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Original

Medication reconciliation for patients after their discharge from intensive care unit to the hospital ward

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ABSTRACT

Objectives: The aim of this study was to determine whether the transition of care from the intensive care unit to the ward would pose a high risk for reconciliation errors. The primary outcome of this study was to describe and quantify the discrepancies and reconciliation errors. Secondary outcomes included classification of the reconciliation errors by type of medication error, therapeutic group of the drugs involved and grade of potential severity.
Methods: We conducted a retrospective observational study of reconciliated adult patients discharged from the Intensive Care Unit to the ward. Before a patient was discharged from the intensive care unit, their last intensive care unit's prescriptions were compared with their proposed medication list in the ward. The discrepancies between these were classified as justified discrepancies or reconciliation errors. Reconciliation errors were classified by type of error, potential severity, and therapeutic group.
Results: We found that 452 patients were reconciliated. At least one discrepancy was detected in 34.29% (155/452), and 18.14% (82/452) had at least one reconciliation errors. The most found error types were a different dose or administration route (31.79% (48/151)) and omission errors (31.79% (48/151)). High alert medication was involved in 19.20% of reconciliation errors (29/151).
Conclusions: Our study shows that intensive care unit to non-intensive care unit transitions are high-risk processes for reconciliation error. They frequently occur and occasionally involve high alert medication, and their severity could require additional monitoring or cause temporary harm. Medication reconciliation can reduce reconciliation errors.

Conciliación de la medicación en el Alta desde la Unidad de Cuidados Intensivos a la planta de Hospitalización

Palabras clave:
Conciliación de medicación
Unidad de Cuidados Intensivos
Alta de pacientes
Errores de medicación
Seguridad de medicamentos

RESUMEN

Objetivos: El objetivo de este estudio fue determinar si la transición del alta de la unidad de cuidados intensivos a la planta de hospitalización conlleva un alto riesgo de errores de conciliación. Se definió como objetivo principal del estudio describir y cuantificar las discrepancias y los errores de conciliación. Los objetivos secundarios incluyeron clasificar los errores de conciliación por tipo, grupo terapéutico de los medicamentos implicados y la gravedad potencial.
Métodos: Se llevó a cabo un estudio observacional retrospectivo de los pacientes dados de alta de la unidad de cuidados intensivos a la planta de hospitalización. Antes de que un paciente fuese dado de alta desde la unidad de cuidados intensivos, sus últimas prescripciones fueron comparadas con el listado de medicación propuesto en la planta de hospitalización. Las discrepancias entre ambos listados fueron clasificadas como discrepancias justificadas o errores de conciliación. Los errores de conciliación fueron clasificados por tipo de error, por gravedad potencial y por grupo terapéutico.

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Resultados: Fueron conciliados 452 pacientes. Se encontró al menos una discrepancia en un 34,29% (155/452), y presentaba al menos un error de conciliación un 18,14% (82/452). Los errores de conciliación más frecuentes fueron diferente dosis o vía de administración (31,79% (48/151)) y errores de omisión (31,79% (48/151)). Un 19,20% (29/151) involucraba a medicamentos de alto riesgo.
Conclusiones: El alta desde la unidad de cuidados intensivos a la planta de hospitalización convencional es una transición asistencial que presenta alto riesgo de errores de conciliación. Los errores de conciliación ocurren con frecuencia, en ocasiones involucran a medicamentos de alto riesgo, su potencial gravedad puede requerir una monitorización adicional o producir daño temporal, y en algunos casos, más de un error de conciliación puede tener lugar. La conciliación de medicamentos por un farmacéutico puede reducir los errores de conciliación.

Introduction

Medical care transitions are generally risky processes as they may generate medication errors (ME). They may involve some changes in a patient's care team and often involve different electronic prescription software. Medication reconciliation (MR) by pharmacists has been known to prevent ME, thus reducing harm to patients and avoiding their associated costs. Previous studies indicate that MR in an intensive care unit (ICU) admission by ICU pharmacists prevent ME, shorten a patient's duration of stay, and decreases mortality.[1–5] Although MR in ICU admission is well studied, little is known about MR after ICU discharge. The transfer of a patient from ICU to ward could be a challenging transition of care. During the transition, some chronic medications are suspended if an acute illness is not yet under control; certain drugs, that are only required during the patient's critical stage, but they are often inadvertently continued in the ward. In addition to this issues, the existence of different specific electronic prescription software could generate problems by itself.[2–8]

ME might have a higher impact on some critically ill patients because the severity of their disease often implies greater fragility in the face of certain events, like the frequent use of high-alert medications (HAM) and the intravenous route of administration.[1,2,6,7]

MR is the formal and standardized process to obtain the complete list of a patient's previous medication list in order to compare, analyze and resolve discrepancies found with active prescribed drugs, according to the "*consensus document on terminology and classification in medical reconciliation*" from the Spanish Society of Hospital Pharmacy (SEFH). Reconciliation errors (RE) occur when a discrepancy is unintentional. Therefore, clinical concerns cannot justify it, and it is usually due to confusion or a lack of communication. Specifically, in the case of transitioning from the ICU to the ward, this definition of MR focuses on the comparison of ICU prescriptions for acute illness with the subsequent treatment prescribed after discharge to the hospital ward. This definition excludes other important functions related to pharmaceutical care, such as adapting medications to the patient's new clinical status (e.g., adaptation of the pharmaceutical form with the withdrawal of tubes and lines or changes in renal and hepatic function) or home treatment reconciliation, because they are not included as processes associated with MR in the ICU to the ward transition.[9]

The aim of this study was to determine whether the transition of care from ICU to the ward would pose a high risk for **RE**. The primary outcome of this study was to describe and quantify the discrepancies and **RE**. Secondary outcomes included classification of the **RE** by type of ME, therapeutic group of the drugs involved and grade of potential severity.

Methods

This was a retrospective observational study covered 13 months (March 2019–March 2020, both included) of observations in a tertiary care academic teaching hospital. Details of all discharged patients from the coronary ICU (comprising 14 beds) or the polyvalent ICU (24 beds) in the morning hours of working days (Monday to Friday) were included.

Methods

When a patient is expected to be discharged from the ICU to the medical ward, ICU physicians transcribe the patient's medication list from the ICU electronic prescription software (IEPS) to the ward electronic prescription software (WEPS). Every morning, from Monday to Friday, between 08:00 AM to 03:00 PM, MR was performed by an ICU pharmacist. The patient's prescriptions in the WEPS were reviewed and compared with the prior prescriptions from the ICU. Each discrepancy detected was communicated to the ICU clinicians. Discrepancies were classified either as **RE** if the physician confirmed that those changes were not intentional or as justified discrepancies (no-error) when the current prescription was continued. When one intervention was not accounted for by any physician, it was assumed to be a justified discrepancy according to the consensus document on medical reconciliation by the SEFH.[9] Fig. 1 shows the reconciliation process.

If one patient was reconciled several times during different ICU admissions, each reconciliation was recorded as performed for a different patient. Fluid therapy was not included.

Classification of **RE** by type was made in accordance with the mentioned consensus document from the SEFH, which proposes five types of **RE**: Omission (one drug was not prescribed), commission (one drug was prescribed, but it should not have been), a different dose or route of administration (one drug was administered in an incorrect dose or route), incomplete prescription (one prescription without any essential drug data) and a wrong medication (one drug was mistakenly prescribed for another).[9]

Drugs involved in **RE** were classified by therapeutic group based on the Anatomical Therapeutic Chemical (ATC) Classification System. They were also divided into HAM or not-HAM, according to the list of High-Alert Medications of the Institute for Safe Medication Practices **(ISMP).**[10]

Since these errors were detected before the patients left the ICU, the detected **RE** did not harm the patients, so they were considered potential ME. The grade of potential severity was classified as "A" through "I" according to the taxonomy of medication errors by the patient outcome of the National Coordinating Council for Medication Error Reporting and Prevention (NCCMERP) index.[11] Every **RE** was rated independently by four clinicians: two pharmacists (one ICU pharmacist) and two ICU physicians. When three or more clinicians agreed upon the grade of severity rated for one **RE**, it was attributed to that **RE**. Nevertheless, a numerical calculation process was done if more than two clinicians disagreed. First, a number value was assigned to each NCCMERP class from 1 (NCCMERP A) to 9 (NCCMERP I). Then arithmetic mean was calculated. The resulting value was then rounded to the nearest integer value. If one mean was a half, it was rounded to the lowest number. Finally, the

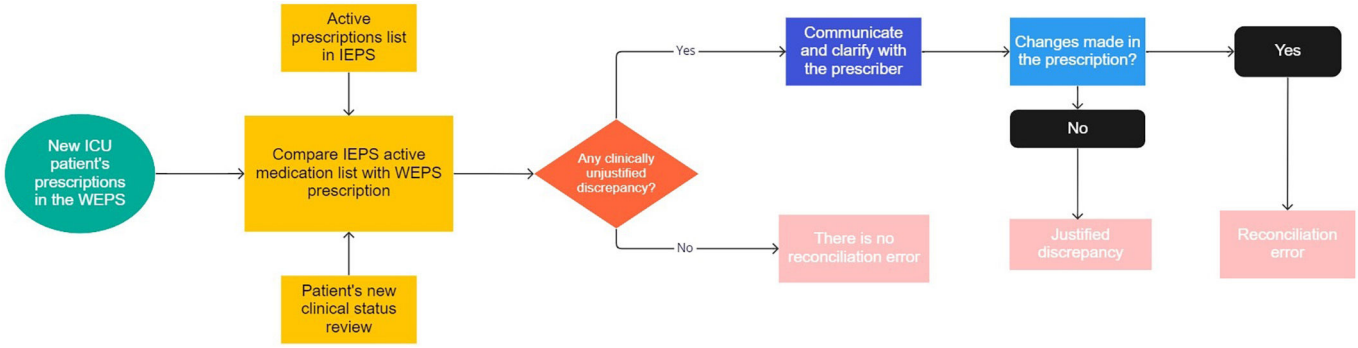

Fig. 1. Medication reconciliation process and discrepancies classification.

NCCMERP class coincident with the number obtained from the arithmetic mean was attributed to each **RE** (*see* Table 1).

Ethics approval

Ethical approval for this study was obtained from the local medical Ethics Committee (code 2021/181) on 25th May 2021. Since this work was a retrospective observational study, it did not involve active sampling. Instead, existing clinical observations through the past year were looked at for analysis. Hence, the ethical approval is for the analysis of existing data instead of collecting new data. The study was performed following the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

Statistical analysis

The Statistical Package for the Social Sciences (SPSS) version 19 was used for statistical analysis. Categorical variables were presented as the number of cases or percentage, and continuous variables were expressed as mean (standard deviation), median, and range.

Results

A total number of 452 patients underwent medication reconciliation. At least one discrepancy was detected in 155 patients (34.29%), 82 of which had at least one **RE** (52.90%; 18.14% from total). Among the patients detected with some **RE**, the mean age was 67.11 years old (standard deviation 11.09), and 52.44% were men.

A total of 1053 drugs were reviewed among 155 patients with at least one discrepancy, and it was observed that 175 drugs were involved in some discrepancy. Of the 82 patients with an **RE**, 876 drugs were reviewed (median of 10 drugs per patient, interquartile range 8–15), and 151 drugs were involved in **RE**.

In the patients with some **RE**, the median number of errors per patient was 1 (range 1 to 14, interquartile range 1–2), and 37.81% had more than one **RE**. Specifically, two patients had incorrect medical orders that were meant for another patient, involving 14 missed drugs and 8 new drugs in one case, and 10 missed drugs and 10 new drugs in the second case. Three patients had been presented with some **RE** at different care transitions (one of them three times).

Table 2 shows the results obtained from MR, including medication with errors, distribution of the errors by type and grade of potential severity, and the therapeutic groups involved.

Among **RE**, 19.20% of the **RE** involved HAM, with enoxaparin being the most frequent drug involved (37.93%).

RE by type and grade of potential severity was broken down by HAM (Table 3). Only six **RE** were classified as NCCMERP class E (nonacog alpha, regular insulin twice and enoxaparin three times); all were HAM. Nonacog alfa was prescribed instead of thiamine to a patient with a Wernicke encephalopathy due to confusion caused by similarity in its commercial name (Benefixce:sup]® (Pfizer Europe, Brussels, Belgium) and Benerva® (TEOFARMA S.R.L., Pavia, Italy) respectively).

Table 1
Taxonomy of medication errors by patient outcome of the National Coordinating Council for Medication Error Reporting and Prevention and numerical value attributed during the qualification of the grade of potential severity of the reconciliation errors.

Category	Description	Numerical value attributed
A	No error, capacity to cause error	1
B	Error that did not reach the patient	2
C	Error that reached patient but unlikely to cause harm (omissions considered to reach patient)	3
D	Error that reached the patient and could have necessitated monitoring and/or intervention to preclude harm	4
E	Error that could have caused temporary harm	5
F	Error that could have caused temporary harm requiring initial or prolonged hospitalization	6
G	Error that could have resulted in permanent harm	7
H	Error that could have necessitated intervention to sustain life	8
I	Error that could have resulted in death	9

Table 2
Results obtained after medication reconciliation in the ICU to the hospital ward transition of care.

	Total
	n (%)
Medication with some reconciliation error	151
All the medicines involved in some RE per patient	1.84
High alert medicines involved in RE	29 (19.20)
Errors by Spanish Society of Hospital Pharmacy consensus type of error classification	
Omission error	48 (31.79)
Different dose or route of administration error	48 (31.79)
Comission error	42 (27.81)
Incomplete prescription	8 (5.30)
Wrong medication	5 (3.31)
Errors by NCCMERP potential severity index	
NCCMERP class C	76 (50.33)
NCCMERP class D	62 (41.06)
NCCMERP class B	7 (4.64)
NCCMERP class E	6 (3.97)
Medication with reconciliation error by anatomical therapeutic group	
ATC N: Nervous system	28 (18.54)
ATC J: Antiinfectives for systemic use	24 (15.89)
ATC B: Blood and blood forming organs	21 (13.91)
Various (ATC G, H, L, M, S and V)	21 (13.91)
ATC A: Alimentary tract and metabolism	20 (13.25)
ATC C: Cardiovascular system	18 (11.92)
ATC R: Respiratory system	19 (12.58)

ATC: Anatomical therapeutic group; ICU: Intensive Care Unit; NCCMERP: National Coordinating Council for Medication Error Reporting and Prevention; RE: Reconciliation errors.

Table 3
Reconciliation errors by type and grade of potential severity (according to the taxonomy of medication errors by the patient outcome of the National Coordinating Council for Medication Error Reporting and Prevention index).

Kind of error	Grade of potential severity of reconciliation errors *n*								Total	
	B		C		D		E			
	All	HAM	All	HAM	All	HAM	All	HAM	All	HAM
Omission	0	0	16	0	30	5	2	2	**48**	**7**
Comission	0	0	21	0	19	6	2	2	**42**	**8**
Different dose or route of administration	5	1	30	5	12	5	1	1	**48**	**12**
Incomplete prescription	2	1	6	0	0	0	0	0	**8**	**1**
Wrong medication	0	0	3	0	1	0	1	1	**5**	**1**
All types of error	**7**	**2**	**76**	**5**	**62**	**16**	**6**	**6**	**151**	**29**

HAM: High Alert Medication.

In one case, the wrong dose of enoxaparin was prescribed. The rest of NCCMERP E **RE** were medications prescribed to the wrong patient.

Discussion

MR has been associated with a decrease in ME in every medical care transition.[8] The American Society of Health System Pharmacy encourages hospitals and health systems to collaborate for establishing organized, multidisciplinary MR programs.[12] In the ICU to ward transition, MR is also recommended by the Society of Critical Care Medicine.[13]

Although discharge from ICU to ward is a common transition point where medication errors can occur, little has been written about the magnitude of such errors or the potentially ameliorative role of medication conciliation in this care transition.

In fact, the few published studies that have evaluated items other than MR have primarily focused on the results of pharmaceutical care during this transition point (such as home MR or adequacy of drug therapy to the new patient status).[4,5,15]

However, our study results focused on MR (according to a consensus document) after discharge from the ICU. While our results provide new specific insights, comparing our study with what has been previously established would be complicated.

In our study, **RE** were found in 18.14% of the patients. A retrospective study in 58 ICUs by Tully et al.,[4] find that 45.7% of the patients transferred from the ICU to a non-ICU location have at least one ME, but more than a half of them are not related to reconciliation (usually the continuation of a medication for an ICU-specific indication (28.4%) or for some unrelated condition (19.4%)).

Bosma et al.[5] also find a greater prevalence of RE than our study. They find that 73.9% of their subjects have at least one RE. Similar results are obtained by Heselmans et al.[14] where drug-related problems are found in 60% of these patients. However, some actions of generic pharmaceutical care are considered and reported as reconciliation, and these do not correspond to standardized RE types.

A study by Pronobost et al.[15] reveals that 94% of the discharged patients have orders changed but including only 33 patients. Reconciliation is done indirectly by measuring the changes in discharge orders compared with initial medication orders. No information is provided about the severity or kind of RE.

The only study that focuses on MR at ICU discharge, similar to this study, is an eight-month prospective observational study by Carrion-Madroñal et al.[16] They find that 10.30% of the patients that are discharged from the ICU to the ward have at least one RE.

A common finding in most prior studies is that omission errors and those associated with dose or route of administration are the most frequently occurring errors.[4,5,14,16] Some examples of these errors are incorrect doses (e.g., double dose of tacrolimus), and incorrect route of administration (e.g., ordering the administration of an oral solution intravenously). The reason for omissions errors being the most prevalent RE in some studies could be explained by the omissions of ambulatory treatments that were temporarily suspended in the ICU. This aspect was not included in our study.

Omission errors were described by the Spanish subdivision of the ISMP as one of the ten most risky ME reported in 2020, because they more frequently resulted in fatal consequences.[17] In our study, 69.76% of the omission errors were categorized as NCCMERP D. Nevertheless, none were classified as NCCMERP E.

It is very difficult to compare severity because of methodological differences. Only the results from Carrión-Maroñal et al.[16] are comparable with ours because they also employ the NCCMERP severity index. In our study, only 3.97% RE were rated as NCCMERP E, whereas they rate 38.8% RE. However, there is no information about RE severity rating process (how the NCCMERP severity index was decided for each RE). Other authors measure severity by implementing self-created indices.[5]

HAM are especially important for critical patients. In our study, HAM were involved in almost 20% of total RE. To the extent of our knowledge, there have been no studies on the proportion of HAM involved in RE. Due to the high use of HAM, this consideration is transcendental when applying our results to practice.

We found that one patient received the medication orders intended for another patient on two separate occasions. They involved 14 and 10 drugs in each case (including some HAM as enoxaparin or insulin). Because the electronic prescription software is not the same, no commission errors would be expected, but an omission error was expected to occur. These patients would not have any prescription when they were in the medical ward, so a delay in administration could be expected.

The ATC group most involved in RE was ATC N. Nevertheless, frequencies were similar to all ATC groups (from 11.92 to 18.54%). However, the literature supports different data. On the one hand, similar to other studies ATC B, C and N were among the most prevalent therapeutics groups, although they are more frequent in studies where home MR was done. On the other hand, the Anti-infectives group is not as frequently reported in other studies as the study by Tully et al. (they report 8.1%)[4] or in the systematic reviews.[3] **The non-inclusion of RE referring to the home medication review in our study** could explain why anti-infective drugs (usually used as an acute treatment) are more prevalent in our results.

Eijsbroek et al.[18] use a semi-structured interview method with patients and caregivers and find that antidiabetic drugs and analgesics are the chronic medicines most associated with an RE. This study also focuses on chronic medication prescription before and after ICU stay. In addition, patients or caregivers are unaware of many acute treatments, such as antiinfective drugs or anticoagulant drugs, so an underestimation could have been made.

A recent clinical practice guideline about safe medication management in the ICU gives MR "no recommendation" for MR in ICU patients because of the lack of evidence.[19] Our results show that several ME can be prevented, which may have a significant impact on patient safety. Bosma et al.[5] find that reconciliation at discharge results in a potential net cost–benefit of 101€ per patient. Therefore, it is not only ensuring

safety but is also cost-effective. It is for this reason that the Society of Critical Care Medicine includes MR as one of the fundamental activities of ICU pharmacists in its 2020 update.[13]

One important aspect is looking at who develops MR. MR is a time-consuming process, and the actual situation of ICU pharmacists in some countries (little staff, lack of resources, etc.)[20] makes it difficult for ICU pharmacists to be able to carry it out themselves. In our study, MR was made by an ICU pharmacist, but some prior studies have involved some other trained personnel. Nurses, pharmacy technician-driven or even pharmacy students decrease ME after reconciliation training.[3,21,22] These can be some good alternatives as long as MR is done in a standardized manner.

Our results are strongly influenced by the coexistence of two different electronic prescription software that are not linked with each other (WEPS and IEPS). Medication transcription is made manually, so a high knowledge about every prescription software management is required to avoid ME. Therefore, the lack of this knowledge is a clear source of errors. Some of the detected errors in our results could have been avoided if transcription was automatized.

Our study had some important limitations. First, our MR did not include reconciliation at ICU admission, so the omission of medications, such as failure to restart home medications, was not included. This makes it difficult to compare our study with previous ones, but it offers an opportunity to improve further studies. MR was not done after 3 PM from Monday to Friday, during weekends, or on ICUs pharmacist's holidays. Every discharge made within that time was not reconciled nor registered. Care transitions were less common during that time, but they were developed by fewer personnel, therefore, a bigger proportion of RE could be expected in these periods.

When RE's grade of potential severity was rated, every RE was evaluated independently, so some patients could have suffered more than one mistake. It is possible that if these errors were analyzed as a whole, their grade of the potential severity would be different.

Our study had some significant strengths. The potential severity of RE was analyzed by four experts in a multidisciplinary manner, so that the evaluation is based on some different perspectives. MR is a standard practice in pharmaceutical care in our ICU. These results are obtained from data on the current clinical practices of our Pharmacy service. Hence, this is a real world study, and many biases were avoided. Finally, we studied RE's grade of severity using standardized scales and analyzed RE while considering the concept of HAM. Until now, prior studies developed used unapproved scales, and the HAM concept was not applied.

We suggest that the future studies should try to estimate the prevalence of RE and which subjects are at a high risk of RE to detect and act on them before discharge.

Our study shows that transitions from the ICU to the ward are high-risk processes for RE because they are frequent, sometimes involve HAM, their severity could require additional monitoring or cause temporary harm, and in some cases, more than one RE per patients could take place. MR by a pharmacist could be an effective intervention to reduce ME, thereby improving patient's safety. Enhancing the integration of information systems is required in order to reduce **RE**.

Aportación a la literatura científica

What this study adds – This study supports the importance of reconciliation at discharge from the intensive care unit through analysis of results from real clinical practice results, and not through studies for short periods of time. Reconciliation errors can be better analyzed by evaluating their potential severity through a multidisciplinary team (intensive care unit physicians and hospital pharmacists) and the use of standardized scales and guidelines.

How this study might affect research, practice or policy – This study demonstrates that the transition from the intensive care unit to the hospital ward is another critical transition for patient safety. Therefore, it should be implemented in every pharmacy service. In addition, our study shows that, when it is done in a standardized way, the magnitude of errors, as well as the type of errors found in medication reconciliation is different from what has been reported to date. For this reason, the orientation carried out in the medical reconciliation should be modified.

Declaración de autoría

AMP y MSAP fueron responsables del diseño del proyecto, de la recolección de los datos y de la escritura del trabajo. Además, conjuntamente con MRA y AND, se estableció la valoración de la potencial gravedad, así como el análisis y la interpretación de los datos. CFO, MIMH, PDS y LMF fueron responsables de revisión crítica, realizando importantes contribuciones intelectuales, así como la selección de la revista científica.

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Conflicto de intereses

Los autores declaran que no presentan ningún tipo de declaración de intereses.

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