

Medication Reconciliation during Admission at University Hospital

Tatiane Contin¹, Liliane Bernardes Campos¹, Mônica Cristina Toffoli-Kadri^{1,2} & Vanessa T. Gubert de Matos^{1,2,3}

¹ Postgraduate Program in Pharmaceutical Sciences, Faculty of Pharmaceutical Sciences, Food, and Nutrition, Federal University of Mato Grosso do Sul, Campo Grande, Mato Grosso do Sul, Brazil

² Faculty of Pharmaceutical Sciences, Food, and Nutrition, Federal University of Mato Grosso do Sul, Campo Grande, Mato Grosso do Sul, Brazil

³ Pharmacy School Prof^a Ana Maria Cervantes Baraza, Faculty of Pharmaceutical Sciences, Food, and Nutrition, Federal University of Mato Grosso do Sul, Campo Grande, Mato Grosso do Sul, Brazil

Correspondence: Vanessa Gubert de Matos, Pharmacy School Prof^a Ana Maria Cervantes Baraza, Faculty of Pharmaceutical Sciences, Food, and Nutrition, Federal University of Mato Grosso do Sul, Campo Grande, Mato Grosso do Sul, Brazil. Tel: 55-(067)-3345-7781.

Received: September 5, 2020 Accepted: October 12, 2020 Online Published: November 16, 2020

doi:10.5539/gjhs.v12n13p1

URL: <https://doi.org/10.5539/gjhs.v12n13p1>

Abstract

Introduction: Medication reconciliation is the process of comparing the most accurate list of all medications that a patient is taking with the list of prescription drugs within the healthcare system while considering the patient's allergies and history of side effects.

Objectives: To reconcile medication upon the patients' admission to a university hospital in the municipality of Campo Grande, Mato Grosso do Sul, Brazil.

Method: A prospective, cross-sectional study was conducted between June 2018 and May 2019 at the medical clinic unit of an university hospital. Discrepancies observed between the prescription and the best possible medication history were classified as intentional discrepancy; undocumented intentional; and unintentional.

Results: A total of 1,134 discrepancies were found between home-based drugs and those prescribed upon admission to the MCU. Among the discrepancies, 815 (72%) were intentional, 89 (8%) were undocumented intentional, and 230 (20%) were unintentional. The number of consultation sources and the number of medicines in use at home showed significant correlation with the occurrence of unintentional discrepancies ($p = 0.039$ and $p = 0.008$, respectively). A total of 318 pharmaceutical interventions were performed, 230 related to unintended discrepancies. Of these, 138 (60%) interventions were not accepted.

Conclusion: The study verified the high frequency of drug omission, conferring treatment interruption and the need for pharmaceutical assistance of polymedicated patients.

Keywords: medication reconciliation, medication errors, patient safety, clinical pharmacy service

1. Introduction

Medication reconciliation is the process of comparing the most accurate list of all medications that a patient is taking with the list of prescription drugs within the healthcare system while considering the patient's allergies and history of side effects. The objective of this process is to provide the correct medications to the patient at all points within the healthcare system, resulting in a reduction in medication errors. (Penn, Vaillancourt, & Pouliot, 2019; The Joint Commission, 2017).

In 2017, the World Health Organization (WHO) launched its third global safety challenge, called "Medication Without Harm," aimed at reducing serious and preventable drug-related harm worldwide by 50%. Damage caused by medication errors accounts for at least one death every day and harms approximately 1.3 million people annually in the USA alone. Worldwide, the annual cost associated with medication errors has been estimated at \$42 billion, or nearly 1% of the total global health expenditure (World Health Organization, 2017).

One of the strategies developed to reduce medication errors is the practice of medication reconciliation, which is designed to overcome challenges in the communication of medication information, reduce medication waste, and limit the number of hospital readmissions (Mekonnen, McLachlan, & Brien, 2016; Shekelle, et al., 2013; Wang,

Fogerty, & Horwitz, 2017).

In the USA, medication reconciliation is a routine process that has been undertaken since 2003, when The Joint Commission accredited the practice to improve patient safety. Since 2006, the process has been implemented, organized, and standardized, becoming a mandatory requirement in health facilities that are accredited by the organization (The Joint Commission, 2019).

Establishing a patient's best possible medication history (BPMH) at the time of hospital admission is an important step in the search for the safety of hospitalized patients, as it contributes to the design of the drug regimen prescribed during hospitalization. Although there are national studies describing the medication reconciliation process at the hospital admission stage, publications of this clinical practice in university hospitals are incipient (Mazhar, Akram, Al-Osaimi, & Haider, 2017; Lindenmeyer, Goulart, & Hegele, 2013; Lombardi et al., 2016; Spalla & Castilho, 2016). Therefore, investigations on medications added, altered, or interrupted in the transition between healthcare levels are necessary to improve patient safety strategies and prevent a repeat of the medication errors occurring in the Brazil scenario discussed below. Considering this, the objective of this study was to reconcile medication upon the patients' admission to a university hospital in the municipality of Campo Grande, Mato Grosso do Sul, Brazil.

2. Materials and Methods

2.1 Outline and Duration of the Study

A prospective, cross-sectional study was conducted between June 2018 and May 2019 in accordance with STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines.

Institutional review board approval from the Federal University of Mato Grosso do Sul was obtained on April 4, 2018 (opinion nº 2.580.775) prior to initiation of the study.

2.2 Place of Study

This study was conducted at the medical clinic unit (MCU) of the Maria Aparecida Pedrossian University Hospital (HUMAP), in Campo Grande, Mato Grosso do Sul, Brazil, which was inaugurated and became a federal institution within the states of Mato Grosso and Mato Grosso do Sul in 1971.

The hospital area consists of specialist outpatient clinics, a surgical center, an obstetric center, adult and pediatric, neonatal, a coronary unit, emergency medical care, diagnostic imaging, radiology services, breast milk bank, hemodialysis (with medical residency in 22 specialties), residency in dentistry, and multiprofessional residency in critically ill patients.

HUMAP has 232 beds and is a reference in the state of Mato Grosso do Sul for infectious diseases and complex procedures, such as cardiovascular surgery, hemodialysis, and neurology, in addition to high-risk pregnancy, tomography, and lithotripsy.

The ward in the hospital's MCU provides full care of individuals over 12 years of age (male and female) who are hemodynamically stable and who has not undergone surgical treatment. In this unit, all prescriptions are electronic, and specialties include nephrology, neurology, cardiology, endocrinology, gastroenterology, pneumology, rheumatology, hematology, and vascular. It focuses on cases of medium complexity and has 30 beds. Patients undergo clinical treatment with varying lengths of hospitalization, depending on the cause.

2.3 Inclusion and Exclusion Criteria

Patients were invited to participate in this study of adults (18 years of age and older) who were transferring from the emergency medical care to the HUMAP MCU and were approached within 24 h of admission. All study procedures were conducted only after the patient had signed the informed consent form.

Patients who were transferred to another hospital unit without approached within 24 h of admission to the MCU were excluded from the study, as well as unaccompanied patients with lowered levels of consciousness and patients who were not using medication at home.

2.4 Interview and Registration of Data

To prepare the BPMH of the patient, two instruments were used. The first was the Guide to Developing the Best Possible History of Medicines, adapted from the Canadian Patient Safety Institute (Gleason et al., 2004). The second was the Admission Drug Reconciliation Form (ADRF), (Giménez Manzorro et al., 2011; Contreras Rey, Arco Prados, & Sánchez Gómez, 2016; Rose, Fischer, & Paasche-Orlow, 2017).

The BPMH assisted in the conduct of research, avoiding process deviations. The guide was used in the

interviews with patients and caregivers, and the questions it contained were related to home-based drugs. For the composition of the BPMH, a review was carried out on the patients' medical records and the medicines and prescriptions that the patients brought with them from home.

All data collected during the research were recorded in the ADRF, which was constructed for this study and was based on medication reconciliation surveys conducted in other countries.

The collected data of the medications were trade and generic name, dosage, route of administration, treatment time, and allergies. Medicinal plants and dietary supplements used as treatments were analyzed and noted by the attending physician during the pharmaceutical interventions. Regarding the origin of home-based drugs, they were categorized as prescription drugs and non-prescription drugs (self-medication). The class of drugs was categorized according to the Anatomical Therapeutic Chemical (ATC) classification system recommended by the WHO (World Health Organization, 2019).

2.5 The Medication Reconciliation

After obtaining all available information from various available sources (interview with patient, interview with companion, packaging of medicines brought from home, prescriptions, and medical records) regarding patient's home-based drug, the BPMH was compared with the patient's medication prescription upon admission to the MCU.

Discrepancies observed between the prescription and BPMH were classified as follows: (1) intentional discrepancy (wherein the difference was documented); (2) undocumented intentional (when there was a difference, but there was nothing in writing to justify it); and (3) unintentional (when there was a difference, there was no documentation, and the doctor confirmed that he/she was unaware of the discrepancy), (Vira, Colquhoun, & Etchells, 2006).

According to Almanasreh, Moles, & Chen (2020) the phases of the medication reconciliation process are as follows: (1) rearrangement of the medication lists into the same order; (2) identification of the reference list or the best possible medication list; (3) matching/reconciliation of the two medication lists (our assumption is that one of the lists should be the best possible medication list (reference list), and the other is a list of newly prescribed medications); (4) marking of any identical medications to simplify the process of identifying medication discrepancies; (5) classification of any mismatched medications (solo drug in any list) based on the first part of the taxonomy (drug mismatched); and (6) analysis of any partially matched (matched but not identical) medications for the presence of medication discrepancies based on a logical order, starting from the name and ending with the time of administration, and classification of any identified medication discrepancies using the second part of the taxonomy (drug partially matched). After classification, the need for pharmaceutical intervention was evaluated. Discrepancies confirmed by doctors as unintentional were considered medication errors.

Medication errors (unintentional discrepancies) were classified according to the medication discrepancy taxonomy (MedTax), (Almanasreh et al., 2020) as follows:

1. Drug mismatched
 - 1.1. Drug omission
 - 1.2. Drug commission (or addition)
 - 1.3. Drug duplication
 - 1.4. Therapeutic class substitution (medication change within a medication class)
 - 1.5. Allergy or intolerance
 - 1.6. Other
2. Drug partially matched
 - 2.1. Discrepancy in the name of drug
 - 2.1.1. Unclear or wrong name (brand name or generic name)
 - 2.1.2. Omission of brand name
 - 2.1.3. Omission of generic name
 - 2.1.4. Different brand name but same generic name
 - 2.2. Discrepancy in the strength and/or frequency and/or number of units of dosage form and/or total daily dose

- 2.2.1. Unclear or wrong strength
- 2.2.2. Omission of strength
- 2.2.3. Different strength and different total daily dose
- 2.2.4. Different strength but same total daily dose
- 2.2.5. Omission of unit of strength
- 2.2.6. Different or wrong unit of strength
- 2.2.7. Same strength but unclear/or wrong frequency
- 2.2.8. Same strength but omission of frequency
- 2.2.9. Same strength but different frequency and omission of the number of units
- 2.2.10. Same strength and same frequency but omission of the number of units
- 2.2.11. Same strength and same number of units but different frequency and different total daily dose
- 2.2.12. Same strength but different frequency and different number of units and different total daily dose
- 2.2.13. Same strength but different frequency and different number of units but same total daily dose
- 2.2.14. Same strength and same frequency but different number of units and different total daily dose
- 2.3. Discrepancy in the dosage form/route of administration
 - 2.3.1. Unclear or wrong dosage form
 - 2.3.2. Unclear or wrong route of administration
 - 2.3.3. Omission of dosage form
 - 2.3.4. Omission of route of administration
 - 2.3.5. Different dosage form but same route of administration
 - 2.3.6. Different dosage form and different route of administration
 - 2.3.7. Same dosage form but different route of administration
- 2.4. Discrepancy in the time of drug administration
 - 2.4.1. Omission of the time of administration
 - 2.4.2. Different time of administration through the day
 - 2.4.3. Discrepancy in the drug administration with respect to food/meal
- 2.5. Discrepancy in the duration or length of therapy
- 2.6. Other

During the interview with the patient and/or his/her companion, demographic data were investigated, and data regarding hospitalization (date of admission, comorbidities, diagnosis resulting from admission, medical specialty, date of departure, and mode of departure) were collected from the patient's medical records.

2.6 Pharmaceutical Interventions

In cases where unintentional discrepancies occurred, interventions were proposed to the prescriber. The pharmaceutical interventions were discussed verbally with the prescribing physicians (residents or tutors), and when the physicians were not present physically, they were contacted by telephone. Both interventions and outcomes (acceptance or nonacceptance) were classified according to the Pharmaceutical Care Network Europe (PCNE) 2019.

PLANNING OF INTERVENTIONS

1. At the prescribing level
 - Prescribed only
 - Prescriber asked for information
 - Proposed intervention to prescriber
 - Intervention discussed with prescriber
2. At the patient level

- Drug-related advice
 - Information provided in writing (only)
 - Patient referred to prescriber
 - Dialogue with family member / caregiver / caregiver
3. At the drug level
- Medicine changed to
 - Posology changed to....
 - Formulation changed to... ..
 - Instructions for use changed to... ..
 - Medication discontinued
 - New medicine started
4. Other intervention or activity
- Other intervention (please specify)
 - Side effect reported to authorities

ACCEPTANCE OF THE PROPOSED INTERVENTIONS

1. Intervention accepted (by doctor or patient)
- Intervention accepted and fully implemented
 - Intervention accepted, partially implemented
 - Intervention accepted but not implemented
 - Intervention accepted, implementation unknown
2. Intervention not accepted (by doctor or patient)
- Intervention not accepted: not feasible
 - Intervention not accepted: no agreement
 - Intervention not accepted: other reason (please specify)
 - Intervention not accepted: unknown reason
3. Other (no acceptance information)
- Proposed intervention, acceptance unknown
 - Intervention not proposed

A discrepancy could generate more than one intervention, according to the classification proposed by the PCNE.

Confirmation of the acceptance or nonacceptance of the proposed intervention(s) was verified in the prescription after the interventions. The justifications received at the time of the intervention(s) were immediately recorded without the need for further confirmation.

2.7 Data Analysis

The comparison between medical specialties in relation to the number of drugs used before and during hospitalization, and the amount of drugs kept during hospitalization was performed using the one-way ANOVA test, followed by the Tukey post-test.

To assess the association between the medical specialty and the occurrence of unintentional discrepancy, chi-square test was used, with Bonferroni correction when necessary. The same test was used in the univariate assessment of the association between unintentional discrepancy and the variables gender, alcoholism and smoking. The comparison between patients with and without unintentional discrepancy regarding the variables age, education, number of comorbidities, consultation sources, amount of medication before hospitalization and quantity of medication at admission was performed using the t-student test.

Multivariate analysis between the occurrence of unintentional discrepancy and the variables gender, smoking, consultation sources and medication before hospitalization (considering only the variables with $p < 0.100$ in the univariate analysis) was performed using the bivariate logistic regression test using the "Enter" method.

All the analyses were conducted using the statistical program SPSS, version 24.0, based on a significance level of 5%.

3. Results

During the 12 months of the study, of the 350 patients admitted to the MCU ward, 304 were included in the study, and 46 did not participate. The number of males ($n = 143$; 47%) and females ($n = 161$; 53%) admitted to the study unit was very similar. Regarding age, 170 patients (55.9%) were 61 years of age or older, 44 (14.5%) of these were between 80 and 90 years of age, and 8 (2.6%) were over 90 years old. The average age of the participants was 61.6 ± 18.64 years.

Regarding education, participants reported having attended incomplete elementary school ($n = 103$; 33.9%). A total of 92 patients (30.2%) were ex-smokers. Table 1 presents the sociodemographic, clinical, and lifestyle characteristics of the research participants.

The most frequent comorbidities observed in medical records were systemic arterial hypertension ($n = 185$; 25.5%) and diabetes mellitus ($n = 117$; 16.1%). A total of 83 patients (27.0%) had at least two comorbidities, and the average number of comorbidities was 2.4 ± 1.41 . The most frequent admission diagnoses were related to the cardiac system ($n = 72$; 23.7%) and neurological disorders ($n = 49$; 16.1%).

The average length of stay in the MCU during the study period was 7.5 ± 8.21 days. Several sources were consulted for the completion of the BPMH. The interview with the patient was always checked first because it only happened after the patient consented to participate in the research. Following, or in parallel, the caregiver was consulted, and both were asked about the prescriptions brought from home and the packaging of the medicines in use. The medical records of all patients were accessed. The average number of sources consulted per patient was 2.9 ± 0.78 (Table 2).

A total of 1,684 drugs were identified for the preparation of the BPMH as being used before hospitalization, and self-medicated drugs and herbal medicines were also considered. The average number of medications taken by patients before hospitalization was 5.5 ± 3.55 , and upon hospital admission, the average number of medication per patient was 12.1 ± 3.85 , with a total of 3,704 prescription drugs.

Of the 1,684 medications used before admission, 724 were maintained on hospital prescription, an average of 2.4 ± 3.37 medications per patient (or 43% of the total medications used at home). Among the self-medicated drugs ($n = 40$; 2.4%), 35.0% were vitamins and minerals ($n = 14$), 25.0% were herbal medicines ($n = 10$), 22.5% were analgesics and/or myorelaxants ($n = 9$), 7.5% were antifungal ointments or antibiotic-containing ointments ($n = 3$), and 7.5% were omega 3 ($n = 3$).

From June 2018 to May 2019, 1,134 discrepancies were found between home-based drugs and those prescribed upon admission to the MCU, which gives an average of 3.7 ± 3.65 discrepancies per patient. Among the discrepancies, 815 (72%) were intentional, 89 (8%) were undocumented intentional, and 230 (20%) were unintentional, and they were therefore classified as medication errors. The performance indicators of the medication reconciliation process and the classification of medication errors are presented in Table 2.

Of the 230 unintentional discrepancies, 31% occurred in patients admitted by the general practitioner, 18% by nephrology, and 13% by cardiology, with drug omission featuring in all specialties.

In addition to one case of thalidomide omission, other situations of omission included treatment for depression (fluoxetine, duloxetine, amitriptyline, and alprazolam), glaucoma (travoprost, tenophthalm, and brimonidine), benign prostatic hyperplasia (doxazosin), chronic venous insufficiency (diosmin and hesperidin), and Alzheimer's disease (memantine, rivastine, and ketipine. All eye drops used by patients were omitted.

The medication reconciliation process seeks to improve patient safety in relation to the use of medicines, and this proved to be essential during the research. Medication errors by medical specialty are presented in Table 3.

Table 1. Characteristics of the patient population

	Medical specialty (n) %										
	Total	GC	Card	Neu	Nephr	Tire	Reu	Gast	End	Hemat	Others
Gender											
Female	(161) 53	(45) 28	(35) 22	(29) 18	(18) 11	(10) 6	(10) 6	(7) 5	(2) 1	(3) 2	(2) 1
Male	(143) 47	(31) 22	(38) 27	(19) 13	(13) 9	(10) 7	(10) 7	(3) 2	(5) 3	(7) 5	(7) 5
Age (years)											
61 or more	(170) 56	(50) 29	(46) 27	(30) 18	(19) 11	(12) 7	(3) 2	(3) 2	-	(3) 2	(4) 2
46–60	(76) 25	(16) 21	(23) 30	(11) 14	(9) 12	(3) 4	(5) 7	(6) 8	-	(3) 4	-
31–45	(31) 10	(5) 16	(4) 13	(5) 16	(3) 10	(2) 6	(6) 19	-	-	(3) 10	(3) 10
18–30	(27) 9	(5) 19	-	(2) 7	-	(3) 11	(6) 22	(1) 4	(7) 26	(1) 4	(2) 7
Schooling											
Illiterate	(46) 15	(19) 41	(8) 17	(9) 20	(3) 7	(5) 11	-	-	-	(1) 2	(1) 2
Incomplete elementary school	(103) 34	(30) 29	(28) 27	(13) 12	(14) 14	(7) 7	(7) 7	(1) 1	-	(1) 1	(2) 2
Complete elementary school	(73) 24	(13) 18	(26) 35	(15) 20	(4) 5	(4) 5	(2) 3	(5) 7	(1) 1	(1) 1	(2) 3
High school	(68) 22	(12) 18	(9) 13	(8) 11	(10) 15	(4) 6	(6) 9	(4) 6	(5) 7	(6) 9	(4) 6
University education	(14) 5	(2) 14	(2) 14	(3) 21	-	-	(5) 36	-	(1) 7	(1) 7	-
Comorbidities											
None	(13) 4	(5) 39	(3) 23	(2) 15	-	-	-	-	-	-	(3) 23
One	(81) 26	(16) 20	(11) 13	(16) 20	(6) 7	(8) 10	(8) 10	(2) 3	(6) 7	(5) 6	(3) 4
Two	(83) 27	(20) 24	(28) 34	(13) 16	(9) 11	(4) 5	(2) 2	(3) 4	-	(2) 2	(2) 2
Three	(63) 21	(17) 27	(17) 27	(9) 14	(3) 5	(5) 8	(5) 8	(4) 5	(1) 2	(1) 2	(1) 2
Four	(40) 13	(11) 28	(6) 15	(6) 15	(8) 20	(3) 7	(3) 7	(2) 5	-	(1) 3	-
Five	(17) 6	(6) 35	(7) 41	(1) 6	(1) 6	-	(1) 6	-	-	(1) 6	-
More than five	(7) 2	(1) 14	(1) 14	(1) 14	(2) 29	-	(2) 29	-	-	-	-

Lifestyle

Tobacco user	(33) 11	(5) 15	(7) 21	(8) 25	(2) 6	(5) 15	-	(2) 6	(1) 3	(1) 3	(2) 6
Tobacco use history	(92) 30	(15) 16	(24) 27	(18) 20	(12) 13	(12) 13	(2) 2	(5) 5	-	-	(4) 4
Alcohol use	(21) 7	(6) 29	(5) 24	(4) 19	(1) 5	(3) 14	(2) 9	-	-	-	-
History of alcohol use	(33) 11	(4) 12	(6) 18	(7) 21	(4) 12	(6) 18	(1) 3	(4) 12	-	-	(1) 3

GC = General Practice, Card = Cardiology, Neu = Neurology, Nephr = Nephrology, Tire = Pulmonology, Reu = Rheumatology, Gast = Gastroenterology, End = Endocrinology, Hemat = Hematology.

Table 2. Performance indicators of the medication reconciliation process

		Medical specialty (n) %										
		Total	GC	Card	Neu	Nephr	Tire	Reu	Gast	End	Hemat	Others
Admitted patients		(304) 100	(76) 25	(73) 24	(48) 16	(31) 10	(20) 7	(20) 7	(10) 3	(7) 2	(10) 3	(9) 3
Medicines used before admission		(1684)	(360) 21	(462) 27	(241) 14	(219) 13	(105) 6	(156) 9	(47) 3	(13) 1	(32) 2	(13) 2
Medicines prescribed on admission		(3704)	(926) 25	(1001) 27	(516) 14	(386) 10	(274) 7	(238) 6	(118) 3	(61) 2	(103) 3	(38) 1
Medicines maintained during admission		(724)	(133) 18	(215) 30	(86) 12	(98) 13	(38) 5	(82) 11	(25) 3	(9) 1	(26) 4	(12) 2
Medication discrepancies	ID	(815) 72	(179) 22	(218) 27	(126) 16	(89) 11	(55) 7	(68) 8	(29) 3	(8) 1	(20) 2	(23) 3
	UND	(89) 8	(24) 27	(38) 43	(10) 11	(8) 9	(6) 7	(0)	(3) 3	(0)	(0)	(0)
	UN	(230) 20	(72) 31	(29) 13	(28) 12	(42) 18	(18) 8	(28) 12	(4) 1	(4) 2	(2) 1	(3) 2
Pharmaceutical interventions	Done	(188)	(57) 30	(25) 13	(19) 10	(41) 22	(13) 7	(23) 12	(3) 1,6	(4) 2	(0)	(3) 1,6
	Accepted	(92)	(34) 37	(8) 8,7	(14) 15	(9) 5	(9) 5	(13) 14	(1) 1	(4) 4	(0)	(0)
	Justified	(56)	(15) 27	(7) 12,5	(5) 2,6	(18) 9,6	(0)	(8) 4	(0)	(0)	(0)	(3) 5
Patient's medication sources consulted	Medical records	(304) 100	(76) 25	(73) 24	(48) 16	(31) 10	(20) 7	(20) 7	(10) 3	(7) 2	(10) 3	(9) 3
	Patient interview	(223) 73	(40) 18	(61) 26	(30) 13	(27) 12	(17) 8	(20) 9	(8) 4	(6) 3	(6) 3	(8) 4
	Medicine packaging	(91) 30	(27) 30	(23) 25	(10) 11	(8) 9	(4) 4	(11) 12	(3) 14	(0)	(4) 4	(1) 1
	Caregiver Interview	(194) 64	(60) 31	(44) 23	(40) 21	(19) 10	(9) 5	(8) 4	(2) 1	(3) 1	(4) 2	(5) 3
	Prescription	(70) 23	(13) 19	(21) 30	(12) 17	(6) 9	(4) 6	(5) 7	(3) 4	(1) 1	(2) 3	(3) 4

I = Intentional, UND = Undocumented Intentional, UN = Unintentional.

Table 3. Unintentional discrepancies identified by drug reconciliation according to the Medical Specialty

	Unintentional discrepancies by medical specialty (n) %										
	Total	GC	Card	Neu	Nephr	Tire	Reu	Gast	End	Hemat	Others
	(230) 100	(72) 31	(29) 13	(28) 12	(42) 18	(18) 8	(28) 12	(4) 1	(4) 2	(2) 1	(3) 2
1 Incompatible drugs											
1.1 Drug omission	(196) 85	(70) 36	(21) 11	(23) 12	(31) 16	(16) 8	(22) 11	(4) 2	(4) 2	(2) 1	(3) 2
1.4 Therapeutic Class Substitution	(1) 0,5	-	(1) 100		-	-	-	-	-	-	-
2 Drug partially matched											
2.2.3 Different strength and different total daily dose	(12) 5	(1) 8	(2) 17	(1) 8	(4) 33	(2) 17	(2) 17	-	-	-	-
2.2.4 Different strength but same total daily dose	(6) 3	-	(1) 17	(1) 17	(3) 49	-	(1) 17	-	-	-	-
2.2.7 Same strength but unclear/or wrong frequency	(2) 1	-	-	(1) 50	(1) 50	-	-	-	-	-	-
2.3.1 Unclear or wrong dosage form	(5) 2	(1) 20	(2) 40	-	-	-	(2) 40	-	-	-	-
2.3.2 Unclear or wrong route of administration	(3) 1	-	(1) 33	(1) 33	(1) 33	-	-	-	-	-	-
2.3.5 Different dosage form but same route of administration	(4) 2	-	(1) 25	(1) 25	(2) 50	-	-	-	-	-	-
2.3.6 Different dosage form and different route of administration	(1) 0,5	-	-	-	-	-	(1) 100	-	-	-	-

When analyzing the discrepancies between home-based drugs and those prescribed upon admission to the MCU, self-medicated drugs was not considered. The drugs most frequently listed in the unintentional discrepancies category were related to the cardiovascular system (28%), digestive system and metabolism (26%), and the nervous system (17%).

Drugs with five or more unintentional discrepancies in hospital prescriptions were related to the cardiovascular system (n = 10; 32%), vitamins and minerals (n = 9; 30%), hypoglycemic agents including insulin (n = 6.19%), eye drops (n = 4; 13%), and central nervous system (n = 2; 6%).

The risk factors, such as age, gender, educational level, alcoholism, smoking, number of comorbidities, consultation sources, number of medicines in use at home and number of medicines on admission were evaluated to determine their correlation with the occurrence of unintentional discrepancies. There was no statistically significant correlation in the following variables: age, gender, level of education, alcoholism, smoking, number of comorbidities, and number of medicines on admission (p value ranging from 0.052 to 0.903) when correlated with the number of unintentional discrepancies. Only the number of consultation sources and the number of medicines in use at home showed significant correlation with the occurrence of unintentional discrepancies ($p \leq 0.001$).

For multivariate analysis, variables with p value < 0.100 in the univariate analysis were considered. The number of consultation sources and the amount of medicines on admission remained significantly related to the unintentional discrepancy (p = 0.039 and p = 0.008, respectively).

A total of 318 pharmaceutical interventions were performed, 230 related to unintended discrepancies. Of these, 138 (60%) interventions were not accepted.

During the study, certain barriers hindered the medication reconciliation process. The barriers included patients being unable to remember or pronounce correctly the names or dosage of medications and the caregiver's lack of knowledge about the patient's drug treatment. Regarding the prescribers, the barriers observed were the lack of autonomy to consider and disregard the proposed pharmaceutical interventions and the difficulty in finding the prescribers in the ward to perform the intervention.

Other research was being conducted concurrently at the MCU, and this proved to be a barrier to the medication reconciliation process, because sometimes, the patient included in the study exhibited stress and/or discomfort.

The healthcare professional performing the medication reconciliation process is required to have considerable time to access all available sources of information. At the MCU, the health professionals appeared to have not been able to continue the medication reconciliation process at the end of data collection by the researcher.

Throughout the research period, collaboration among the multidisciplinary team, especially the nurses, nursing technicians, physiotherapists, and occupational therapists, contributed positively to the research development. There was also an interest and appreciation of the study by patients and caregivers. Both of these factors made the medication reconciliation process easier.

4. Discussion

The homogeneous profile of the men and women observed in this research is due to the fact that the MCU is a mixed environment, which has female and male rooms, where patient admission to the sector occurs according to the availability of beds.

The average age of the patients was 61.6 years. Studies reveal that between 2000 and 2050, the proportion of people aged 60 and above will increase from 11% to 22% of the total population. The average life expectancy for women in Latin America and the Caribbean is expected to reach 74.7 years for men and 80.7 for women by 2030. This increase in life expectancy and the consequent increase in the proportion of economically dependent people pose a challenge to the healthcare system, which must meet the needs of the aging population (United Nations, 2019; Organização Pan-Americana da Saúde, 2015; World Health Organization, 2016).

Regarding education, the results reflect the reality of the Brazilian population seeking public health services. In Brazil, illiteracy is concentrated in the older population, despite attempts to improve this over time. In 2001, illiterate people aged 50 and above accounted for 27.5% of the Brazilian population, and this decreased to 18.3% in 2012 (Brasil, 2016).

Regarding lifestyle, 30% (n = 92) of the patients said they were former smokers. This result is above the national average (10.1%), as identified in the last National Health Survey (PNS) conducted by the Ministry of Health in 2017. Cardiovascular diseases are the leading cause of death worldwide, accounting for 44% of all deaths due to chronic noncommunicable diseases. Tobacco use is the leading cause of cardiovascular disease, including heart attacks and strokes. Approximately 11% of deaths due to cardiovascular disease in the Americas are associated

with tobacco use (Brasil, 2018).

Data published by the Ministry of Health (2018) reveals that in 2017, 19.1% of adults living in the 26 Brazilian state capitals and the Federal District reported abusive alcohol consumption (four or more units for women and five or more units for men – on a single occasion), and the Midwest region of Brazil had the highest rate (16.2%) of consumers (WHO, 2018).

Due to the number of comorbidities noted (mean 2.4 ± 1.41), there is a greater need for attention to these patients by health professionals. During the medication reconciliation process, polymedicated patients most often did not immediately remember the names of all the medications they were using or were unaware that non-pharmacological treatments, such as teas and dietary supplements, are relevant in pharmacotherapy.

In 65% ($n = 193$) of the medication reconciliation cases, three to four sources of information were used, of which five were established (interview with the patient, interview with the caregiver, packaging of medicines brought from home, prescriptions, and medical records). The elaboration of the BPMH in use before hospital admission ensured greater reliability and credibility of the findings and greater patient safety (The Joint Commission, 2006). Durán-García, Fernández-Llamazares & Calleja-Hernández (2012) state that the accuracy of the medication history used before hospitalization correlates with the number of available sources consulted.

Among the drugs used before hospital admission, only 2.4% ($n = 40$) were by self-medicated, despite the tendency of the Brazilian population to self-medicate (Galato, Madalena & Pereira, 2012; Naves, Castro, Carvalho & Merchán-Hamann, 2010). According to Arrais et al. (2016) the prevalence of self-medication in Brazil in 2016 was 16.1% (95% CI 15.0–17.5), mainly by women; inhabitants of the North, Northeast, and Midwest; and individuals who have had one, two, or more chronic diseases.

The average household medication collected by the BPMH was $5.5 (\pm 3.55 \text{ SD})$ medications per patient. Mongaret et al. (2018) conducted a study of patients using more than five home-based drugs and identified this as a predictive factor for discrepancies in hospital admission, as a result of the univariate regression analysis (OR 4.67; 95% CI 2.01–10.83; $p < 0.001$). Corroborating the previous study, De Antônio et al. (2019) also found that patients using five or more medications at home had discrepancies in 67.1% of cases, and the discrepancy rate was 33% for those using below five medicines.

The main classes of medicines used at home were those for the cardiovascular system ($n = 665$; 40%), digestive system and metabolism ($n = 547$; 32.5%), and nervous system ($n = 220$; 13%). During the medication reconciliation process in a Swiss hospital, Giannini et al. (2019) found that the drugs of these similar classes were the ones most involved in unintentional discrepancies ($n = 32$, 28.8% cardiovascular system; $n = 25$, 22.0% nervous system; and $n = 15$, 13.5% digestive tract and metabolism).

Drug standardization in hospitals is a common and recommended practice, as is the development of clinical therapeutic protocols. These, in addition to improving patient safety and saving the institution, also facilitate the preparation of prescriptions, proposing automatic therapeutic substitutions depending on the software used for electronic prescriptions (Wang et al., 2017).

However, such therapeutic substitution may, in some cases, lead to confusion when unmonitored and may increase the likelihood of unintentional discrepancies (Glaholt, Hayes & Wisniewski, 2014).

It was observed during the interview that some patients had been followed up for years in primary care without adequate monitoring of the evolution of their underlying diseases. Despite this follow-up, there was complication of the underlying disease, resulting in hospitalization and the use of new, more potent, more selective drugs to stabilize it.

In this study, 1,134 discrepancies between the home-based drugs and those prescribed at hospital admission were observed. Of these, 20% ($n = 230$) were unintentional, corroborating the unintentional discrepancy rate found in the study by Andreoli et al. (2014), (18.8%), the rate observed by Magalhães et al. (2014) in the cardiology unit of a teaching hospital in Bahia (17.7%), and the rate observed by Lindenmeyer et al. (2013) in an oncology unit in Paraná (17.7%).

However, other medication reconciliation studies conducted around the world have shown different results from unintentional discrepancies, highlighting the importance of this process in care transitions, regardless of the country or location to which it applies. Mazhar et al. (2017) performed the medication reconciliation process with elderly patients at the MCU at a university hospital in Saudi Arabia and found unintentional discrepancies at a rate of 37%. Tamiru, Edessa, Sisay, & Mengistu (2018) performed the medication reconciliation process on the internal transition from a university hospital in Ethiopia and identified a rate of 33.3%.

Unintentional discrepancies are considered medication errors and may affect the prescription, dispensing, consumption, and monitoring of medications, resulting in serious harm, disability, and even death (WHO, 2017). Also, of the total discrepancies between the drugs, 8% (n = 89/1134) were classified as undocumented intentional. Such discrepancies are not considered medication errors but have to the potential to be.

The three main classes of drugs involved in unintentional discrepancies are the same classes as those most commonly used at home, drugs for the cardiovascular system (65/230, 28.%), digestive system and metabolism (60/230, 26%), and nervous system (39/230, 17%), according to ATC level I classification. Similar results were observed by Giannini et al. (2019) (n = 32, 28.8% cardiovascular system; n = 25, 22% nervous system; and n = 15, 13.5% digestive system and metabolism) and Chung et al. (2019) (17/77, 22.1% nervous system; 15 / 77, 19.5% cardiovascular system; and 14/77, 18.2% digestive tract and metabolism). Therefore, reconciling the drugs belonging to these classes can contribute to the safety of the patients who use them.

In this study, the omission was the predominant unintentional discrepancy (196/230, 85%) in all MCU specialties, as well as in surveys conducted in Saudi Arabia (77%) (Abdulghani, Aseeri, Mahmoud, & Abulezz, 2018), Ireland (76.6%) (Holland, 2015), and Spain (65%) (Rodríguez Vargas, Delgado Silveira, Iglesias Peinado, & Bermejo Vicedo, 2016), demonstrating the importance of reconciling drugs and preventing treatment interruption (Mekonnen et al., 2016).

In institutions where the demand for pharmacists is scarce, it is recommended to direct the pharmaceutical reconciliation services to the specialties or hospital sectors with the largest number of unintentional discrepancies (Tamiru et al, 2018; Bilbao Gómez-Martino, Nieto Sánchez, Fernández Pérez, Borrego Hernando, & Martín-Sánchez, 2017; Patel, Pevnick & Kennelty, 2019).

The medication reconciliation process seeks to improve patient effectiveness and safety with regard to drug use, and this process proved essential during the research by identifying a case in which thalidomide was omitted in leprosy treatment, which could expose not only the patient himself/herself to the disease but also the other people he/she may have contact with. In addition, continuity of treatment is essential for its effectiveness in patients with depression, glaucoma, hyperplasia, chronic venous insufficiency, and Alzheimer's disease. In general, omitting a treatment may prolong hospital stays, thus increasing the cost of hospitalization, and reduce the turnover and availability of beds.

The pharmaceutical interventions performed in this study involved patients, caregivers, and prescribers, who contribute greatly to patient safety. Patients and caregivers received counseling on the use of self-medication, and those using eye drops were instructed on the correct application. Other counseling was given according to the needs expressed by the patients and caregivers during the interviews, emphasizing the importance of the clinical pharmacist in all hospital sectors.

All unintentional discrepancies found (n = 230, 85%) resulted in an intervention by the prescriber. A total of 318 interventions were performed in this study, most of them referring to incompatible drugs. The percentage of acceptance of interventions by prescribers was 71% (n = 226/318).

Medicines considered unnecessary included mainly vitamins, contraceptives, thyroid hormones, minerals, and omega 3. As in the study by Rodrigues et al (2019) vitamins were among the drugs most involved in pharmaceutical interventions, with vitamin B12 being the most commonly used drug associated with the "omitted drug reintroduction" intervention. Vitamin B12 deficiency, however, can trigger neuronal damage and neurological disorders, such as dementia and neuropathic pain (Moore et al., 2012).

Medication reconciliation is a process that depends on the collaboration of health professionals, patients, and caregivers to be well executed and to achieve good results (Karaoui et al., 2019). During this research, a noted barrier was the low educational level of patients, which implies a reduced knowledge about the names of prescribed drugs, indications for use, and general instructions, as identified in the study by Spalla & Castilho, 2016.

Pronouncing drug names correctly is not easy for anyone. Even health professionals sometimes stumble over words, which are long and similar to other medications. For polypharmacy patients, this difficulty becomes even greater, therefore requiring more time for the health professional to build the BPMH and to perform the medication reconciliation process.

An important factor for medication reconciliation, described by Cornish et al (2005), was the accuracy of the medication history at the time of interview with patients and family members. Accuracy is often compromised by factors, such as time available for the interview, language barriers, severity of the patient's disease, cognitive status, and familiarity of the patient and caregiver with their medication regimen.

The risk factors for the occurrence of unintentional discrepancies identified in this study were the number of consultation sources and the amount of medicines on admission, which were similar to the results obtained by Rodríguez Vargas et al. (2016). Cornish et al. (2005) found no correlation between the number of medications used before hospitalization and the occurrence of discrepancies.

Other variables did not present statistically significant results when correlated with unintentional discrepancies. Two studies conducted in 2012 indicated age as a risk factor for drug errors, differing from the results presented in this study (Hellström, Bondesson, Höglund & Eriksson, 2012; Salanitro et al., 2012).

A study by Afonso (2015) in Portugal revealed that all hospitals that have implemented the medication reconciliation methodology, or even those that are still in pilot studies, face several barriers, which include the lack of the availability of a multidisciplinary team, the lack of an information system that enables the recording of all interventions performed, and the difficulties in integrating them efficiently. In this study, however, the multidisciplinary team contributed positively to the development of the medication reconciliation process and could be considered as a facilitator rather than a barrier.

5 Conclusions

This study reflects the observations from one hospital in Brazil where it was verified the high frequency of drug omission upon admission to the MCU and the need for greater pharmacotherapeutic follow-up of polymedicated patients. The medication reconciliation process proved to be effective in identifying medication errors, providing greater safety in drug treatment for all patients who were followed up.

Funding

This work was supported in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – Finance Code 001 and Universidade Federal de Mato Grosso do Sul (UFMS).

Competing Interests Statement

The authors declare that there are no competing or potential conflicts of interest.

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