

INTERVENÇÕES LIDERADAS POR FARMACÊUTICOS PARA A PROFILAXIA RACIONAL DA LESÃO DE MUCOSA RELACIONADA AO ESTRESSE EM UTIS: UMA REVISÃO INTEGRATIVA

PHARMACIST-LED INTERVENTIONS FOR RATIONAL STRESS-RELATED MUCOSAL DISEASE PROPHYLAXIS IN ICU: AN INTEGRATIVE REVIEW

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Luana Caroline Radun¹ 
Federal University of Santa Catarina

Filipe Carvalho Matheus² 
Federal University of Santa Catarina

ABSTRACT: Introduction: Pharmacist interventions have been shown to enhance clinical outcomes in the prophylaxis of stress-related mucosal disease (SRMD) in intensive care units (ICUs) and to decrease hospital expenditures. This review aims to identify effective pharmacist strategies that mitigate the inappropriate utilization of proton pump inhibitors (PPIs) for the prophylaxis of acute gastric mucosal injury (AGMI) in ICU patients. Methods: An integrative review was conducted searching the following databases: VHL, LILACS, PubMed (MEDLINE), SciELO, Cochrane Library, and Google Scholar. The analysis focused on articles published over the last 5 years until November 2022. The study employed a descriptive approach to explore pharmaceutical interventions and their outcomes. Results: A total of 204 records were retrieved and 9 articles were included. Pharmaceutical interventions such as guidelines and protocols improved the clinical effectiveness of SRMD prophylaxis in ICUs, with appropriate prescriptions and adherence to guidelines. In addition to clinical benefits, these pharmacist-led interventions also significantly reduced monthly and annual costs. Conclusion: The participation of clinical pharmacists in the development of guidelines and protocols for SRMD prophylaxis, together with their presence in multidisciplinary rounds, appears to be the most effective strategy to improve outcomes. Nevertheless, further studies are necessary to assess the cost-effectiveness of this approach.

Keywords: Critical Care; Deprescribing; Patient Safety; Clinical Pharmacy; Stress Related Mucosal Disease.

RESUMO: Introdução: As intervenções farmacêuticas melhoram os desfechos clínicos na profilaxia de lesão da mucosa relacionada ao estresse (LMRE) em unidades de terapia intensiva (UTIs) e reduzem os custos hospitalares. Esta revisão identifica estratégias de farmacêuticos para reduzir o uso inadequado de inibidores da bomba de prótons (IBPs) na profilaxia de lesão aguda da mucosa gástrica (LAMG) em pacientes de UTI. Métodos: Foi realizada uma revisão integrativa em bases de dados como BVS, LILACS, PubMed (MEDLINE), SciELO, Cochrane Library e Google Scholar, com foco em estudos dos últimos 5 anos (até novembro de 2022). Utilizou-se uma abordagem descritiva para analisar as intervenções farmacêuticas e seus resultados. Resultados: Dos 204 registros identificados, 9 artigos atenderam aos critérios de inclusão. Intervenções como diretrizes e protocolos aumentaram a eficácia clínica da profilaxia de LMRE em UTIs, garantindo prescrições adequadas e adesão às diretrizes. Essas estratégias também reduziram significativamente os custos mensais e anuais. Conclusão: A participação de farmacêuticos clínicos no desenvolvimento de diretrizes de profilaxia de LMRE e nas discussões multidisciplinares mostrou-se a estratégia mais eficaz para melhorar os desfechos. Contudo, são necessários mais estudos para avaliar a relação custo-efetividade dessas intervenções.

Palavras-chave: Terapia Intensiva; Deprescrição; Segurança do Paciente; Farmácia Clínica; Lesão da Mucosa Relacionada ao Estresse.

¹ Aluna do Programa de Mestrado em Assistência Farmacêutica da Universidade Federal de Santa Catarina e Centro Hospitalar Unimed, Joinville, Santa Catarina, Brasil. E-mail: luanacarolineradun@gmail.com

² Docente do Programa de Pós-Graduação em Assistência Farmacêutica da Universidade Federal de Santa Catarina, Florianópolis, Santa Catarina, Brasil. E-mail: filipejfmatheus@gmail.com

INTRODUCTION

Proton pump inhibitors (PPIs) decrease hydrochloric acid production in the stomach and are employed to treat various gastrointestinal disorders and prevent stress related mucosal disease (SRMD) in critical care settings, such as intensive care units (ICUs) (Pham *et al.*, 2006; Savarino *et al.*, 2018). Gastrointestinal bleeding due to SRMD is a complication that affects critically ill patients who require prophylaxis based on defined criteria. These injuries can occur in hospitalized patients under conditions of physiological stress or as a result of polypharmacy (Grube; May, 2007; Rhodes *et al.*, 2017). The exact causes and mechanisms of SRMD are not fully understood, but there is evidence suggesting a link with reduced blood flow, mucosal ischemia, and reperfusion injury (Guillamondegui *et al.*, 2008). Nevertheless, the clinical significance of these injuries may be minimal. According to Krag *et al.* (2015), routine SRMD prophylaxis in ICU patients has been found to provide no significant benefit.

SRMD prophylaxis is commonly administered in ICUs to prevent gastrointestinal bleeding in critically ill patients (Savarino *et al.*, 2018; Pham *et al.*, 2006). However, the use of PPIs has been linked to adverse events such as *Clostridium difficile* infection, pneumonia, renal failure, and others (Barrett *et al.*, 2016). Gastrointestinal bleeding attributable to SRMD affects a small percentage of patients (Grube; May, 2007; Rhodes *et al.*, 2017), with reported prevalence rates ranging from 0.6% to 7.0% in ICU settings (Krag *et al.*, 2015; Ye *et al.*, 2020).

The studies by Mousavi *et al.* (2018), Hatch, Schulz, and Fish (2019), and Muñoz-Pichuante and Villa-Zapata (2017) address the relevance of clinical pharmacists in healthcare settings. The study by Mousavi *et al.* (2018) focuses on reducing non-indicated prescriptions of gastric acid-suppressing medications, especially after discharge from the ICU. Using pharmacist-led educational interventions and medication reconciliation, the study achieved a reduction of 64.3% in non-indicated prescriptions after discharge, demonstrating the effectiveness of these strategies. The study conducted by Hatch, Schulz, and Fish (2019) at an adult ICU in Chile evaluated the cost-saving potential of clinical pharmacist interventions. Over the course of one year, 505 interventions were implemented, leading to significant savings in various areas, including the prevention of adverse drug-related events and the efficient use of resources. The overall cost-benefit ratio was 1:24.2, highlighting the economic benefits and quality assurance delivered by clinical pharmacists in ICU settings. This evidence highlights the importance of clinical pharmacists for optimizing patient care, reducing healthcare costs, and ensuring medication-related safety in ICUs in terms of both appropriate prescription and economically effective interventions.

The recent BMJ Rapid Recommendation guideline, released on January 6, 2020, has introduced a novel approach to prophylaxis in ICU patients, specifically focusing on the risk of clinically significant gastrointestinal bleeding. This guideline categorizes patients into four groups based on their risk levels, recommending acid suppression prophylaxis for those at higher risk (4% or more) and those in close proximity to this threshold (Krag *et al.*, 2020). In this literature review, we examine pharmaceutical interventions, specifically focusing on the rational use of Proton Pump Inhibitors (PPIs) in the context of ICU settings. Additionally, our review aims to assess the existing body of evidence to determine the extent to which studies align with this updated guideline.

Given the crucial role of pharmacists in pharmacotherapy management, it is essential to identify and evaluate the strategies they use to reduce the unjustified use of proton pump inhibitors (PPIs) in the prophylaxis of acute gastric mucosal lesions (AGML) in patients admitted to intensive care units (ICUs). Considering the potential adverse effects associated with the inappropriate use of PPIs, as well as the clinical and economic benefits of successful pharmaceutical interventions, this study aims to answer the question: "Which strategies utilized by pharmacists achieved the best results in reducing the unjustified use of proton pump inhibitors (PPIs) in the prophylaxis of AGML in patients admitted to ICUs?" By investigating this question, we intend to provide an evidence base that contributes to the optimization of clinical practice and the improvement of care provided to critically ill patients.

METHODS

This was an integrative review of pharmacist-led interventions regarding the inappropriate use of SRMD prophylaxis in ICUs (Mousavi *et al.*, 2019).

ELIGIBILITY CRITERIA

The inclusion criteria followed the PICO (population, intervention, comparator, outcome) strategy (Hatch, Schulz, and Fish, 2018). The population comprised critically ill patients admitted to the ICU or those under short-term observation. Studies that encompassed all hospital sectors but did not disaggregate data specifically for ICUs were excluded.

The interventions considered in the study were required to be conducted either partly or fully by pharmacists (i.e., pharmacist-led). Interprofessional approaches were included only if pharmacists played a primary role in decision-making.

Studies on pharmacotherapeutic interventions for SRMD prophylaxis were included if they reported it as a primary or secondary outcome. Review articles were excluded. The timeframe for assessing outcome indicators—whether during hospitalization, at ICU discharge, or at hospital discharge—was not restricted.

The underlying research question for the study is: "Which strategies utilized by pharmacists achieved the best results in reducing the unjustified use of proton pump inhibitors (PPIs) in the prophylaxis of AGML in patients admitted to ICUs?"

SEARCH STRATEGY

The search strategy employed free-text terms, including "Proton Pump Inhibitors," "pharmacist", "critically ill", and "gastric mucosal lesion prophylaxis." To ensure a comprehensive and relevant search, the following guidelines were followed:

- **Inclusion and Exclusion Criteria:** Studies that addressed the intervention of pharmacists in the management of proton pump inhibitors (PPIs) for critically ill patients in ICUs, focusing on the prophylaxis of acute gastric mucosal lesions (AGML), were included. Studies that did not provide specific data for ICUs or did not address pharmacist interventions were excluded.
- **Specific Search Terms:** Search terms were adapted as necessary for each database. For example:
- **For PUBMED (MEDLINE):** ("Proton Pump Inhibitors" AND "pharmacist" AND "critically ill" AND "gastric mucosal lesion prophylaxis").
- **For BVS/LILACS:** ("Inibidores de bomba de prótons" AND "farmacêutico" AND "paciente crítico" AND "profilaxia de lesão de mucosa gástrica").
- **For SCIELO and Google Scholar:** Similar terms were used with linguistic and contextual adjustments specific to each platform.
- **Language of the Search:** Searches were conducted primarily in English, Portuguese, and Spanish to capture a broad spectrum of relevant literature available in the mentioned databases.

REVIEW AND UPDATE

The initial literature review was conducted from November 20 to 22, 2022. An update was performed on September 23, 2023, to include more recent studies and ensure that the conclusions reflected the most current available evidence.

STUDY SELECTION

A Microsoft Excel® spreadsheet was used for reference management and removal of duplicates. LCR screened all titles and abstracts. Articles included after this step were submitted to full-text reading.

DATA COLLECTION

Data were extracted from the selected studies using specific Excel® spreadsheet forms developed for this purpose. The following data were extracted: author’s name, year, country of origin of the study, objective of the study, database from which the article was extracted, method (study design), sample size, population, main intervention, and outcomes found.

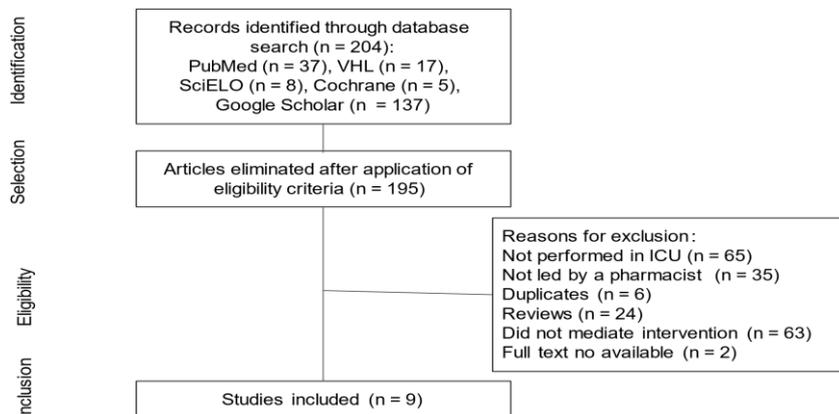
DATA SYNTHESIS AND ANALYSIS

In view of the predictable heterogeneity of participants and interventions and inadequate criteria, a comprehensive descriptive analysis of the participants, content and implementation of the interventions, and impacts on inappropriate prescription rates was conducted. The studies were examined specifically regarding the outcomes of the pharmaceutical interventions performed in order to address the questions outlined in this review.

RESULTS

The database search retrieved 204 studies. Of these, 195 studies were excluded. The main reasons for exclusion were intervention outside the ICU, not a pharmacist-led strategy, pharmacists did not mediate interventions, and duplicate articles (Figure 1). Nine studies were included in the review (Yailian *et al.*, 2022; Amir *et al.*, 2021; Bazan *et al.*, 2021; Franchitti *et al.*, 2020; Hong *et al.*, 2020; Mahmoudi *et al.*, 2019; Anstey *et al.*, 2019; Masood *et al.*, 2018; Luo *et al.*, 2018).

Figure 1 - Flow diagram of the article selection process.



Source: Developed by the author (2024).

Regarding the study design, three were prospective cohort studies (Mahmoudi *et al.*, 2019; Anstey *et al.*, 2019; Amir *et al.*, 2021), four were retrospective observational studies (Hong *et al.*, 2020; Yailian *et al.*, 2022; Masood *et al.*, 2018; Luo *et al.*, 2018), one was an observational cross-sectional study (Franchitti *et al.*, 2020), and one was a quasi-experimental non-randomized clinical trial (Bazan *et al.*, 2021). The characteristics of the included studies are shown in Table 1.

Table 1 - Characteristics of the included studies.

Authors/Year	Country	Study design	Sample size	Population	Main intervention
Yailian <i>et al.</i> (2022)	France	Retrospective observational	Of the 620,620 pharmacist interventions registered, 29,694 targeted the use of PPIs	No limitations	Data collection to determine which interventions were performed
Amir <i>et al.</i> (2021)	Pakistan	Cross-sectional retrospective cohort	540	Every adult patient admitted to a 9-bed adult ICU	Review of prophylactic SRMD pharmacotherapy during rounds
Bazan <i>et al.</i> (2021)	Egypt	Quasi-experimental, non-randomized clinical study	177	Every adult patient admitted over a 6-month period was screened	Development of a protocol, education and awareness campaign
Franchitti <i>et al.</i> (2020)	Switzerland	Observational	140	Adult patients without a prior indication for acid-suppressing therapy who were hospitalized in the ICU for over 24 hours during a two-month period were included.	Clarifying indications for prophylactic SRMD pharmacotherapy and adjustments of drug use
Hong <i>et al.</i> (2020)	China	Retrospective cohort	814	All adult patients lacking a prior need for acid-suppressing therapy and admitted to the ICU.	Development of a protocol, education and awareness campaign
Mahmoudi <i>et al.</i> (2019)	Iran	Prospective cohort	354	Adults hospitalized in inpatient, surgical, and intensive care units of two large academic	Clarifying indications for prophylactic SRMD pharmacotherapy and adjustments of drug use

				medical centers for 6 months	
Anstey <i>et al.</i> (2019)	Australia	Prospective cohort Multicenter pre-post implementation improvement study	531 (pre-implementation) and 393 (post-implementation)	All adult patients hospitalized in 5 adult ICUs	Review of prophylactic SRMD pharmacotherapy during rounds
Masood <i>et al.</i> (2018)	USA	A retrospective, observational pre-post intervention study conducted in an academic medical ICU.	202 (pre-intervention)/162 patients admitted to the ICU in the post-intervention month	Adult patients admitted to the hospital's ICU who had not received prior therapy and had no contraindications.	Review of prophylactic SRMD pharmacotherapy during rounds
Luo <i>et al.</i> (2018)	China	Retrospective observational study of prescriptions over the last decade (January 2007 to December 2016)	Pre-intervention (July to December 2015) and post-intervention (July to December 2016) medical records were exported and 300 samples were randomly collected	All adult patients who received PPIs and did not have systemic diseases were enrolled.	Development of a protocol, education and awareness campaign

Source: Prepared by the author (2024).

CLINICAL OUTCOMES

As shown by Mahmoudi *et al.* (2019), following the American Society of Health-System Pharmacists (ASHP) guidelines not only enhanced patient care quality but also led to significant cost savings for hospitals (Mahmoudi *et al.*, 2019). Amir *et al.* (2021) showed that pharmaceutical interventions played a key role in optimizing SRMD therapy, with a variety of recommendations such as parenteral to oral conversion and renal dose adjustment resulting in significant therapeutic improvements (Amir *et al.*, 2021). Bazan *et al.* (2021) found that the standardization of SRMD prophylaxis protocols resulted in significant cost savings without increasing bleeding events. The authors highlighted the importance of adherence to established protocols (Bazan *et al.*, 2021).

In the study by Hong *et al.* (2020), the implementation of continuous interventions led by guidance from a clinical pharmacist team through a Plan-Do-Check-Act (PDCA) cycle significantly reduced the rate of irrational PPI prescriptions, with a notable decrease in the total costs associated with these medications (Hong *et al.*, 2020). The PDCA cycle is a management tool for continuous improvement that is widely used in organizations to improve processes, products, and services. It consists of four interconnected stages: Plan stage, where goals and action plans are implemented; Do stage, where actions are executed; Check stage, where the results are monitored and compared with the established goals, and Act stage, where corrections and improvements are made based on what was learned during the process.

As demonstrated by Masood *et al.* (2018) and Luo *et al.* (2018), minimizing the inappropriate utilization of PPIs not only enhanced therapeutic efficacy but also markedly decreased hospital expenditures (Masood *et al.*, 2018; Luo *et al.*, 2018). Yailian *et al.* (2022) showed that interprofessional collaboration in the management of SRMD therapy resulted in the acceptance of pharmaceutical recommendations by physicians, contributing to the correction of prescription errors (Yailian *et al.*, 2022).

Taken together, these outcomes highlight the importance of multidisciplinary approaches, standardized protocols, and pharmaceutical interventions for improving the clinical outcomes and financial efficiency related to SRMD prophylaxis.

ECONOMIC RESULTS

Six of the nine studies analyzed (Mahmoudi *et al.*, 2019; Bazan *et al.*, 2021; Mousavi *et al.*, 2021; Luo *et al.*, 2018; Hong *et al.*, 2020; Yailian *et al.*, 2022) reported positive results

in terms of cost reduction for pharmacist-led interventions in all scenarios, as shown in Table 2.

Table 2 - Main results found.

Authors/Year	Results found
Mahmoudi <i>et al.</i> (2019)	In the study, 81.2% of patients received prophylactic treatments, with adherence to standard guidelines observed in 67.1% of cases. Following the implementation of ASHP guidelines by a clinical pharmacist, monthly savings exceeded US\$18,000.00, with projected annual savings surpassing US\$216,000.00.
Anstey <i>et al.</i> (2019)	The percentage of hospital prescriptions inadequately addressing SRMD prophylaxis decreased significantly from 42.4% (78/184) to 7.7% (11/143) post-implementation (odds ratio = 8.83; 95% CI 4.47-17.45; P < 0.0001). This reduction was accompanied by a decrease in <i>Clostridium difficile</i> infections from 10 patients pre-implementation to 1 patient post-implementation.
Amir <i>et al.</i> (2021)	During the pre-intervention period, pharmacists documented recommendations for SRMD therapy in only 4% (7 of 169) of cases. Following the intervention, clinical pharmacists made 80 recommendations out of 337 cases (23%). The most frequent recommendations included parenteral to oral conversion (40%), correction of dosing frequency (17.5%), conversion from omeprazole to ranitidine (17.5%), management of drug interactions (11.25%), and renal dose adjustment (7.5%). One adverse event was reported.
Franchitti <i>et al.</i> (2020)	Esomeprazole was used for SRMD prophylaxis in 686 (86.2%) patient-days. Overall, prophylaxis was inadequate for 558 (65.3%) patient-days, primarily due to unnecessary prescriptions (543 patient-days, 63.5%). Upon ICU discharge, SRMD prophylaxis was inadequately continued in 55 patients (51.9% of survivors), and similarly in 30 patients (28% of survivors) upon hospital discharge. The estimated annual hospital cost of appropriately prescribing prophylaxis was approximately \$3,100.
Bazan <i>et al.</i> (2021)	A total of 177 patients were included. Non-adherence to the SRMD prophylaxis protocol was significantly lower in the control group (64.7%) compared to the intervention group (90.9%; P < 0.0001), with comparable bleeding events. Actual cost savings from protocol adherence totaled US\$149.44 (US\$118.95 in control, US\$30.49 in intervention), while estimated total savings reached US\$948.56.
Hong <i>et al.</i> (2020)	Continuous CPGT-led intervention and a PDCA cycle significantly reduced irrational PPI use rates (53.06% vs. 8.57%), addressing duration, route of administration, indication, and dosing frequency. Costs per patient for total (US\$211.28 ± 162.33 vs. 53.17 ± 22.32) and inappropriate use (US\$76.70 ± 59.78 vs. 2.25 ± 3.86) were also significantly decreased.

Masood <i>et al.</i> (2018)	Reduction of 73.31% in the incidence of inappropriate PPI use (7.14 per 100 patient-days [n = 1,149 total patient-days]). Additionally, the total cost of inappropriate use was reduced to US\$239.80.
Luo <i>et al.</i> (2018)	After the intervention, omeprazole use decreased by 35% in 2016. Significant reductions were seen in both the average cost of the drug and overall PPI costs (P < 0.05). Improvements were observed in the inappropriate use of PPIs, including indications, drug selection, dosage, administration route, solvent, substitution, and duration (P < 0.05).
Yailian <i>et al.</i> (2022)	PPI-related issues primarily involved 'prescribing unavailable drugs' (26.1%) and 'unindicated use' (18.3%). The main pharmacist interventions included 'switching drugs' (35.9%) and 'discontinuing drugs' (26.1%). Physicians accepted a total of 18,919 pharmacist interventions (63.7% acceptance rate).

Source: Developed by the author (2024).

QUALITY OF STUDIES

Assessing the methodological quality of observational studies is a major challenge. We used the Newcastle-Ottawa Scale (NOS) (Herzog *et al.*, 2013) for cohort studies and the adapted NOS for cross-sectional studies (Herzog *et al.*, 2013) to measure the quality of the studies included in this review. The NOS is the most widely used instrument to evaluate the methodological quality of case-control and cohort studies in terms of sampling, selection, exposure, and clinical outcomes. A star is assigned to each item, resulting in scores ranging from 0 (worst) to 9 (best). The results are described in Table 3.

Only one of the nine studies analyzed obtained a score of 6, while all other studies had total scores less than 5.

A NOS score below 5 in most studies suggests several significant methodological limitations, such as selection bias in sampling, inconsistencies in exposure measurement, and lack of rigor in clinical outcome assessment. These deficiencies compromise the validity and reliability of the results, hindering the ability to generalize findings and trust in study replicability. Additionally, the presence of bias may diminish the utility of these studies in informing clinical practices or health policies.

Table 3 - The quality assessment of the included articles was conducted using the Newcastle-Ottawa Scale.

Study	Design	Selection	Comparability	Exposure	Total
Anstey <i>et al.</i> (2019)	Prospective cohort	1	2	3	6
Amir <i>et al.</i> (2021)	Retrospective cohort	1	1	1	3

Mahmoudi <i>et al.</i> (2019)	Prospective cohort	1	1	1	3
Hong <i>et al.</i> (2020)	Retrospective cohort	1	1	1	3
Yailian <i>et al.</i> (2022)	Retrospective observational	1	2	3	6
Franchitti <i>et al.</i> (2020)	Retrospective observational	1	1	1	3
Masood <i>et al.</i> (2018)	Retrospective observational	1	1	1	3
Luo <i>et al.</i> (2018)	Retrospective observational	1	1	1	3
Bazan <i>et al.</i> (2021)	Quasi-experimental	1	2	1	4

Source: Developed by the author (2024).

DISCUSSION

The primary findings comprised the clarification of indications for SRMD prophylactic pharmacotherapy, implementation of educational campaigns, regular patient medication reviews during clinical rounds, and adjustments in medication protocols. Throughout hospitalization, findings from five out of nine studies indicated that interventions led by pharmacists correlated with reduced incidences of inappropriate prophylactic pharmacotherapy (Amir *et al.*, 2021; Bazan *et al.*, 2021; Masood *et al.*, 2018; Luo *et al.*, 2018; Hong *et al.*, 2020). Franchitti *et al.* (2020) found that SRMD prophylaxis was deemed inappropriate in 558 patient-days (65.3%), primarily due to unwarranted prescriptions (543 patient-days). Additionally, upon ICU discharge, SRMD prophylaxis was not appropriately continued for 55 patients (51.9% of survivors).

Amir *et al.* (2021) listed other important interventions: parenteral to oral conversion (40%), wrong frequency (17.5%), conversion from omeprazole to ranitidine (17.5%), drug interaction (11.25%), and renal dose adjustment (7.5%). Similar results have been reported by Yailian *et al.* (2022), indicating that discrepancies in prophylactic therapy are incompatible with standard treatment guidelines and highlight the importance of deprescribing strategies for unnecessary pharmacological prophylaxis.

In 67% (6/9) of the reported studies, the pharmacist-led intervention was associated with significant cost savings (Mahmoudi *et al.*, 2019; Bazan *et al.*, 2021; Hong *et al.*, 2020; Masood *et al.*, 2018; Luo *et al.*, 2018; Yailian *et al.*, 2022).

Although several guidelines on SRMD prophylaxis have been published (ASHP, 2018; NICE, 2020; AGA, 2021; SSHP, 2022; WHO, 2023), inadequate prescription is significant and can compromise patient safety, for example, due to the association of PPIs (the class of drugs most used for prophylaxis) with *Clostridium difficile* infection, pneumonia, renal failure, and other adverse events (Pham *et al.*, 2006; Savarino *et al.*, 2018).

Limitations of this study include the possibility of not covering all relevant sources of literature due to the specific selection of databases and the focus on the last five years of publications until November 2022. Additionally, the descriptive approach to the studies may have limited the analysis of more in-depth data or critical evaluation of the results. Furthermore, the integrative review may be subject to selection and publication biases, as only available and published articles were considered. These limitations should be considered when interpreting the results and generalizing the conclusions of this study.

The role of the clinical pharmacist in developing guidelines, protocols, or pharmacotherapy algorithms for LAMG prophylaxis, combined with participation in multidisciplinary rounds, appears to be the most suitable intervention strategy to achieve better clinical and economic outcomes (Amir *et al.*, 2021; Bazan *et al.*, 2021; Hong *et al.*, 2020; Yailian *et al.*, 2022).

FINAL CONSIDERATIONS

Based on the findings of this review, it is concluded that the role of the clinical pharmacist is crucial in reducing the unjustified use of proton pump inhibitors (PPIs) in the prophylaxis of acute gastric mucosal injury (AGMI) in patients admitted to ICU. Strategies led by pharmacists, such as the development of guidelines/protocols or algorithms for AGMI pharmacotherapy, combined with active participation in multidisciplinary rounds, have proven to be effective in improving clinical and economic outcomes. The implementation of these strategies resulted in a significant reduction in inappropriate pharmacotherapy, enhancing the quality of patient care and generating substantial cost savings for hospitals. However, it is important to emphasize the need for further studies to continually assess and update these strategies according to new recommendations and available evidence. In summary, interprofessional collaboration and active involvement of the clinical pharmacist — a core component of clinical pharmacy practice — are essential for optimizing AGMI prophylaxis in ICUs and ensuring better outcomes for patients.

DATA AVAILABILITY

All data used were compiled from publicly accessible sources, such as electronic databases and scientific publications. Readers interested in examining the underlying data of this study more closely can access it through the cited references or by contacting the authors directly. However, it is important to note that some data may not be available due to confidentiality or intellectual property restrictions. In such cases, the authors are available to provide additional information about the methodology and results of the study within the limits allowed by data sharing policies.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest regarding the publication of this article.

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