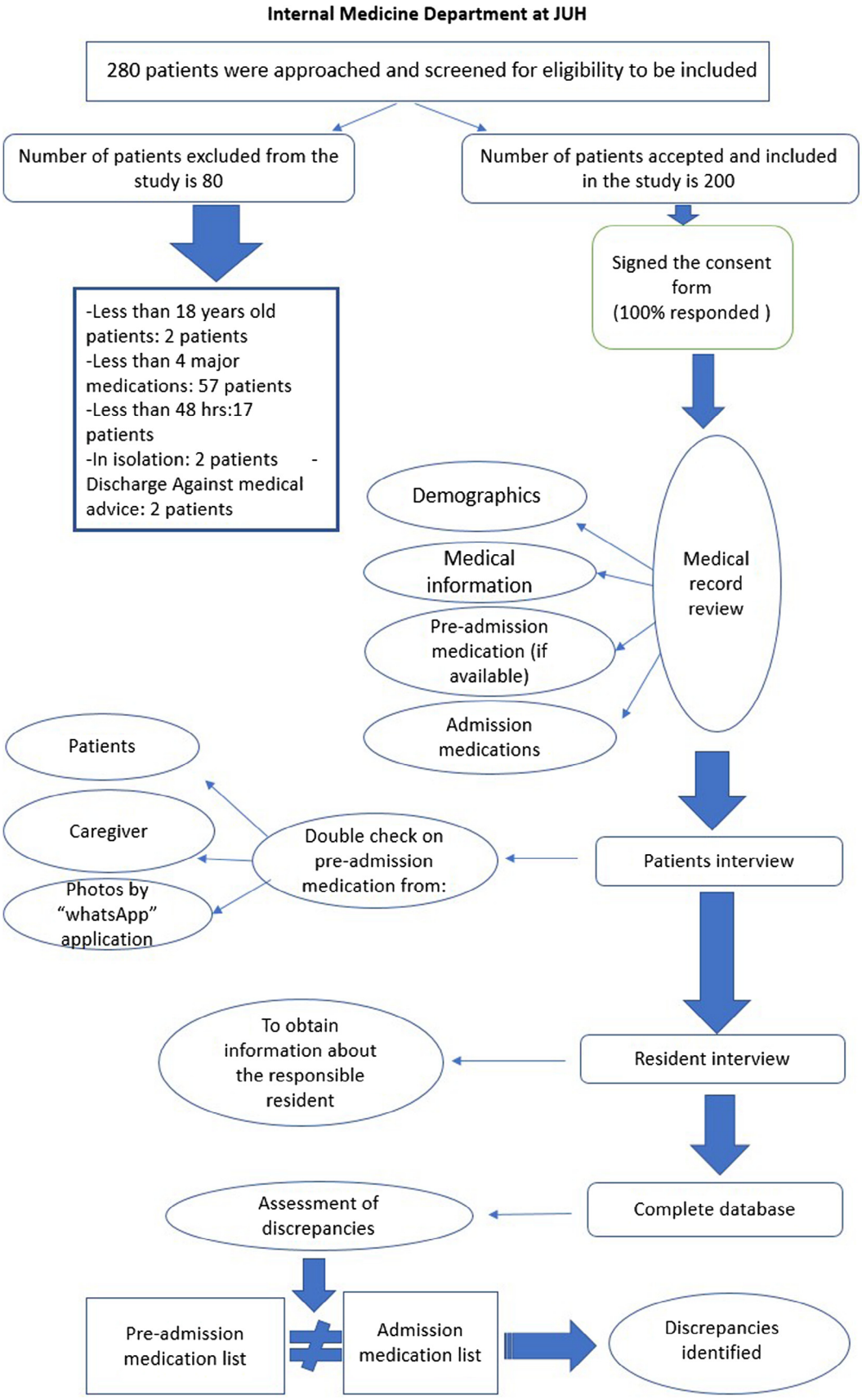

Fig. 1. Schematic presentation for data collection method used in this study.

potential harm they may cause into three categories: Class 1 discrepancies are discrepancies unlikely to cause patient discomfort or clinical deterioration; Class 2 discrepancies are discrepancies with the potential to cause moderate discomfort or clinical deterioration, and Class 3 discrepancies had the potential to result in severe discomfort or clinical deterioration.

In the case of disagreement, the discrepancy was discussed by the study researchers until consensus was reached.

2.4. Ethical consideration

Ethical approval from the Institutional Review Board at the JUH was obtained (Reference number: 65/2017). The study was conducted following the ethical standards outlined in the World Medical Association Declaration of Helsinki guideline (World Medical Association, 2013). Patient's confidentiality was preserved throughout the study.

2.5. Statistical analysis

Data was entered and analyzed using Statistical Package for Social Science (SPSS) version 22 (SPSS Inc., Chicago, IL, USA). The descriptive analysis was done using mean and standard deviation (SD) for continuous variables and percentage for qualitative variables. Checking for normality was carried out using Shapiro-Wilk test, with P-value $\geq$.05 indicating normally distributed continuous variables. Initial screening of risk factors affecting the number of medication discrepancies was carried out using simple linear regression. These factors included: patients age, gender, educational level, monthly income, CCI, number of pre-admission medications, number of admission medications, number of comorbidities, hospital length of stay, and residents' gender. A p value <0.05 was considered statistically significant, and all tests were two-tailed.

Any independent variable that had a p value of <0.05 was considered a candidate for multiple linear regressions after checking for the absence of multicollinearity (r < 0.9 between tested independent variables).

2.6. Sample size calculation

In order to reveal the risk factors for the identified discrepancies, multiple linear regression analysis was planned to be performed. Based on Tabachnick and Fidell recommendation for sample size calculation in multiple linear regression analysis, 20 subjects per each predictor are suggested to be preferable, with the minimum required subject per predictor being five (Tabachnick and Fidell, 2006). Based on the number predictors or independent variables used in this study (n = 10) and the preferred number of subject per predictor, a sample size of 200 was considered suitable.

3. Results

3.1. Demographic characteristics of the study sample

During the study period, 280 patients were screened for eligibility criteria. Of these, 200 patients were eligible and agreed to take part in the study (100% response rate). The remaining 80 patients were excluded due to several reasons. The most common reason for patient exclusion was receiving less than 4 major medications (Fig. 1).

Mean age of participants was 63.1 years (SD 14.6); with 111 patients (55.5%) being males. Most of the patients were married (149, 74.5%) and about half of them (101, 50.5%) had educational level of diploma or higher. The majority of patients have a monthly income below 750 JD (189, 94.5%) (Table 1).

3.2. Participant medical information

The mean (SD) number of pre-admission medications was 6.9 (2.9), and was increased to 10.3 (4.6) for admission medications. Patients were found to have a mean number of 2.9 (1.3) medical comorbidities, with hypertension being the most common medical condition identified (157, 78.5%), followed by diabetes (109, 54.5%). Among the study patients, 60 patients (30%) presented with CCI $\geq$ 4, Table 2.

Patients were recruited from different internal medicine departments, with respiratory department being the main site of

Table 1
Demographic characteristics of the study sample (n = 200).

Parameter	Mean (SD)	n (%)
Age, years	63.1 (14.6)	
Gender		
Males		111 (55.5)
Marital status		
Single		11 (5.5)
Married		149 (74.5)
Divorced		4 (2.0)
Widowed		36 (18.0)
Educational level		
Not educated		36 (18.0)
Primary School/high school		63 (31.5)
Diploma/BSc		96 (48.0)
Masters/PhD		5 (2.5)
Monthly income[a]		
1–250 JD		75 (37.5)
251–500 JD		54 (27.0)
501–750 JD		60 (30.0)
751–1000 JD		7 (3.5)
More than 1000 JD		4 (2.0)

[a] 1 JD = 0.71 US$.

Table 2
Medical histories and administrative data of the study sample (n = 200).

Parameter	Mean (SD)	n (%)
Number of Pre-admission Medications	6.9 (2.9)	
Number of Admission Medications	10.3 (4.6)	
Number of Medical Conditions	2.9 (1.3)	
Length of Stay (days)	6.4 (4.6)	
Admission department		
o Cardiology		28 (14.0)
o Nephrology/Urology		15 (7.5)
o Neurology		27 (13.5)
o Respiratory		62 (31.0)
o Endocrinology		4 (2.0)
o Gastroenterology		31 (15.5)
o Oncology/hematology		20 (10.0)
o Infectious		12 (6.0)
o Rheumatology		1 (0.5)
Charlson Comorbidity Index (CCI)		
o 0		14 (7.0)
o 1		30 (15.0)
o 2		49 (24.5)
o 3		47 (23.5)
o $\geq$4		60 (30)
Most Common Medical Conditions		
o Hypertension		8.5)
o Diabetes		109 (54.5)
o Coronary Heart Diseases		85 (42.5)
o Chronic Renal Failure		36 (18.0)
o Asthma		9 (4.5)

admission (62, 31%) followed by the gastrointestinal department (31, 15.5%). The mean length of stay for study participants was 6.4 (4.5) days.

Regarding the responsible residents, 140 patients (70%) were treated by female resident, and 170 patients (85%) were treated by resident who received a recent reconciliation workshop at JUH. Residents has an average of 1.15 years of experience at JUH (SD 0.36).

3.3. Medications discrepancies among study sample

A total of 412 medication discrepancies were identified among the study cohort, with a mean of 2.1 (SD 2.0) and a range of 0–11. All of the identified discrepancies were undocumented. From the 412 discrepancies, 144 (35.0%) were identified as unintentional discrepancies, with a mean of 0.73 error per patient (SD 0.93). The remaining 268 discrepancies (65.0%) were intentional (documentation errors). Among the study sample, 94 patients (47%) were found to have at least one unintentional discrepancy and 92 (46%) have at least one documentation error.

Addition of unnecessary medication was the most frequently identified unintentional discrepancies (61, 42.4%), followed by omission of medications (52, 36.1%) (Fig. 2). Examples of the different types of identified discrepancies are presented in Table 3.

Table 3
Examples of the identified unintentional medication discrepancies.

Type of discrepancy	Example
Addition	On admission, proton pump inhibitor was added to the patient's medications without justification
Omission	Patient was on metformin 850 mg twice daily, the resident forgot to prescribe the drug on admission
Wrong dose	During admission, the patient was on atorvastatin 40 mg daily while at home he was taking 20 mg daily
Duplication	At home, the patient was on propranolol 10 mg once daily, and during admission the resident prescribed propranolol 10 mg once daily and metoprolol 25 mg once daily
Wrong frequency	The resident added an unjustified extra dose of calcium carbonate for the patient during his stay in the hospital
Wrong drug	The patient was prescribed omeprazole on admission and he was on clopidogrel, which may affect the efficacy of clopidogrel

Proton pump inhibitors were the most common drug therapies involved in medication discrepancies among the study sample (42, 29.2%), followed by antidiabetic agents (24, 16.7%), Fig. 3.

The seriousness of the identified unintentional discrepancies revealed that 81 (56.3%) discrepancies were judged to be associated with a potential moderate harm or deterioration to patients

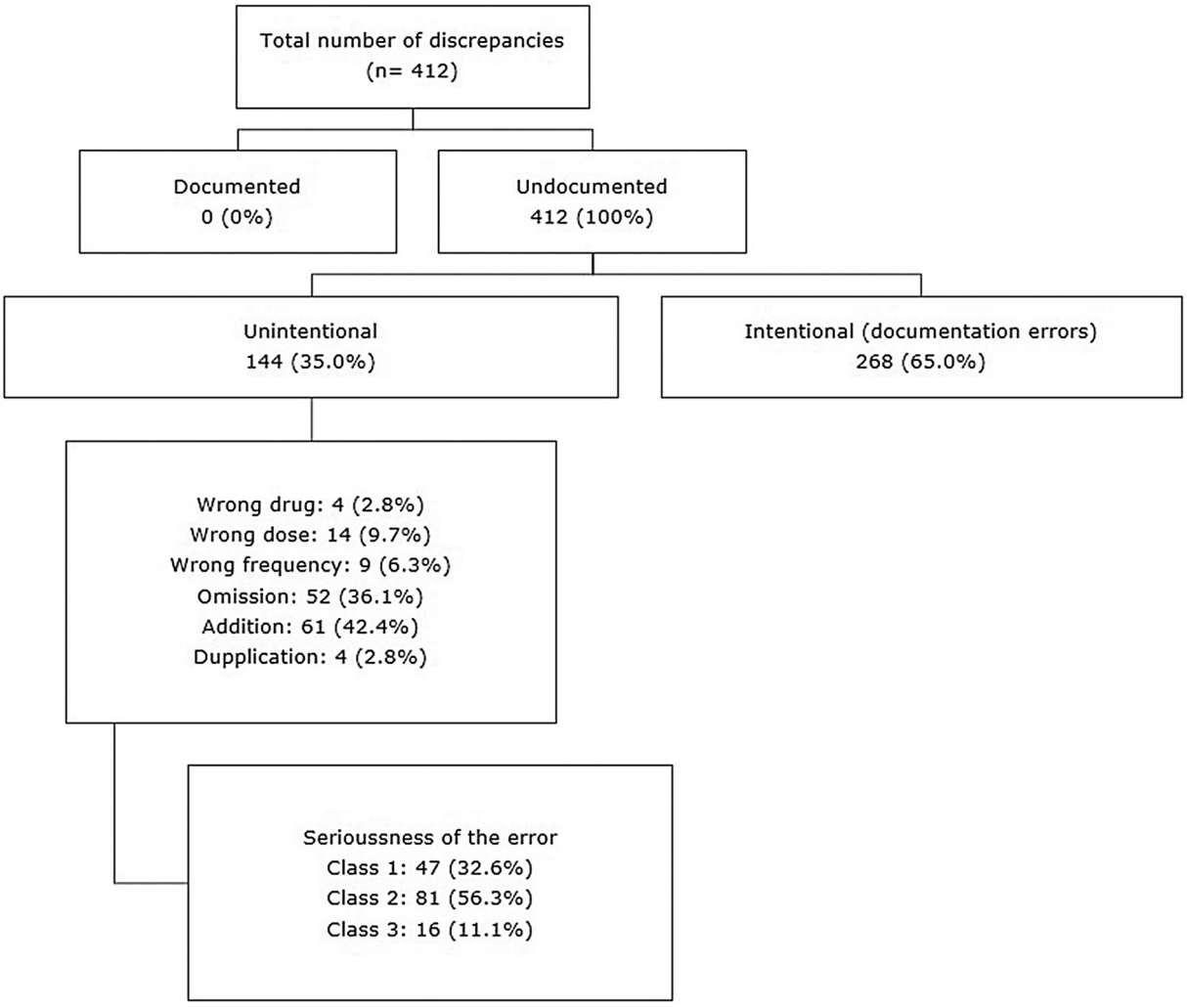

Fig. 2. Classifications of medication discrepancies identified among study sample (n = 200).

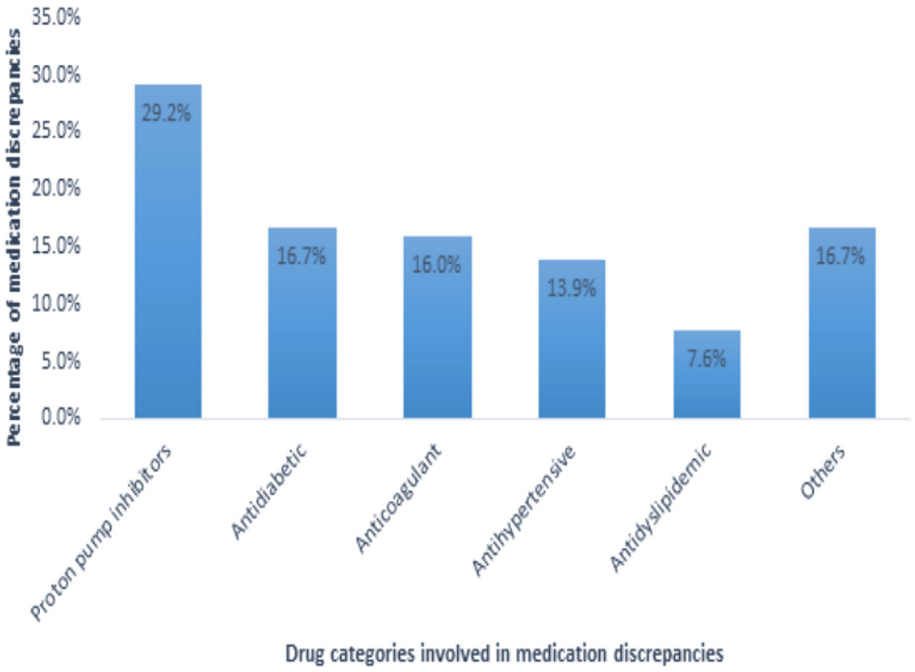

Fig. 3. Percentage of medication discrepancies associated with different drug classes.

and 16 (11.1%) discrepancies were judged to be associated a potential severe harm or deterioration to patients.

3.4. Risk factors for medication discrepancies

The effect of different covariates on the incidence of unintentional medication discrepancies, showed that unintentional discrepancies was significantly increased with increasing patients' age (beta = 0.195, p-value = .013) and for patient being treated by female residents (beta = 0.139, p-value = .045) (Table 4).

4. Discussion

The present study examined the prevalence and types of medication discrepancies at the time of hospital admission. To the best of our knowledge, there were no previous studies conducted in Jordan evaluating the prevalence of medication discrepancies at hospital setting. Results of the study showed an alarming rate of discrepancies, with about half of the patients having at least one unintentional discrepancy. Results also shed light on the seriousness of the identified discrepancies, as more than 67% of them were found to be associated with a potential moderate to severe harm/deterioration to the patient. Identifying unintentional discrepancies is important in drawing the attention of the health care providers to the nature of such errors.

The prevalence of unintentional discrepancies varied within the literature. Some studies showed high prevalence rates (>60% of patients experienced at least one unintentional discrepancies) (Cornish et al., 2005; Okerosi et al., 2017; Vira et al., 2006). Others reported similar (47%) (Hellström et al., 2012) or lower (33%) prevalence (Quélennec et al., 2013) compared to this study (48%). This variation in the prevalence of medication discrepancies may be attributed to the different definitions used in the assessment and identification of discrepancies amongst the studies. Some researchers considered medication discrepancies as medication errors, while others defined them as the unintentional mismatch between two medication lists (medication lists before and after hospital admission). In addition, different studies used different study design and inclusion criteria for the recruited patients, leading to variations in the study population.

Table 4
Regression analysis for determination of predictors to unintentional discrepancies among study sample (n = 200).

Variables	Dependent variable Number of unintentional discrepancies			
	Beta	p-value[$]	Beta	p-value[#]
Age (years)	0.259	<.001*	0.195	.013*
Gender (1: males, 2: females)	0.180	.011*	0.054	.448
Educational level	−0.188	.008*	−0.082	.310
Monthly Income	−0.137	.053	–	–
Charlson Comorbidity Index	−0.025	.724	–	–
Number of Pre-admission Medications	−0.091	.200	–	–
Number of Admission Medications	−0.060	.398	–	–
Number of Medical Conditions	−0.046	.520	–	–
Length of Stay (days)	0.099	.164	–	–
Resident gender (1: males, 2: females)	0.188	.008*	0.139	.045*

[$] Simple linear regression analysis,
[#] Multiple linear regression analysis.
* Significant at 0.05 level. Beta: standardized regression coefficient.

It was promising to identify an average of 0.7 unintentional discrepancies per patient in this study. Previous studies reported higher rates of unintentional discrepancies, ranging from 1.5 to 2.3 unintentional discrepancies per patient (Hellström et al., 2012; Okerosi et al., 2017; Vira et al., 2006). This might be related to the recent accreditation the JUH owned in 2017 by the JCI on Accreditation of Healthcare Organization. Other factors could have played a role, such as high awareness amongst medical staff towards safety and recuperation of patients, good design of the reconciliation medical charts, and reconciliation workshop attendance by the hospital physicians.

Addition of unnecessary medication was the most frequently identified unintentional discrepancy (42.4%), followed by the omission of medications (36.1%). Most published studies also identified omission and addition of medications to be the most common types of discrepancies (Assiri et al., 2017; Cornish et al., 2005; Hellström et al., 2012; Zarif-Yeganeh et al., 2017). Study results showed that proton pump inhibitors were the most frequent drugs involved in drug discrepancies. It was surprising to find that this type of medication was frequently added to patients' therapeutic regimens with no proper justification documented. Overuse of proton pump inhibitors is not new in Jordan, as previous research findings highlighted that 73% of patients in Jordanian hospitals receive proton pump inhibitors with no documented valid indications (Zalloum et al., 2016). The overuse of proton pump inhibitors in the hospital setting has also been identified overseas (Eid et al., 2010; Moran et al., 2014; Naunton et al., 2000), drawing attention to the importance of incorporating suggested resolutions in the in-services provided by the hospital-based clinical pharmacist.

Not all discrepancies are of equal value when it comes to the level of harm it may cause to the patient. Majority of the identified unintentional discrepancies (67.4%) were serious, as they were associated with a potential harm/deterioration to the patient. Similarly, several previous studies conducted in Saudi Arabia and Canada found that most identified discrepancies had the potential to cause harm to the patient, being classified as serious (Al-Rashoud et al., 2017; Ann Nickerson and Lauza, 2005). Studies conducted in Ireland and France classified most of the discrepancies as moderate or minor in seriousness (Grimes et al., 2011; Quelennec et al., 2013). Hence, this potentially serious nature of most of the discrepancies necessitates the implementation of medication reconciliation services after patient admission to avoid patient harm.

Undocumented intentional discrepancies are dangerous, as the prescriber intentionally decides to make the changes but does not clearly document it, creating confusion and the potential for medication errors. The incidence of undocumented intentional discrepancies in this study was high (65%), coinciding with previous findings (Franklin et al., 2011). Organization and management factors, the work environment and team factors are possible causes identified previously (Franklin et al., 2011). Anecdotal comments indicated that the high burdens on physicians at JUH play a role in increasing the number of undocumented intentional discrepancies. It would be beneficial for future studies to explore such factors in the Jordanian health system.

For physicians and pharmacists alike, identifying risk factors for the occurrence of discrepancies provides critical information to assess and manage the risk in individuals and/or physicians. Age of the patient and resident gender emerged as risk factors in this study. Older patient age is a significant predictor for unintentional medication discrepancies. This was not related to the number of medications nor the number of medical discrepancies for this group of patients. Higher level of care received by the younger patient groups could explain such results. Similar results were obtained from several previous studies conducted in the United States (Bedell et al., 2000; Gleason et al., 2010; Salanitro et al., 2012). Some studies showed no relationship between age and the number of medication discrepancies (Stitt et al., 2011; Zarif-Yeganeh et al., 2017), while other revealed contrary results, where older age was associated with less medication discrepancies (Okerosi et al., 2017).

Being a female resident was significantly associated with higher number of discrepancies. No previous studies supporting this statistical significance were found. It has been acknowledged however, that female residents experience greater domestic responsibilities, especially in regard to raising the children, than men residents (Barr, 2017). Such greater responsibilities might affect the quality of medical care provided by the female resident.

It is worth mentioning the main limitations of this study. Firstly, the study was conducted at an internal medicine department at one hospital in Amman, Jordan, which may limit the study generalizability. Secondly, the classification of the seriousness of medication discrepancies relied on subjective judgment of the researchers and is therefore subject to bias. However, the study was strengthened by the fact that the researchers used several methods to obtain patients' pre-admission medication list (patients' interview, caregivers' interview, and photos by 'whatsApp' application) which might reduce the possibility of recall bias by the patients.

5. Conclusion

This study highlighted the high prevalence of medication discrepancies at the time of hospital admission at an educational hospital in Amman, Jordan. Majority of the identified discrepancies were associated with a potential harm to the patient. The findings of the present highlight the need to identify these discrepancies in hospital setting, and support the necessity for implementing the medication reconciliation service in the country, engaging pharmacists and other healthcare providers in the process of identification and resolution of medication discrepancies. A future randomized controlled study is needed to investigate the impact of a pharmacist-directed medication reconciliation service on reducing the number of medication discrepancies at the time of hospital admission.

Conflict of interest

None of the authors have any conflict of interest.

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