The Review Of
DIABETIC
STUDIES OPEN ACCESS

Medication Reconciliation In Intensive Care Units Of A Tertiary Hospital In Madina, Saudi Arabia: An Evaluation Of Medication Discrepancies

Emad A. Alharbi[1], Abdulaziz J. Alshehri[1*], Basim Alhejaili[1], Abdulraouf F. Alrehili [1], Hamed M. Alorfi, Sara E. Ibrahim[2] , Mohammed Hashim Albashir[3], Mona Thamer Alharbi [4] , Layan Alhusini [4] , Mawaddah Aljohani [4]

[1]Department of Pharmacy Services, King Salman bin Abdulaziz Medical City, (KSAMC), Madinah-42319, Saudi Arabia.
[2]Clinical Pharmacy Department, Al-Rayan National College of Health Sciences and Nursing, Madinah 42541, Saudi Arabia
[3]General Sciences Department, Al-Rayan National College of Health Sciences and Nursing, Madinah 42541, Saudi Arabia
[4]PharmD Graduate, College of Pharmacy, Taibah University, Madinah 42353, Saudi Arabia
[*]Corresponding author: Ash7Ri@gmail.com (Abdulaziz J. Alshehri)

Abstract:

Background: Medication reconciliation is an important patient safety practice in the intensive care unit (ICU), where transfer of care increases the likelihood of discrepancies. International evidence highlights the clinical importance of addressing these differences to avoid preventable adverse events (ADE). This study enriches global literature by stating from a tertiary care hospital in Madina, Saudi Arabia and is part of the continuous quality improvement program in collaboration with Vision 2030 goals. To assess the prevalence, patterns and factors associated with medication discrepancies among ICU admitted patients in a tertiary hospital in Madina. **Methods and Materials:** A retrospective observational cohort study was performed with 134 adult ICU survivors discharged in the year 2024/2025. Discrepancies between pre-admission medications and prescriptions at ICU discharge were categorized into six types: medication omitted, duplicated, prescribed at the wrong dose, prescribed through an inappropriate route of administration, continued for the wrong duration or no longer indicated. The main outcome was description of discrepancies; second analyses of factors risking. Statistical analyses were conducted using descriptive frequencies, chi-square/Fisher's exact tests, and multivariable logistic regression analysis and significance was taken as $p<0.05$.**Results:**Seventy (52.2%) patients were found to have at least one medication discrepancy. Among the types, omission of drugs and changes in dosage were the most frequently observed. Polypharmacy (or ≥5) emerged as a strong correlate of discrepancies in univariate analysis (all commercials had $p<0.001$), and was the only independent predictor identified on multivariable modeling (OR ≈ 5.8; 95% CI = [1.8, 18.9]; $p=0.0037$). Other comorbidities, such as cardiovascular disease and pulmonary disease were associated in univariate analyses but lacked independence. **Conclusion:** Medication discrepancies were commonly observed in discharges from the ICU with polypharmacy as the most important independent predictor. These occur emphasize the need for formal reconciliation process, especially in patients with polypharmacy to improve patient safety and care continuity that meet international standards as prescribed by Vision 2030.

Key-words: ADE, ICU, Patient safety, Intervention, Polypharmacy and Medication errors.

Introduction

Medication reconciliation is an essential patient safety intervention intended to optimize medication management across transitions of care. It consists of a standardized approach to reviewing both the pre-admission medications and the list of discharge or transfer prescriptions, to identify and resolve unintentional differences [1]. These inconsistencies which include drug omissions, duplications,

inappropriate doses and routes as well as unjustified continuations represent one of the most common sources of preventable adverse drug events (ADEs) [2,3]. Medication errors are a well-documented problem. Cornish et al. reported that 54% of patients had at least one error on admission to the hospital [4]. Also, Tam et al. reported that dosing errors were the most common type of medication discrepancies that cause significant medication error [5]. Mueller and coauthors highlighted poor consistency in hospital-based reconciliation in their systematic review, with varying degrees of standardized adoption [6]. These problems are even more difficult in the ICU due to patient complexity, polypharmacy, and rapidly changing treatment plans [7].

ICU-specific evidence supports this concern. Wong et al. found that medication discrepancies at transitions of care of critical care patients, up to 60% developed one or more discrepancies (most commonly drug omissions) [8]. Gleason et al., in their review of the MATCH study, also found that transitions represent particularly dangerous points of reconciliation failure [9]. Indeed, systematic reviews have shown not only that medication differences are common, but also, they carry potentially significant clinical consequences [10]. The accuracy of reconciliation can be improved by pharmacist-led interventions. Pharmacist-led reconciliation programs are significantly associated with reduction in errors and potential ADEs in a meta-analysis from Mekonnen et. al., [11]. Kwan et al. also found better results with standardized reconciliation programs [12]. More recently, Hiasat et al. in Jordan, found that pharmacist-driven reconciliation interventions led to a significant reduction of discrepancies at hospital admission [13].

There's research in Saudi Arabia on reconciliation and medication safety that is growing. Al-Jazairi et al. found that 45% of ICU patients had discrepancies at discharge, and that polypharmacy was a significant risk factor [14]. Balkhi et al. reported a high prevalence of polypharmacy among Saudi adults and its relation to chronic diseases [15]. Alqurain et al. found high levels of hyper-polypharmacy in outpatient clinics, emphasizing its importance [16]. Alharbi and colleagues in Qassim reported incorrect prescription trends among elderly patients with multiple comorbidities [17]. These results underline polypharmacy as a common issue in Saudi practice, which intersects with risk of reconciliation.

Polypharmacy is already well-recognized as a global determinant of reconciliation errors. Doumat et al. showed evidence of a strong correlation between polypharmacy, healthcare use and hospital admission in elderly [18]. A Brazilian scoping review found that reconciliation in emergency and acute care settings faces barriers for implementation, also among complex medication users [19]. The World Health Organization (WHO) has more recently emphasized conciliation as a strategy improving patient safety in on its Global Patient Safety Action Plan 2021-2030 [20]. Although evidence from international data is strong, there is still limited evidence at the tertiary hospital level ICUs in Saudi Arabia. This paper provides a current overall assessment of the prevalence, types and predictors of medication discrepancies amongst patients admitted to intensive care units (ICUs) in Saudi Arabia, contributing to enable ongoing quality improvement informed by international best practice and consistent with Vision 2030.

Methods and material

Study Design and Setting

Methods This work was planned as a retrospective observational cohort study that took place in the intensive care units (ICUs) of a tertiary hospital, located in Madina, Saudi Arabia. The observation period was set from January 1st 2024 to Abril 30st 2025 and included all adult patients discharged from the ICU during these four months. The protocol of this study was approved by the local institutional review board of our hospital, and it complied with the Declaration of Helsinki.

Study Population

Patients >/=18 years old and admitted to and discharged from the ICU during the study period were eligible for inclusion. Exclusion criteria included patients (1) with incomplete medication history, (2) who died in the ICU and were not discharged from the hospital, or (3) transferred to other institutes before full

documentation was completed at discharge. After the use of these criteria, 134 patients were analyzed in total.

Data Collection

Drug data were taken from the electronic health care record (HER) of the patient. For every patient, the pre-admission drug prescription (as taken from admissions history) was compared with prescriptions at discharge from ICU. Demographics (age; sex), admission features, number of medications and comorbidities (endocrine disease, cardiovascular disease, pulmonary disease, gastrointestinal disease, neurological disorders, infectious diseases and shock) were collected. Polypharmacy was defined as the simultaneous use of five or more drugs.

Medication errors were defined as unanticipated differences between the medications patients took prior to admission and the drugs prescribed at ICU discharge. Differences were classified into six categories: (1) Omission (the failure to carry on a pre-admission medication without valid reason). (2) Replicating (prescribing two medications from the same class at the same time). (3) Incorrect dose. (4) Inappropriate route. (5) Inappropriate duration. (6) Prescription without clinical indication. Differences between groups were independently checked and the patient's clinical state, as well as its documentation, was serving as a control.

Outcomes

The primary Outcome was to describe medication discrepancies, their frequency and type. The secondary outcome was risk factors for the presence of discrepancies (polypharmacy and major comorbidities).

Statistical Analysis

Data were processed by SPSS 20.0 software (SPSS Inc., Chicago, IL, USA). Data analysis Descriptive statistics were used to summarize categorical variables as frequencies and percentages, and continuous variables as means ± standard deviation (SD), or medians with interquartile ranges (IQR) where appropriate. The associations of categorical variables to the presence of inaccuracies were examined with the χ^2 test, or Fisher' s exact test when appropriate. Variables that had a $p < 0.05$ in univariate analyses were included in the multivariable logistic regression model to find predictors independently associated with disagreements. Odds ratios (OR) with 95% confidence intervals (CI), two-sided p-value < 0.05 were considered as statistical significance.

Results

Study Population

A total of **134 ICU patients** were included. Of these, **70 patients (52.2%)** had at least one medication discrepancy at ICU discharge, while 64 patients (47.8%) had none. Baseline demographic and clinical characteristics are summarized in **Table 1**.

Table 1. Baseline characteristics of ICU patients (n = 134).

Characteristic	No discrepancy (n=65)	With discrepancy (n=69)
Age, mean ± SD (years)	32.2 ± 20.1	53.3 ± 23.4
Age, median (range)	23 (15–84)	58 (15–96)
Male sex, n (% of group)	7 (10.8%)	13 (18.8%)
Female sex, n (% of group)	46 (70.8%)	38 (55.1%)

Missing gender, n (%)	12 (18.4%)	18 (26.1%)
Number of medications, mean ± SD	3.03 ± 1.89	4.01 ± 1.96
Admission type (ER), n (% of group)	63 (96.9%)	66 (95.7%)

Types of Medication Discrepancies

A total of **110 discrepancies** were identified among the 70 affected patients. The most frequent type was drug omission (41.8%), followed by unnecessary medication without indication (30.9%). Less frequent types included therapeutic duplication (4.5%), inappropriate route (4.5%), and incorrect dose (0.9%). No inappropriate duration was observed (**Table 2**). A graphical representation of discrepancy distribution is shown in **Figure 1**.

Table 2. Distribution of medication discrepancy types (n = 110).

Type of discrepancy	Frequency	Percentage (%)
Drug omission	46	41.8
No indication for therapy	34	30.9
Therapeutic duplication	5	4.5
Inappropriate route	5	4.5
Incorrect dose	1	0.9
Inappropriate duration	0	0.0

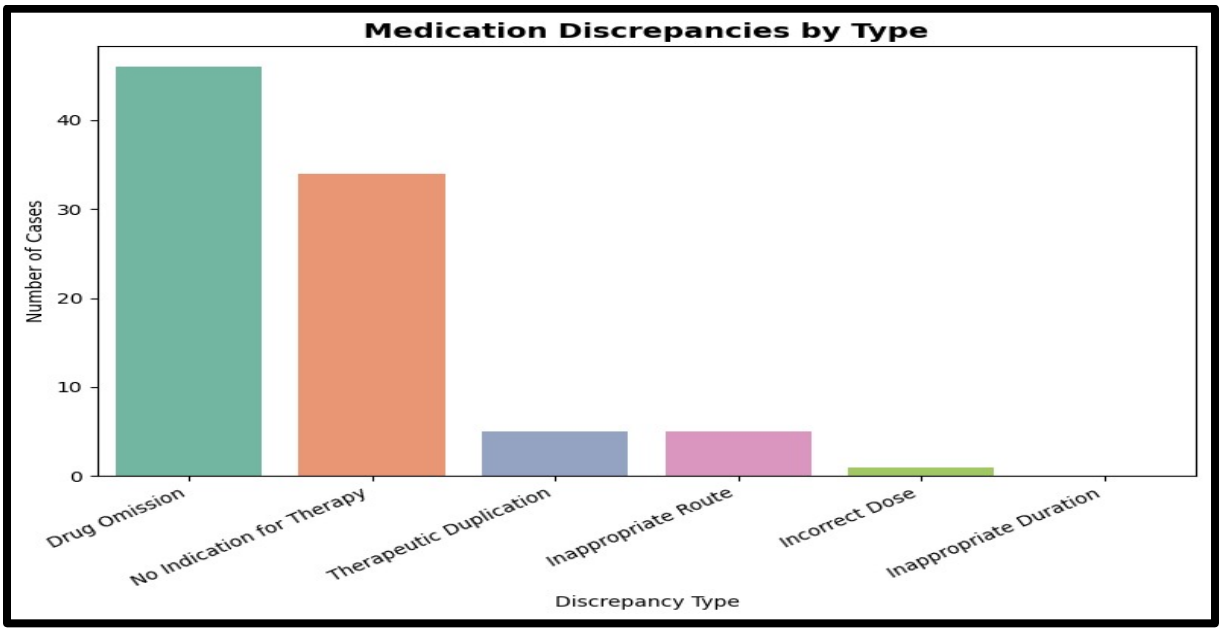

Figure 1. Distribution of discrepancy types among ICU patients (n=110).

Causes of Discrepancies

Documented causes of discrepancies are summarized in **Table 3**. Prescriber oversight accounted for the largest proportion (38.2%), followed by incomplete medication history (28.2%) and unclear documentation (21.8%). **Figure 2** shows the proportional distribution of discrepancy causes.

Table 3. Causes of medication discrepancies (n = 110).

Cause of discrepancy	Frequency	Percentage (%)
Prescriber oversight	42	38.2
Incomplete history	31	28.2
Unclear documentation	24	21.8
Communication gaps	8	7.3
Transcription errors	5	4.5

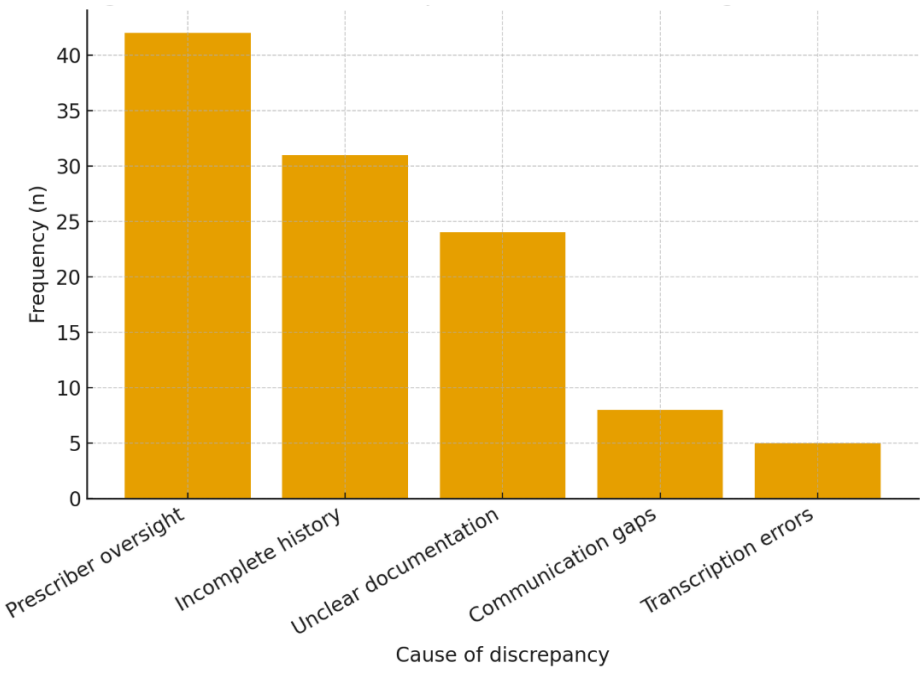

Figure 2. Causes of discrepancies in ICU discharge medications.

Information Sources and Discrepancy Rates

The source of medication history significantly influenced discrepancy rates (**Table 4**). Patients self-reporting their medications had fewer discrepancies (30.8%) compared with family-reported (77.8%) or EHR-based (57.6%). The association trend was significant in linear-by-linear analysis ($p = 0.038$). A bar chart is presented in **Figure 3**.

Table 4. Information source and discrepancy rates (n = 127).

Source of information	No discrepancy n (%)	With discrepancy n (%)	p-value
Patient (n=26)	18 (69.2)	8 (30.8)	-
Family (n=9)	2 (22.2)	7 (77.8)	-
EHR (n=92)	38 (41.3)	53 (57.6)	0.066

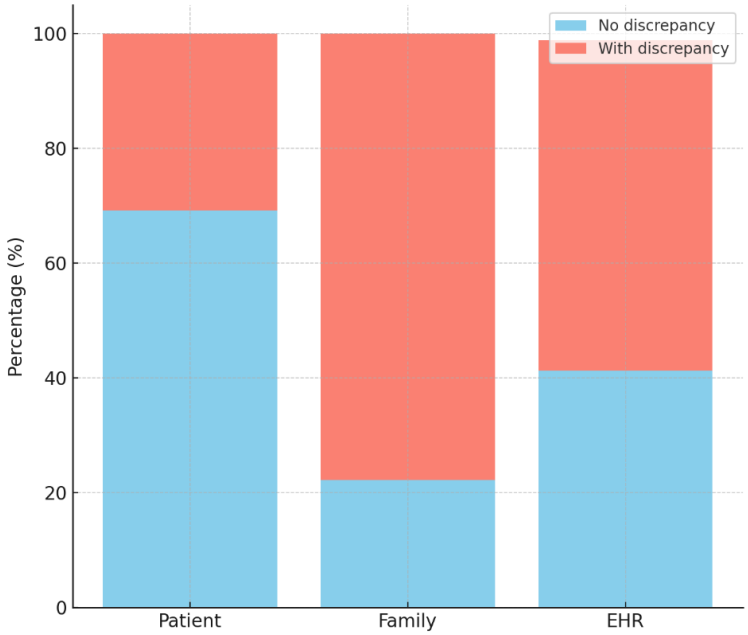

Figure 3. Discrepancy rates by source of medication history.

Comorbidities and Risk Factors

Among patients with discrepancies (n=70), the most frequent comorbidities were endocrine (68.6%) and cardiovascular (60%). Other comorbidities included gastrointestinal (25.7%), pulmonary (21.4%), neurological (17.1%), infectious (11.4%), and shock (8.6%) (**Table 5**).

Table 5. Comorbidities among patients with discrepancies (n = 70).

Comorbidity	n	%
Endocrine	48	68.6
Cardiovascular	42	60.0
Gastrointestinal	18	25.7
Pulmonology	15	21.4
Neurological	12	17.1
Infectious	8	11.4
Shock	6	8.6

Statistical Associations

Bivariate analysis showed strong associations between discrepancies and:

- **Polypharmacy (≥5 medications)** ($p < 0.001$).
- **Cardiovascular disease** ($p = 0.0009$).
- **Pulmonology disease** ($p = 0.037$).
- **Infectious disease** ($p = 0.015$).
- **Shock** ($p = 0.015$).

Endocrine, gastrointestinal, and neurological conditions were not statistically significant.

Multivariable Logistic Regression

After adjustment, only **polypharmacy** remained an independent predictor (OR 5.8, 95% CI: 1.8–18.9, $p = 0.0037$). Other comorbidities lost significance. Results are summarized in **Table6**.

Table 6. Logistic regression predictors of discrepancies.

Variable	β coefficient	OR (95% CI)	p-value
Polypharmacy	1.75	5.8 (1.8–18.9)	0.0037
Cardiovascular	0.25	1.28 (0.44–3.71)	0.645
Endocrine	-0.75	0.47 (0.18–1.27)	0.138
Pulmonology	0.94	2.57 (0.26–25.5)	0.419

Medications Most Frequently Involved in Discrepancies

Analysis of specific medications implicated in discrepancy events revealed that **omeprazole** was the most frequently involved drug, accounting for nearly one-fifth of all discrepancies (19.3%). Other commonly affected medications included aspirin (3.6%), atorvastatin (2.9%), Novorapid insulin (2.2%), and spironolactone (2.2%). These results are summarized in **Table7**.

Table 7. Most frequently implicated medications in discrepancy events.

Medication	Frequency	Percentage (%)
Omeprazole	27	19.3
Aspirin	5	3.6
Atorvastatin	4	2.9
Novorapid	3	2.2
Spironolactone	3	2.2

Discussion

This study provides substantial information on medication discrepancies upon discharge of patients from ICU in a tertiary hospital from Madina. A majority of patients (52.2%) had one or more discrepancies emphasizing the importance of this issue in critical care and as a topic in need of continual improvement. The most frequent types of discrepancies found were non-prescribed drugs (41.8%) and drugs prescribed without a clear indication (30.9%), in line with what has been described in international literature [4-8] (Table 2, Figure 1). Importantly, such results can be used to improve decision support for reconciliation procedures to enhance patient safety. Our findings support previous research globally and regionally. Cornish et al. identified discrepancies in 54% of patients admitted to hospital [4], while Wong et al. reported a discrepancy rate of 60% among ICU patients [8]. Locally, Al-Jazairi et al. noted a 45% dissonance rate in Saudi ICUs, with polypharmacy being an important contributory factor [14]. The correlation between our results and these studies confirms medication reconciliation is a global imperative, and our data contribute to local evidence in support of Saudi Arabia's larger quality and safety endeavors (Table 1).

Polypharmacy (≥5 medications) was the strongest independent discriminator of discrepancies, with nearly six times higher odds (OR 5.8, 95% CI: 1.8–18.9; p = 0.0037). This finding is in alignment with international findings that complex regimens require higher monitoring [15,18]. Cardiovascular, pulmonary, infection and shock were related to discordances between univariate analysis but no determining in multivariable analysis. This result highlights that the global drug load, and not individual diagnoses, is the determinant factor in discrepancies. Such understanding may help clinicians to prioritize attempts at reconciliation of patients receiving polytherapy (Table 2). It also became clear in the analysis of sources of information that quality was a fundamental dimension. The physician-documented medication history was least discrepant with directly solicited histories from patients (30.8%) than from family members (77.8%) or electronic medical records (57.6%). This does not signal deficits but instead the opportunity to further ensure that more accurately structured patient interviews, pharmacist-led and validated electronic medical record entry can contribute to improve accuracy of reconciliation (Table 4, Figure 3).

Strengths and Limitation

Strength:

This study represents strong evidence from the Saudi region of an ICU patients, with comprehensive categorization of types of discrepancies, their causes, and predictors. The findings do not indicate failings; rather, they provide a basis for quality improvement efforts. Determining Polypharmacy as a major predictor can provide us with an opportunity to establish specific protocols addressed to the high-risk patients. Furthermore, identifying reasons such as lack of documentation or history serve as actionable advice that can be used to improve the current processes.

Limitation:

- Single-center tertiary hospital in Madina with a retrospective design relying on existing records; small sample (n=134) limits generalizability and detection of uncommon predictors.
- Focused on detecting and classifying medication discrepancies without evaluating clinical significance or harm, limiting outcome-related inferences.

Conclusion

This study shows that medication discrepancies at discharge are common among ICU patients, and more than 50% have one or more discrepancies. Most of the differences were related to missed doses or drugs not added to treatment. However, 5 or more medications was the most powerful independent predictor with patients receiving 5 or more drugs being almost six times as likely to experience discrepancies and demonstrating a strong relationship between polypharmacy and errors in reconciliation. Whereas cardiovascular, pulmonary, infectious diseases and shock were found to have differences in univariate analyses, these are mitigated by adjustments and suggest that it is the total drug burden rather than individual

comorbidities driving discrepancies. Furthermore, the accuracy of medication reconciliation differed by source with patient-reported history having the least discrepancy when compared to family-report or EMR-based data. These results emphasize the importance of polypharmacy as a need-sensitive intervention area and call attention to the structured interviews with patients, pharmacists' reconciliations and more structured documentation methods. By adopting these strategies, patient safety in ICUs will be improved and healthcare quality as per Saudi Vision 2030 will move forward.

Acknowledgment

The authors express their gratitude to the medical professionals who evaluate patients for safety while working in the intensive care unit. The authors are grateful to the Cochrane Database, editors, publishers, DOAJ, PubMed, Medline, Google Scholar, Cochrane Library, CINAHL, Embase, and BMJ Clinical Evidence for providing the literature required to compile the study.

Author contributions

The first author wrote the original manuscript text. Before the manuscript is submitted to a journal for publication, each author must provide their final approval. Each co-author helped with the paper's editing, the literature review, and the creation of the table and figures.

Conflict of Interest

The authors declare no conflict of interest, financial or otherwise.

Ethical Approval

Not Applicable

Funding

There is no funding received for this article.

References

1. World Health Organization. Medication reconciliation: Technical report. Geneva: WHO; 2016.
2. Institute for Healthcare Improvement. Medication reconciliation review. IHI; 2015.
3. Bates DW, et al. The impact of adverse drug events on patient safety. JAMA. 1995;274(1):29–34.
4. Cornish PL, et al. Unintended medication discrepancies at the time of hospital admission. Arch Intern Med. 2005;165(4):424–429.
5. Tam VC, et al. Frequency, type, and clinical importance of medication history errors at hospital admission: a systematic review. CMAJ. 2005;173(5):510–515.
6. Mueller SK, et al. Hospital-based medication reconciliation practices: a systematic review. Arch Intern Med. 2012;172(14):1057–1069.
7. Pronovost PJ, et al. Medication reconciliation in the ICU: A patient safety imperative. Crit Care Med. 2003;31(5):1419–1426.
8. Wong JD, et al. Medication reconciliation at hospital discharge: evaluating discrepancies. Ann Pharmacother. 2018;52(10):986–993.
9. Gleason KM, et al. Results of the MATCH study: analysis of medication reconciliation errors at admission. J Gen Intern Med. 2010;25(5):441–447.
10. Kwan JL, et al. Medication reconciliation during transitions of care as a patient safety strategy: a systematic review. Ann Intern Med. 2013;158(5):397–403.

11. Mekonnen AB, et al. Effectiveness of pharmacist-led medication reconciliation programmes: systematic review and meta-analysis. BMJ Open. 2016;6(2):e010003.
12. Carter MK, et al. Implementing structured medication reconciliation in hospitals: outcomes and challenges. Pharm Pract. 2012;10(2):72–79.
13. Hiasat L, et al. Pharmacist-led medication reconciliation in Jordanian hospitals: a randomized trial. Int J Clin Pharm. 2020;42(3):745–753.
14. Al-Jazairi AS, et al. Medication discrepancies in critically ill patients: a Saudi perspective. Saudi Pharm J. 2017;25(5):699–704.
15. Balkhi B, et al. Polypharmacy and associated factors in Saudi adults. Saudi Med J. 2019;40(2):123–131.
16. Alqurain A, et al. Hyper-polypharmacy prevalence in Saudi outpatient clinics. BMC Health Serv Res. 2021;21:312.
17. Alharbi F, et al. Polypharmacy and inappropriate prescribing among elderly in Qassim, Saudi Arabia. Int J Clin Pharm. 2022;44(1):85–94.
18. Doumat G, et al. Polypharmacy and its impact on hospitalization in older adults. Drugs Aging. 2020;37(8):589–600.
19. Oliveira JS, et al. Pharmacist-led medication reconciliation in emergency departments: a scoping review. Res Social Adm Pharm. 2021;17(6):1032–1040.
20. World Health Organization. Global Patient Safety Action Plan 2021–2030. Geneva: WHO; 2021.