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Evaluation of Omeprazole prescription for stress ulcer prophylaxis in a public trauma referral hospital: monocentric cross-sectional study

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Abstract

Objective: To evaluate the compliance to indication and prescription of Omeprazole, for stress ulcer prophylaxis in intensive care units and and hospital wards, in a public emergency and urgency hospital that is a referral in trauma, according to scientific evidence and criteria used in the present study. **Method:** This is a retrospective cross-sectional study. The research was carried out over a period of one day, on March 15,2023. Clinical data, previous medical history, health conditions, and eletronic prescriptions were analysed. Data were collected from all hospitalized patients aged 18 years or older. Patients without a Hospital Admission Authorization and those using omeprazole for other treatment purposes were excluded. To assess the indication for prophylaxis, the recommendations from the UpToDate database were used, on the risk factors for stress ulcers, in this database, were also listed in the guideline of the Portuguese Society of Intensive Care or in the BMJ-Best Practice, according to the practice guideline "Gastrointestinal bleeding prophylaxis for critically ill patients: a clinical practice guideline". The data were analysed in the R software, version 4.1.1, and the results were presented in tables. **Results:** A total of 307 patients were screened, of whom 254 were considered eligible for evaluation of prophylaxis indication. Overall, 61.4%of patients showed adequate use. However, for 72.8% of patients prescribed omeprazole, there was no indication for its use, and among patients with an indication, prophylaxis was omitted for 17.1%. The non-critical patients' wards had a percentage of 88.9% of patients prescribed prophylaxis, but without indication, while intensive care units had 31.4%. **Conclusion:** The study showed a considerable inadequacy in the use of stress ulcer prophylaxis in non-critical wards and, although smaller, a relevant inadequacy in intensive care units. Therefore, stands out the importance of establishing institutional interventions, such as a clinical protocol, to guide prescription practice.

Keywords: care unit, intensive, proton pump inhibitors, omeprazole, ulcer, prophylaxis, gastrointestinal bleeding.

Avaliação da prescrição de omeprazol para profilaxia de úlcera de estresse em um hospital público referência em trauma: estudo transversal monocêntrico

Resumo

Objetivo: Avaliar a conformidade da indicação e prescrição de omeprazol para profilaxia de úlcera de estresse, nas unidades de terapia intensiva e demais setores de internação, em um hospital público de urgência e emergência referência em trauma, de acordo com evidências científicas e critérios utilizados no presente estudo. **Métodos:** O estudo é do tipo transversal retrospectivo. A pesquisa foi realizada no período de um dia, na data de 15/03/2023. Foram analisados dados clínicos, história prévia pregressa, condições de saúde, prescrições eletrônicas e coletados dados de todos os pacientes internados, com idade igual ou superior a 18 anos. Foram excluídos os pacientes sem Autorização de Internação Hospitalar e os em uso de omeprazol para fins de tratamento. Para a avaliação de indicação da profilaxia, utilizou-se as recomendações da base de dados UpToDate, caso os fatores de risco para úlcera de estresse, descritos nessa base, estivessem elencados também na diretriz da Sociedade Portuguesa de Cuidados Intensivos ou no *BMJ Best Practice*, conforme a diretriz de prática "*Gastrointestinal bleeding prophylaxis for critically ill patients: a clinical practice guideline*". Os dados foram analisados no software R, versão 4.1.1, e os resultados foram apresentados em tabelas. **Resultados:** Foram mapeados 307 pacientes, dos quais 254 foram considerados elegíveis para a avaliação da indicação da profilaxia. No geral, 61,4% dos pacientes apresentaram uso adequado. Entretanto, para 72,8% dos pacientes com prescrição de omeprazol, não havia indicação para sua utilização, e, entre os pacientes com indicação, para 17,1% a profilaxia foi omitida. O setor de pacientes não críticos apresentou percentual de 88.9% dos pacientes com prescrição da profilaxia, porém sem indicação, enquanto as unidades de terapia intensiva apresentaram 31,4%. **Conclusão:** O estudo revelou uma considerável inadequação

no uso da profilaxia de úlcera de estresse em setores não críticos e, embora menor, também uma inadequação relevante nas unidades de terapia intensiva. Desta forma, ressalta-se a importância de estabelecer intervenções institucionais, como protocolo clínico, para orientar a prática de prescrição.

Palavras-chave: unidades de terapia intensiva, inibidores da bomba de prótons, omeprazol, úlcera, profilaxia, sangramento gastrointestinal.

Introduction

Stress ulcer (SU) is an erosive lesion that occurs in the mucosa of the upper gastrointestinal tract[1]. It typically begins in the stomach within hours after trauma or severe illness[2-4].

Gastrointestinal bleeding due to SU is a potential complication in critically ill patients[5]. Therefore, SU prophylaxis is considered an important aspect of care for critically ill patients with risk factors for gastrointestinal bleeding[6-7]. Clinically significant bleeding can lead to undesirable outcomes such as increased length of hospital stay, mortality, and healthcare costs[8].

In this context, proton pump inhibitors (PPIs), such as omeprazole, are recognized as indicated and effective medications for prophylactic use[8-10]. However, inappropriate use of PPIs may expose patients to the risk of adverse events, such as increased creatinine and urea levels, development of chronic kidney disease, hypomagnesemia, decreased vitamin B12 absorption, and hyponatremia[11-12]. Additionally, studies highlight the increased risk of *Clostridioides difficile* infection and nosocomial pneumonia[13-14].

Discontinuation of prophylaxis is considered after the resolution of risk factors or discharge from the intensive care unit (ICU), unless criteria for continued use persist. However, the exact timing of discontinuation remains uncertain[1,15]. Biyase N, et al., in a study conducted in ICUs, identified that among all patients receiving prophylaxis, its use was considered appropriate in only 38.5% of cases[16]. Furthermore, research shows inappropriate use of prophylaxis in 88.5% of cases among non-critical patients[15]. Araújo SN, et al., in a study conducted in non-intensive care units, reported that 99% of patients received prescriptions without a valid indication[17].

In the literature, studies involving SU prophylaxis in emergency and trauma reference hospitals are scarce, as shown in the literature review mentioned in the "Methods" section, under "Methodology for Guideline Search on SU Prophylaxis." Therefore, the aim of this study was to evaluate the compliance of the indication and prescription of omeprazole for SU prophylaxis in intensive care units and other inpatient wards of a public emergency and trauma reference hospital, based on scientific evidence and the criteria adopted in this study.

Methods

This is a retrospective cross-sectional study aimed at evaluating stress ulcer (SU) prophylaxis, conducted at Hospital João XXIII, located in Belo Horizonte, Minas Gerais. The institution is a public hospital that provides high-complexity care in emergency and urgent situations, and it serves as a referral center for polytrauma, major burns, intoxications, and clinical and/or surgical conditions with life-threatening risks. It is also a teaching hospital that receives medical and multiprofessional residents. The study was approved by the Research Ethics Committee of the Hospital Foundation of the State of Minas Gerais (FHEMIG), under approval number CAAE 71282123.4.0000.5119.

The study was conducted in the adult intensive care units (ICUs), including the Adult ICU and the Severe Burn Treatment Unit (UTQ), as well as in non-critical care wards (neurology, internal medicine, general surgery, plastic surgery, and burn wards), the Progressive Care Unit (PCU), the emergency department, and the surgical block. The study was carried out on a single day, March 15, 2023.

Inclusion and Exclusion Criteria

All adult patients aged 18 years or older who were hospitalized on March 15, 2023, were included in the study. Patients without Hospital Admission Authorization (AIH) and those using omeprazole for treatment purposes were excluded, specifically when gastrointestinal bleeding was suspected or confirmed, as recorded in the medical chart through evidence of gastrointestinal hemorrhage, melena, blood in the nasogastric aspirate, hematemesis, or upper gastrointestinal endoscopy (UGIE). Study subjects were identified using the PENTAHO software (a platform used in the hospital for data search, processing, analysis, and monitoring), in collaboration with the Medical and Statistical Records Service (SAME).

Data Collection

Data collection was carried out using an instrument developed by the researchers. Electronic medical records were analyzed, and demographic and epidemiological data were collected, along with information on the hospitalization unit, nutritional status, comorbidities, and clinical data such as: Glasgow Coma Scale (GCS), creatinine, total bilirubin, lactate, leukocyte count, prescribed norepinephrine, platelet count, international normalized ratio (INR), activated partial thromboplastin time (aPTT), prescribed glucocorticoids, prescribed enteral diet, enteral diet in relation to total energy expenditure (TEE), and the presence of relevant health conditions for deciding whether or not to initiate SU prophylaxis. These conditions included traumatic spinal cord injury, %TBSA (total body surface area burned), sepsis, and septic shock. Specific data on omeprazole prescriptions—such as dose, route, and frequency of administration—were also collected.

Guideline Search Methodology for SU Prophylaxis

The guideline mapping was conducted in December 2022 using the Medline database via PubMed and LILACS via the Virtual Health Library (VHL). The only filter applied was the publication period, limited to the past 5 years (2017–2022). The objective was to identify guidelines with recommendations for SU prophylaxis, as well as studies and research on the topic. Descriptors were identified using controlled health vocabularies (DeCS and MeSH).

References were searched using the descriptors listed below, along with their synonyms and translations, combined using the Boolean operators AND and OR.

PubMed Search Strategy: "Mass Drug Administration", "Primary Prevention", "Disease Prevention", "Preventive Medicine", "Proton Pump Inhibitors", Omeprazole, "stress ulcer", "Stomach Ulcer", "Peptic Ulcer", "Duodenal Ulcer", "Peptic Esophagitis", "Peptic Ulcer Perforation".

VHL Search Strategy: "úlcera péptica", "Hemorragia gastrointestinal", "Peptic Ulcer", "gastrointestinal bleeding", "Gastrointestinal hemorrhage", "Úlcera de estresse", "Úlcera Gástrica", "gastric ulcer", "Stomach Ulcer", "Stress Ulcer", "Cuidados críticos", "critical care", "Terapia intensiva", "Cuidado Intensivo", "Intensive therapy", "Intensive Care", "Unidade* de Terapia Intensiva", ICU, critical care unit, "Intensive Care Units", "Prevenção de doença*", "disease prevention", "Inibidor* da Bomba de Prótons", "Proton Pump Inhibitors", omeprazole*, "Inappropriate prescribing", "Prescrição inapropriada", "stress ulcer prophylaxis", prophylaxis.

The search returned two recommendations: one from the Portuguese Society of Intensive Care Medicine[15] and a clinical practice guideline published in BMJ Best Practice, titled "Gastrointestinal bleeding prophylaxis for critically ill patients: a clinical practice guideline"[7]. However, the latter did not include polytrauma patients.

Searches were also conducted on the Brazilian Medical Association's Guidelines Project, the Society of Critical Care Medicine (SCCM), and the European Society of Intensive Care Medicine (ESICM), but no protocol specific to SU prophylaxis was found. Similarly, searches were performed on the American Society of Health-System Pharmacists (ASHP) and the Eastern Association for the Surgery of Trauma (EAST), where protocols from 1999 and 2008[4,6] were identified, respectively.

Finally, the recommendation available in the UpToDate database[1-3] was chosen to assess the indication for SU prophylaxis, after confirming alignment with the results obtained from PubMed and VHL. UpToDate is a clinical decision support database that is periodically updated with new scientific evidence. Additionally, the Micromedex[18] database was also used to establish specific criteria for dosage, administration route, and frequency of the acid suppressant under evaluation.

Recommendations for Evaluating the Indication of SU Prophylaxis

The recommendations for evaluating the indication of SU prophylaxis, according to the UpToDate database, are presented in Table 1.

In the present study, for the evaluation of prophylaxis indication, high-risk factors defined in the UpToDate[1] database were considered, provided they were also specified in the guidelines from the Portuguese Society of Intensive Care Medicine[15] or the BMJ Best Practice guideline titled *"Gastrointestinal bleeding prophylaxis for critically ill patients: a clinical practice guideline"*[7]. Table 2 presents the criteria for the indication of SU prophylaxis considered in this study.

Additionally, prophylaxis was evaluated for critically ill patients who did not meet the high-risk criteria, such as patients with burns involving 20% to 35% of total body surface area (TBSA), which are considered severe burns[19], and patients receiving enteral nutrition (EN) and with three or more comorbidities, as specified in Table 1 under the section *"Patients without high-risk indication criteria"*.

UpToDate suggests continuing prophylaxis after ICU discharge if risk factors persist. Therefore, criteria for prophylaxis indication were defined for use outside the ICU, regardless of whether patients had been previously admitted to the ICU or not, as detailed in Table 2.

Acid Suppressant Evaluated

The drug evaluated in this study was omeprazole, the only acid suppressant included in the institution's formulary. Appropriate use was defined as 40 mg intravenously and 20 mg orally or via enteral tube (as long as prescribed with dilution in sodium bicarbonate), with an administration frequency of every 24 hours, in accordance with the criteria outlined in the section *"Guideline Search Methodology for SU Prophylaxis"[7,15,18].

Appropriate Use of Prophylaxis

The appropriate use of omeprazole in this study was defined as when indicated and prescribed, and when not indicated and not prescribed. Additionally, a separate evaluation was performed specifically for patients who had an omeprazole prescription, in order to determine the percentage of patients who were prescribed the drug without an appropriate indication. A patient was considered to have no indication for omeprazole prescription if none of the risk factors defined in this study were present.

Data Analysis Methodology

The information obtained from the medical records, as outlined in the *"Data Collection"* section under *"Methods"*, was analyzed to assess the indication for SU prophylaxis, according to the criteria established in the section *"Recommendations for Evaluating the Indication of SU Prophylaxis"*. The initial assessment of indication was conducted by a pharmacy resident and subsequently reviewed by a clinical pharmacist and an intensive care physician—both co-authors of this study and qualified to perform such analysis.

Data analysis was performed using R software, version 4.1.1. Results were presented in tables. Categorical variables were expressed as absolute and relative frequencies, while numerical variables were presented as mean ± standard deviation.

Results

Sample Composition

A total of 307 hospitalized patients were mapped on March 15, 2023, and, after evaluating the inclusion and exclusion criteria described in the "Methods" section, 254 patients were deemed eligible for evaluation of stress ulcer (SU) prophylaxis indication. Among the ineligible patients, the following were identified: 26 minors, 7 without Hospitalization Authorization (AIH), 9 with duplicate records, 1 admitted deceased, 1 without data for analysis, and 9 with suspected or confirmed gastrointestinal bleeding.

The mean age of the patients was 50.6 ± 17.9 years; 140 (55.1%) were between 30 and 59 years old, and 188 (74%) were male. The most frequent diagnosis was trauma, including traumatic brain injury (TBI), fractures, and others, representing 152 (59.8%) of the eligible subjects. Regarding comorbidities, 151 (59.4%) had none, while 19 (7.5%) had three or more comorbidities. Among these 19 patients, 13 were evaluated without criteria for prophylaxis indication, while the remaining had high-risk factors. In addition, 51 patients (20.08%) were identified with enteral nutrition (EN) prescriptions in the ICU, Burn ICU (UTQ), and Progressive Care Unit (UCP). Of these, 10 (19.6%) had EN meeting total energy expenditure (TEE) targets, 11 (21.56%) had EN not meeting TEE, and in 30 (58.82%) it was not possible to determine whether the EN met TEE goals. However, 12 of those 30 patients had no indication for prophylaxis, and among the 18 with indication, 13 had indications based on other risk factors, independent of EN status. Table 1 presents the sociodemographic and clinical characteristics of the sample.

Description of Risk Factors for Gastrointestinal Bleeding and Quantification of Patients with SU Prophylaxis Indication

Considering the total of 254 eligible patients, the following risk factors for gastrointestinal bleeding were identified, along with the number of patients presenting each risk factor and those with indication for SU prophylaxis:

- 11 (4.3%) patients with coagulopathy (*8 with prophylaxis indication*);
- 18 (7.1%) patients on mechanical ventilation (MV) > 48 hours (*16 with indication*);
- 2 (0.8%) patients with chronic liver disease (*none with indication*);
- 80 (31.5%) patients with TBI (*18 with indication*);
- 6 (2.4%) patients paraplegic due to spinal cord injury (*1 with indication*);
- 8 (3.1%) patients tetraplegic due to spinal cord injury (*all with indication*);
- 21 (8.3%) patients with burn injuries (*4 with indication*);
- 8 (3.1%) patients with two or more minor criteria (*all with indication*).

The most frequent high-risk factor for which prophylaxis was indicated was TBI, followed by MV > 48 hours. Among the 18 TBI patients with indication, 15 had a Glasgow Coma Scale (GCS) ≤ 12, and for the 3 with GCS > 12, it was not possible to determine whether EN met TEE targets. However, 1 of these 3 had indication due to other risk factors. Of the 18 patients on MV > 48 hours, 2 were not indicated for prophylaxis due to EN meeting TEE targets. For the 16 with indication, it was not possible to determine TEE status in 11, but 8 of those 11 had other qualifying risk factors, as did 1 of the 2 who were initially not indicated. Additionally, 4 patients had prophylaxis indication due to burn injuries, with 2 having TBSA > 35%, and 2 with TBSA between 20–35% combined with EN not meeting TEE targets. Among the 11 patients with coagulopathy, 3 had no indication because their INR elevation was related to anticoagulant therapy in non-ICU units. Finally, among the 8 patients with two or more minor criteria, all had sepsis, 3 had septic shock, 5 had acute kidney injury (AKI), and 1 was on corticosteroid therapy (hydrocortisone > 250 mg).

Distribution of Patients According to Omeprazole Indication and Prescription

Regarding the indication and prescription of omeprazole, among the 254 patients, 125 (49.2%) had a prescription for the acid suppressant, while 129 (50.8%) did not. Among the 125 patients with a prescription, 34 (27.2%) had a proper indication for prophylaxis, which was correctly prescribed. However, for 91 patients (72.8%), no indication for prophylaxis was identified based on the scientific evidence and the criteria used in this study. Among the 129 patients without a prescription, 7 (5.43%) had an indication for prophylaxis but did not receive a prescription. The remaining 122 patients (94.57%) had no indication, and prophylaxis was not prescribed.

Overall, 156 of the 254 patients (61.4%) received appropriate prophylaxis use, meaning either prophylaxis was indicated and prescribed (34 patients), or not indicated and not prescribed (122 patients). As described in the "Methods" section under "Appropriate Use of Prophylaxis," omeprazole use was deemed appropriate when it was both indicated and prescribed, or not indicated and not prescribed. Additionally, considering only the 41 patients with an indication for prophylaxis, 7 cases (17.1%) had prophylaxis omitted. Among the 34 patients with both indication and prescription, all had appropriate dosing and route of administration, with only one patient receiving an inappropriate dosing frequency.

Frequency of Appropriate Prophylaxis Use

Table 2 presents the frequency of appropriate use of stress ulcer prophylaxis and the distribution of patients by indication and omeprazole prescription, broken down by hospital unit. In general, the ICUs (adult ICU and burn ICU) showed an appropriate use rate of 68.9%, corresponding to 31 of 45 patients. The other hospital sectors had a combined rate of 59.8%, equivalent to 125 of 209 patients. Individually: The adult ICU had an appropriate use rate of 63.9% (23 patients). The burn ICU (UTQ) had the highest rate, with 88.9% (8 patients). The sector with the lowest rate of appropriate use was the burn ward, with 2 patients (20.0%) —all cases of < 20% TBSA among those with inappropriate use. Other units with low rates included the emergency department (21 patients, 44.7%) and the general surgery ward (14 patients, 45.2%). In contrast, the units with the highest frequencies of appropriate use were: internal medicine ward (24 patients, 88.9%), plastic surgery ward (22 patients, 71%), and again, the burn ICU (UTQ, 8 patients, 88.9%). Furthermore, considering only patients with omeprazole prescriptions, among the 209 non-critical patients, 90 (43.1%) had a prescription for the acid suppressant. However, in 80 of these (88.9%), there was no indication for prophylaxis. In the ICUs (adult ICU and UTQ), 35 patients received a prescription, but in 11 cases (31.4%), no indication was found.

Frequency of Appropriate Omeprazole Use by Unit and Risk Factor

A high frequency of appropriate omeprazole use was observed for the following risk factors: coagulopathy, mechanical ventilation (MV) > 48 hours, chronic liver disease, and minor criteria. For the criterion MV > 48 hours, the use was appropriate in 100% of patients in the ICUs (adult ICU: 11 patients, 100.0%; burn ICU: 3 patients, 100.0%). In contrast, the risk factor with the lowest rate of appropriate use was tetraplegia due to traumatic spinal cord injury. The data mentioned are presented in Table 3.

Table 1. UpToDate Recommendations for Stress Ulcer Prophylaxis in the ICU (March 2023).

High-risk criteria for prophylaxis indication
Coagulopathy (platelet count < 50,000, INR > 1.5, and aPTT > 2 times the control value)
Mechanical ventilation > 48 hours (especially in patients without enteral nutrition)
Chronic liver disease
Traumatic brain injury (i.e., cranioencephalic trauma)
Traumatic spinal cord injury
Burns covering > 35% of total body surface area (TBSA)
History of gastrointestinal ulceration or bleeding in the past year
Use of nonsteroidal anti-inflammatory drugs (NSAIDs) or antiplatelet agents
Two or more of the following minor criteria: sepsis, ICU stay longer than one week, occult gastrointestinal bleeding for six or more days, glucocorticoid therapy (> 250 mg of hydrocortisone or equivalent)
Patients without high-risk criteria for prophylaxis indication
In these cases, UpToDate recommends individual assessment and consideration of factors that may influence the decision to initiate prophylaxis, including: enteral nutrition, number of comorbidities (≥ 3) and severity of illness.

INR – International Normalized Radio; aptt – Activated Partial Thromboplastin Time; TBSA – Total Body Surface Area. Adapted by the authors, 2024.

Table 2. Criteria for Indicating Stress Ulcer Prophylaxis Considered in This Study

Prophylaxis Indication in ICUs
Coagulopathy (platelet count < 50,000; INR > 1.5; and aPTT > 2 times the control value);
Mechanical ventilation > 48 hours (if enteral nutrition outside estimated total energy expenditure [TEE] or if TEE not identified);
Chronic liver disease
Traumatic brain injury (TBI) (if Glasgow Coma Scale [GCS] score on the day of data collection was ≤ 12; for GCS > 12, only if enteral nutrition was outside TEE or TEE not identified);
Traumatic spinal cord injury (if the patient was tetraplegic or paraplegic);
Burn injury (if TBSA > 35%; for TBSA between 20–35%, only if enteral nutrition was outside TEE or TEE not identified);
Two or more of the following minor criteria: sepsis; acute kidney injury (AKI); glucocorticoid therapy > 250 mg of hydrocortisone or equivalent; shock as described in the medical record and presence of one or more of the following: continuous infusion of vasopressors or inotropes, systolic blood pressure [SBP] < 90 mmHg, mean arterial pressure [MAP] < 70 mmHg, or plasma lactate level ≥ 4 mmol/L.
Prophylaxis in Non-ICU Settings
Coagulopathy: prophylaxis was not considered in cases where elevated INR was due to warfarin or rivaroxaban use;
TBI: prophylaxis was considered in the Progressive Care Unit (PCU) only in cases with GCS ≤ 12;
Traumatic spinal cord injury: prophylaxis was considered for tetraplegic patients in the PCU and wards, and for paraplegic patients only in the PCU;
Mechanical ventilation > 48 hours and minor criteria were considered for prophylaxis in the PCU.

INR – International Normalized Ratio; aPTT – Activated Partial Thromboplastin Time; MV – Mechanical Ventilation; TEE – Total Energy Expenditure; TBI – Traumatic Brain Injury; GCS – Glasgow Coma Scale; TBSA – Total Body Surface Area; AKI – Acute Kidney Injury; SBP – Systolic Blood Pressure; MAP – Mean Arterial Pressure; mmol – Millimole; L – Liter; PCU – Progressive Care Unit. Adapted by the authors, 2024.

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Table 1. Sample Characterization (n = 254).

	Frequencies Absolute	Relative (%)
Age[1]	50.6 ± 17.9	
	49.0 (36.0 – 63.8)	
18 to 29 years	33	13.0
30 to 59 years	140	55.1
60 years or older	81	31.9
Sex		
Female	66	26.0
Male	188	74.0
Length of stay until 03/15/2023[2]	35.6 ± 62.7	
	11.0 (4.0 – 38.8)	
Diagnosis		
Trauma	152	59.8
Burns	19	7.5
Circulatory system diseases	16	6.3
Skin diseases	12	4.7
Others	55	21.7
Hospital unit		
Emergency Department	47	18.5
Surgical Block	3	1.2
Adult ICU	36	14.2
PCU	25	9.8
General Surgery Ward	31	12.2
Neurology Ward	35	13.8
Internal Medicine Ward	27	10.6
Plastic Surgery Ward	31	12.2
Burns Ward	10	3.9
Burn ICU	9	3.5
Comorbidities		
Patients with up to 5 comorbidities		
0	151	59.4
1	58	22.8
2	26	10.2
3	11	4.3
4	7	2.8
5	1	0.4
Prevalence of Comorbidities		
Arterial hypertension	68	26.8
Diabetes mellitus	41	16.1
Chronic kidney disease	14	5.5
Stroke	13	5.1
Asthma	10	3.9
Heart failure	10	3.9
Others	20	7.87
Overweight/Obesity	47	18.5
Alcohol use	56	22.0
Smoking	46	18.1
Enteral nutrition within TEE – ICU, PCU, and BICU (n = 51)	10	19.6

[1,2] Mean ± standard deviation and median (1st quartile – 3rd quartile); ICU – Intensive Care Unit; PCU – Progressive Care Unit; BICU – Burn Intensive Care Unit; TEE – Total Energy Expenditure. Adapted by the authors, 2024.

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Table 2. Distribution of patients regarding omeprazole indication and prescription by hospital unit (n=%).

Unit	Proton Pump Inhibitor (omeprazole)				Appropriate Use	Inappropriate Use
	Indicated		Not Indicated			
	Prescribed	Not Prescribed	Prescribed	Not Prescribed		
Emergency Room	0 (0.0)	0 (0.0)	26 (55.3)	21 (44.7)	21 (44.7)	26 (55.3)
Surgical Ward	0 (0.0)	0 (0.0)	1 (33.3)	2 (66.7)	2 (66.7)	1 (33.3)
Adult ICU	18 (50.0)	3 (8.3)	10 (27.8)	5 (13.9)	23 (63.9)	13 (36.1)
PCU	10 (40.0)	1 (4.0)	7 (28.0)	7 (28.0)	17 (68.0)	8 (32.0)
General Surgery Ward	0 (0.0)	0 (0.0)	17 (54.8)	14 (45.2)	14 (45.2)	17 (54.8)
Neurology Ward	0 (0.0)	2 (5.7)	10 (28.6)	23 (65.7)	23 (65.7)	12 (34.3)
Internal Medicine Ward	0 (0.0)	0 (0.0)	3 (11.1)	24 (88.9)	24 (88.9)	3 (11.1)
Plastic Surgery Ward	0 (0.0)	1 (3.2)	8 (25.8)	22 (71.0)	22 (71.0)	9 (29.0)
Burn Unit	0 (0.0)	0 (0.0)	8 (80.0)	2 (20.0)	2 (20.0)	8 (80.0)
SBTU	6 (66.7)	0 (0.0)	1 (11.1)	2 (22.2)	8 (88.9)	1 (11.1)

ICU – Intensive Care Unit; PCU – Progressive Care Unit; SBTU – Severe Burn Treatment Unit. Adapted by the authors, 2024.

Table 3. Frequency of appropriate omeprazole use by hospital unit and risk factor for stress ulcer.

Risk Factor	Unit					
	Surgical Block	Inpatient Units	Emergency Room	UCP	ICU	UTQ
Coagulopathy	-[1]	3 (100.0)	-	1 (100.0)	4 (80.0)	2 (100.0)
MV > 48 hours	-	-	-	3 (75.0)	11 (100.0)	3 (100.0)
Chronic liver disease	-	2 (100.0)	-	-	-	-
Traumatic brain injury	0 (0.0)[2]	38 (82.6)	5 (62.5)	6 (66.7)	12 (75.0)	-
Traumatic spinal cord injury (paraplegic)	-	2 (40.0)	-	-	1 (100.0)	-
Traumatic spinal cord injury (tetraplegic)	-	0 (0.0)[3]	-	3 (75.0)	0 (0.0)[4]	-
Burn injury	-	3 (27.3)	0 (0.0)[5]	-	-	8 (88.9)
Two or more minor criteria	-	-	-	-	4 (80.0)	3 (100.0)

[1] The dash (–) in the table indicates that there are no patients in the sector with the risk fator; [2](1), [3](3), [4](1), [5](1): the number in parentheses in this footnote indicates the total number of patients with the risk factor in the sector, and (0.0) shown in the table body indicates that no patient had appropriate use of omeprazole; UCP- Progressive Care Unit; MV- Mechanical Ventilation; ICU- Intensive Care Unit; UTQ- Burn Treatment Unit. Prepared by the authors, 2024.

Discussion

The purpose of this study was to assess the appropriateness of omeprazole indication and prescription for stress ulcer prophylaxis (SUP) in the ICUs and other hospital inpatient units. The study identified a significant inadequacy in prophylaxis use. The overall results showed that 72.8% of patients received prophylaxis prescriptions without having an actual indication for its use. A previous study using the same definition of appropriate use also found that inappropriate prophylaxis use mostly resulted from prescription without indication[20].

It is assumed that the high percentage of inappropriate prescriptions observed in this study—i.e., prophylaxis prescribed without indication—may be explained by fear of suspending or omitting prophylaxis and thereby causing clinically significant bleeding, as well as the lack of reassessment of patients who no longer met prophylaxis criteria as their clinical condition evolved. Previous studies suggest that older age and longer hospital stays may be predictors of overuse[17,21]. Although this study did not analyze the length of hospital stay by unit, as done by Araújo SN et al.[17], it considers that this may be a contributing factor to prophylaxis overuse.

Additionally, the hospital does not have a clinical protocol for SUP, there is no universally accepted practice guideline, and existing recommendations vary regarding the indications for stress ulcer prophylaxis. These factors may also contribute to inappropriate use.

The rate of inappropriate use was lower among patients who did have risk factors (17.1%). Nevertheless, this finding warrants attention, since omission of prophylaxis in high-risk patients may increase length of hospital stay, mortality, and healthcare costs due to clinically important bleeding[22].

The rate of prescription without indication was notably higher in non-critical care units, where 88.9% of patients with a prescription had no indication. This has also been reported in previous studies[17,23-24]. In the ICUs, the rate of appropriate use was 63.9% in the adult ICU and 88.9% in the burn ICU (UTQ). These findings are similar to those reported in other ICU-based studies[25,5].

The higher rate of appropriate prophylaxis use in the ICUs may be related to the fact that available guidelines are specifically targeted at critically ill patients. Conversely, the high rate of prescription without indication in other units underscores the need for implementing an institutional protocol and interdisciplinary education regarding appropriate prophylaxis use.

Among the units with the lowest frequency of appropriate omeprazole use, the burn ward stands out, where prophylaxis was prescribed to all patients with < 20% TBSA, which is inconsistent with scientific evidence supporting SUP only in severe burn cases[1,15,19]. In the general surgery ward, all patients who received omeprazole prescriptions had no indication for it. Excessive prophylaxis use in general surgery patients was also reported by Bez C et al.[24], who found that 88% of patients were inappropriately prescribed prophylaxis at hospital discharge.

It was not within the scope of this study to assess discharge prescriptions; however, this is a plausible scenario, particularly in non-critical patients who are inappropriately using prophylaxis. This issue is concerning, as patients may continue using the medication indefinitely, increasing the risk of adverse events or drug interactions. This further reinforces the need for institutional interventions.

It is important to highlight that the three clinical guidelines used in this study served as the basis for defining indication criteria. Regarding enteral nutrition (EN), its role has been widely discussed in the scientific community[26-28]. Some studies suggest that EN tolerance alone may be effective as prophylaxis[29-30] and that combining it with pharmacological therapy may increase the risk of nosocomial pneumonia[31]. The recommendations used in this study support the idea that EN can be used to determine the duration of prophylaxis[1,3], to discontinue prophylaxis in the absence of risk factors[15], and to assess continuation of prophylaxis in patients with mechanical ventilation (MV)[7,1].

Regarding traumatic brain injury (TBI), the UpToDate database[1], as well as most clinical guidelines[4,6], recommend stress ulcer prophylaxis (SUP) in all cases of TBI, whether mild, moderate, or severe. Other studies support its use primarily in severe TBI[15,32]. In this study, the severity of TBI was assessed; however, the indication for prophylaxis was based on the Glasgow Coma Scale (GCS) score on the day of data collection. As for spinal cord injury, studies highlight that patients with cervical lesions are at high risk for gastrointestinal bleeding, even during rehabilitation. Therefore, SUP was considered important even outside the ICU setting[33-34].

One of the strengths of this study was the inclusion of all hospitalized patients in the institution. However, it has some limitations, such as the possibility that the sample may not be representative. Additionally, as a retrospective study using data exclusively from electronic medical records, the accuracy of information may be compromised by missing or incorrect documentation, leading to information bias. Another point to consider is that, being a single-center study, the findings may not reflect the reality of other healthcare settings, although they are in line with previous studies. Moreover, cross-sectional studies do not allow for an assessment of temporal trends, and data collected on a single day may not reflect the usual variability in healthcare services.

Finally, this study confirms an international trend of inappropriate SUP use, which may result in adverse events[11]. The association between proton pump inhibitors (PPIs) and the development of infections, particularly *Clostridioides difficile* infection and nosocomial pneumonia, has been widely studied[13-35]. Inappropriate use may also lead to increased mortality, length of hospital stay, and healthcare costs. For instance, considering the patients with inappropriate prescriptions in this study (27 using injectable omeprazole and 64 using capsules), and using current drug prices from the hospital's Pharmaceutical Supply Center—R$ 5.61 per injectable unit and R$ 0.07 per capsule—the potential cost savings would be R$ 4,678.50 per month and R$ 56,142.00 annually. If we consider 91 patients using injectable omeprazole, the annual savings could reach R$ 183,783.60.

Thus, the importance of institutional interventions is emphasized. Previous studies have positively evaluated the implementation of SUP protocols, along with educational strategies, in reducing inappropriate use without increasing rates of gastrointestinal bleeding, and have also demonstrated positive economic impacts on therapy costs[36-37].

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Conclusion

This study observed considerable inadequacy in SUP use, particularly in non-critical care units, and to a lesser extent, also in intensive care units (ICUs). Therefore, it emphasizes the need for institutional interventions, such as the development of clinical protocols, to guide prescribing practices—especially in teaching hospitals, where high staff turnover is common.

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FDS, FBC, ACAFM: Study design, data collection and analysis, manuscript drafting. All authors approved the final version to be published and are responsible for the accuracy and integrity of all parts of the work.

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Conflict of Interest Statement

The authors declare no conflicts of interest related to this article.

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