

Analysis of potentially inappropriate medications in two cardiac intensive care units: a cross-sectional study

Análise dos medicamentos potencialmente inapropriados em duas unidades cardio intensivas: estudo transversal

Análisis de medicamentos potencialmente inadecuados en dos unidades coronarias: estudio transversal

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ABSTRACT

Objective: to analyze the association between the use of potentially inappropriate medications and the comorbidities of elderly patients hospitalized in cardiac intensive care units, with a focus on patient safety **Method:** observational cross-sectional study with a quantitative approach. Approved under ethical opinion number 4,503,135. The study settings were two coronary intensive care units in a university hospital in Rio de Janeiro. Data collection was documentary. Potentially inappropriate medications were classified based on the Beers Criteria[®]. Odds ratio and a p-value of less than 0.05 were used for association analysis. **Results:** data from 201 patients were analyzed, identifying 2,259 prescribed medications, with 369 (16.3%) being potentially inappropriate medications. Omeprazole was the most prevalent drug among prescriptions, with 145 (39.2%). **Conclusion:** hypertension was the comorbidity that showed a positive association with the use of potentially inappropriate medications (OR=1.6).

Descriptors: Patient Safety; Aged; Cardiovascular Diseases; Drug Utilization; Potentially Inappropriate Medication List.

RESUMO

Objetivo: analisar a associação entre o uso de medicamentos potencialmente inapropriados e as comorbidades de pessoas idosas internadas em unidades cardio intensivas a luz da segurança do paciente. **Método:** estudo observacional transversal com abordagem quantitativa. Aprovado sob parecer ético de número 4.503.135. Os cenários de estudo duas foram unidades cardio intensivas de um Hospital Universitário, no Rio de Janeiro. A coleta dos dados foi documental. Os medicamentos potencialmente inapropriados foram classificados a partir dos Beers Criteria[®]. Para análise de associação utilizou-se *odds ratio* e um p-valor menor que 0,05. **Resultados:** Foram analisados dados de 201 pacientes, nos quais foram identificados 2.259 medicamentos prescritos, sendo 369 (16,3%) medicamentos potencialmente inapropriados. O omeprazol foi o fármaco de maior prevalência nas prescrições 145 (39,2%). **Conclusão:** a hipertensão arterial foi a comorbidade que apresentou associação positiva com a utilização medicamentos potencialmente inapropriados (OR=1,6).

Descritores: Segurança do Paciente; Idoso; Doenças Cardiovasculares; Uso de Medicamentos; Lista de Medicamentos Potencialmente Inapropriados.

RESUMEN

Objetivo: analizar la asociación entre el uso de medicamentos potencialmente inadecuados y las comorbilidades en adultos mayores ingresados en unidades coronarias desde el punto de vista de la seguridad del paciente. **Método:** estudio observacional transversal con enfoque cuantitativo. Aprobado bajo dictamen ético número 4.503.135. Los dos escenarios del estudio fueron unidades coronarias de un Hospital Universitario de Río de Janeiro. La recolección de datos fue documental. Los medicamentos potencialmente inapropiados se clasificaron utilizando los Beers Criteria[®]. Para el análisis de asociación se utilizó *odds ratio* y un valor de p inferior a 0,05. **Resultados:** Se analizaron datos de 201 pacientes, en los que se identificaron 2.259 medicamentos prescritos, de los cuales 369 (16,3%) eran medicamentos potencialmente inadecuados. El omeprazol fue el fármaco más prevalente en las prescripciones 145 (39,2%). **Conclusión:** la hipertensión arterial fue la comorbilidad que presentó asociación positiva con el uso de medicamentos potencialmente inadecuados (OR=1,6).

Descriptores: Seguridad del Paciente; Anciano; Enfermedades Cardiovasculares; Utilización de Medicamentos; Lista de Medicamentos Potencialmente Inapropiados.

INTRODUCTION

Potentially inappropriate medications (PIMs) are drugs that have a relative contraindication for use in a specific population, defined by clinical condition and/or aging, due to their higher potential to cause adverse incidents¹. The maintenance of the use of PIMs in elderly individuals must be evaluated very cautiously by nurses.

According to the World Health Organization, in 2018, the number of elderly people aged 65 years old and over worldwide surpassed the number of children under five years of age. Moreover, it is estimated that the aging population

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will triple, from 143 million in 2019 to 426 million by 2050². In Brazil, the demographic scenario is similar to the global one; in 2021, elderly individuals aged 65 years old and over accounted for 10% of the population, with an estimate that this percentage will rise to 26% by 2060³.

Alongside demographic transition, epidemiological transition occurs. Currently, it is possible to identify changes in the processes of illness and morbidity and mortality. In this sense, chronic diseases surpass communicable diseases, leading to higher morbidity rates in the population and consequently increasing the need for multiple medication therapies.

A study conducted in 2019 by the University of São Paulo reported that the proportion of elderly people with Chronic Non-Communicable Diseases (CNCDs) in the country is 76.3%, with cardiovascular diseases being the most prevalent⁴. Additionally, another study published in 2016 in the Journal of Public Health reported a high prevalence of medication use among elderly individuals with CNCDs⁵.

In this context, elderly individuals are considered a vulnerable group due to the physiology of aging. Events such as decreased body water and reduced hepatic and renal metabolism create an inappropriate environment for certain medications, as changes in pharmacokinetics and pharmacodynamics result in variations in drug bioavailability, increasing sensitivity to Adverse Drug Reactions (ADRs) and iatrogenesis⁶.

To reduce PIM use in this population, the American Geriatrics Society (AGS), known Beers Criteria® (AGS Beers Criteria®), to identify PIMs. These criteria identify medications that are inappropriate, those that should be used with caution, and those that are contraindicated in older adults. All these criteria aim to enhance medication safety and optimize clinical use in patients to control disease progression without compromising quality of life.^{7,8} In this context, identifying the PIMs in use and associating them with comorbidities in elderly people can assist nurses and other health care professionals provide more targeted care and preventing harm.

Studies report that prescribing multiple PIMs for older adults leads to longer hospitalization, higher hospital costs, and increased mortality⁹. A systematic review based on the BEERS criteria identified a high prevalence of PIMs, with 65% of the sample using at least one PIM, particularly in the gastrointestinal system (15.3%), pain medications (10.5%), and the central nervous system (9.7%). The main PIMs prescribed were proton pump inhibitors (27.7%), opioids (27.2%), and benzodiazepines (19.0%)¹⁰.

In this context, there is a need for the nursing team to identify PIMs and adopt multiprofessional strategies for the deprescription of these medications to enhance medication safety among aging population. These strategies need to align with the individual needs of each patient; therefore, assessing comorbidities related to PIMs can more effectively guide nursing care.

Based on the above, this study aims to analyze the association between the use of potentially inappropriate medications and the comorbidities of elderly patients hospitalized in cardiac intensive care units concerning patient safety.

METHOD

This is an observational cross-sectional study, documentary in nature, with a quantitative approach. In the observational strategy, the researcher quantifies factors but does not intervene, aiming to depict the scenario experienced by a specific population¹¹. To ensure methodological rigor, the 22 items of the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines were followed, which guide the conduct of cross-sectional studies¹².

Data were collected from the Cardiac Intensive Units: the Coronary Care Unit (CCU) and the Cardiac Intensive Care Unit (CICU) of a university hospital. The CCU has nine beds and admits patients experiencing acute heart failure, pre- and post-percutaneous interventions such as angioplasty and catheterization, pre-transplant, in cardiogenic shock, and for procedures like cardioversion and vasoreactivity testing with Swan-Ganz. The CICU has 12 beds, admitting patients' post-cardiac surgery, such as myocardial revascularization, valve repair, valve replacement, aneurysm correction, and transplantation.

Eligible prescriptions were those for patients over 60 years of age, as this is the age considered for defining elderly individuals by the World Health Organization (WHO) in developing countries, and for patients hospitalized for more than 24 hours due to heart disease complications or for pre- and post-surgical care. Medical records of patients in end-of-life care and those hospitalized for exams were excluded.

The sample was obtained through simple random sampling, with a draw among eligible prescriptions. For sample size calculation, using SurveyMonkey®, a confidence level of 95% and a margin of error of 5% were employed. Analyzing the aging population (over 60 years old), the sample of prescriptions analyzed in the CCU was composed of n=106 and in the CICU of n=95, resulting in a final sample of 201 medication prescriptions for older patients.

Data collection occurred from January to June 2023, the necessary period to reach the calculated sample, through documentary analysis of medical records, observing medication prescriptions and clinical patient records. Collection was guided by a data collection instrument with the following variables: age, gender, pre-existing comorbidity, polypharmacy, medications used, duration and reason for hospitalization, potentially inappropriate medications; medications that should generally be avoided in elderly individuals with certain conditions; and medications to be used with caution.

To analyze the data on PIMs, the BEERS criteria⁷, which identify: potentially inappropriate medications for most elderly patients; medications that should be avoided in aging people with certain conditions; medications that should be used with caution; and drug interactions.

Descriptive analysis employed simple statistical measures of absolute and relative frequency, mean, and standard deviation. For association analysis, Fisher's test, uncorrected chi-square test, and odds ratio were used.

The research adhered to ethical principles, respecting participant anonymity and their cultural, social, moral, and religious values, based on scientific facts, in accordance with resolution 466/2012¹³. The study was approved under opinion 4,503,135 on January 19, 2021.

RESULTS

A total of 201 medication prescriptions were analyzed, comprising 115 (57.21%) from aging men and 86 (42.78%) from women. There was no sample loss, as all selected prescriptions were included. Ages ranged from 60 to 88 years old (standard deviation of 6.7). The identified comorbidities included hypertension in 161 (80%) patients, diabetes mellitus in 84 (41%), arrhythmias in 35 (17.4%), coronary artery disease in 34 (16.9%), dyslipidemia in 28 (13.9%), heart failure in 27 (13.4%), among others, with hypertension being the most common, present in 80% of patients. The average length of hospitalization was 5 (± 10.69) days.

Among the 201 medication prescriptions, a total of 2,259 medications were analyzed, of which 369 (16.3%) were considered PIMs. The average number of prescribed medications was 11.2, ranging from four to 22 drugs. The average number of PIMs prescribed was 1.8 (± 1.1), varying between zero and six PIMs.

According to the BEERS criteria, 163 (44%) drugs were considered potentially inappropriate, 63 (17%) should be used with caution, and 12 (3.2%) were identified as having a high risk of drug interactions. A description of the medications is presented in Table 1.

Table 1: Frequency of Potentially Inappropriate Medications according to medication class and system based on the BEERS criteria. Rio de Janeiro, RJ, Brazil, 2023.

Medication Class	Related System	Medication	n	%
Inhibitor of H+	Gastrointestinal	Omeprazole	145	39.90
NSAIDs	Cardiovascular	ASA	42	11.30
Peptide Hormone	Endocrine	Regular insulin	42	11.30
Benzodiazepine	CNS	Clonazepam/Midazolam	38	10.25
Opioid	CNS	Tramadol/Fentanyl	35	9.40
Class III Antiarrhythmic	Cardiovascular	Amiodarone	16	4.30
Laxative	Gastrointestinal	Lactulose	14	3.70
Benzamides	Gastrointestinal	Metoclopramide	10	2.70
Lubricants	Gastrointestinal	Mineral Oil	8	2.10
Antihistamine	CNS	Dexchlorpheniramine	4	1.80
Digitalis	Cardiovascular	Digoxin	2	0.50
Anticoagulant	Cardiovascular	Warfarin	2	0.50
Serotonin Inhibitors	CNS	Fluoxetine	1	0.20

Key: NSAIDs: Non-Steroidal Anti-Inflammatory Drugs; CNS: Central Nervous System; ASA Acetylsalicylic Acid

The PIMs were analyzed and grouped, with Omeprazole (H⁺ inhibitor) identified as the most frequently prescribed, present in 145 (39.2%) of the prescriptions, followed by Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) in 42 (11.3%), among others listed.

When analyzing the association between comorbidities and potentially inappropriate medications, omeprazole was found to be the most frequently prescribed drug among patients with hypertension, diabetes mellitus, heart failure, and dyslipidemia.

In patients with arrhythmias, regular insulin was prescribed eight times, followed by amiodarone, which was prescribed six times, among other less frequent medications.

To assess the association between PIMs and comorbidities, a 2x2 table was used, and the Odds Ratio calculation was performed (Table 2).

Table 2: Association of PIM Use with the Presence of Patients' Clinical Comorbidities.. Rio de Janeiro, RJ, Brazil, 2023.

Comorbidity	Potentially Inappropriate Medication		Odds Ratio	p-value
	Yes	No		
Hypertension			1.6	0.34**
Yes	147 (73%)	32 (15.9%)		
No	17 (8.4%)	6 (2.9%)		
Diabetes Mellitus			0.9	0.87**
Yes	76 (37.8%)	103 (51.2%)		
No	8 (3.9%)	10 (4.9%)		
Heart failure			0.6	0.61*
Yes	23 (11.4%)	156 (77.6%)		
No	4 (1.9%)	17 (8.4%)		
Arrhythmias			0.5	0.22**
Yes	30 (%)	150 (74.6%)		
No	6 (%)	16 (7.9%)		
Dyslipidemia			0.5	0.40*
Yes	24 (%)	152 (75.6%)		
No	5 (%)	17 (8.4%)		

Key: * = p-value calculated by Fisher's exact test; ** = p-value calculated by the uncorrected chi-square test.

Although the p-value did not show statistical significance in the association between PIM use and the presence of comorbidities, hypertension exhibited a positive association (OR of 1.6 and p-value of 0.34), meaning hypertensive patients have 1.6 times the likelihood of using PIMs. This is justified as 73% of the total sample were hypertensive and had at least one PIM prescribed.

Regarding the risk criteria for drug interactions, fentanyl (opioid) and midazolam (benzodiazepine) were found in 10 (4.9%) of the prescriptions.

Another drug interaction risk, according to Beers criteria, was the concomitant use of warfarin (anticoagulant) with amiodarone (class III antiarrhythmic), present in 2 (0.9%) of the prescriptions. Notably, both drug interactions occurred in patients with excessive polypharmacy, defined as having 10 or more medications prescribed.

DISCUSSION

Among the drugs found in the study, 16 classes of medications were identified as PIMs, associated with four systems: gastrointestinal, endocrine, cardiovascular, and CNS. Of these, the H⁺ inhibitor was the most frequent, present in 39.9% of the sample. A study published in 2016 in the Journal of Public Health reported a high prevalence of omeprazole use among older adults with CNCs⁵.

NSAIDs were the second most prevalent drug class, present in 11.3% of the sample, with a higher prevalence among aging hypertensive people. This class is clinically relevant to the target population, as the analyzed sectors consist of cardiac patients who regularly use anticoagulants.

A study conducted in Pará, Brazil, in 2021 reported that among the PIMs listed in the STOPP criteria (used to assist in de-prescribing PIMs), ASA stood out among the elderly, due to the high prevalence of chronic diseases in this population, which increased the likelihood of polypharmacy, drug interactions, and complications such as urinary incontinence¹⁴.

Another relevant drug class identified in the prescriptions was regular insulin, present in 11.3% of the sample. These medications are often prescribed for administration based on capillary blood glucose results. However, despite being prescribed "on a protocol basis" (for capillary blood glucose levels above 180 mg/dl), this approach does not eliminate the possibility of iatrogenesis, as usage can become regular depending on the patient's level of decompensation. These findings align with a 2020 study in the Journal of the Brazilian Medical Association, which observed regular insulin prescribed "as needed" in 23.1% of the sample¹⁵.

Among drug interactions, opioids and benzodiazepines were found in 4.9% of the sample, posing a higher risk of overdose according to the BEERS criteria. Furthermore, all patients with drug interactions presented excessive polypharmacy, with more than 10 drugs in their prescriptions.

Excessive polypharmacy can be a problem for medication safety, as it increases the risk of interactions and/or incompatibilities. Additionally, a 2018 study in the Einstein Journal highlighted that this issue may be even more severe in cardiac patients¹⁶.

Given this, it is essential to develop strategies to reduce the use of PIMs and enhance patient safety regarding medication use, especially in cardiac patients with multiple associated comorbidities. One alternative could be ongoing multiprofessional education aimed at disseminating knowledge and enabling teams to use the Beers criteria for better medication management in this population.

In line with this, creating a standardized list of safe medications tailored to the profile of the institution's users would be beneficial. Many PIMs are included in the National List of Essential Medicines from the Ministry of Health. This can lead to their prescription without individualized analysis of clinical context and pharmacotherapy, thus creating an environment conducive to medication incidents¹⁴.

Another multiprofessional strategy related to nursing to reduce the use of PIMs involves daily reevaluation of medications regarding dosage, frequency, and duration of pharmacotherapy. This includes evaluating the need for de-prescribing, which means discontinuing a medication once the acute condition has stabilized and when the benefits of therapy are outweighed by its harms¹⁶.

In this particular population—older adults and cardiac patients—de-prescribing requires greater caution due to the body's dependence on certain medications. Therefore, elderly patients should be closely monitored by the team to evaluate signs of withdrawal and decompensation¹⁵.

Furthermore, the presence of clinical pharmacy is crucial for medication safety, as it allows for medication reconciliation, correcting prescription errors related to dosage, frequency, and interactions, and can prevent incidents before they cause harm to patients. However, despite recommendations from international institutions such as the World Health Organization, a 2019 study reported that clinical documentation by pharmacists is often lacking due to practical inexperience and heavy workloads. This highlights the need for institutional policies and training to support these professionals in improving care quality through medication safety¹⁷.

The use of computerized systems with alerts whenever a PIM is prescribed, accompanied by guidance and suggestions for therapeutic doses or alternative medications according to the patient's profile, is also considered an important strategy against the indiscriminate use of PIMs¹⁷.

It is suggested that nurses, as part of the interdisciplinary team, recognize PIMs and assess whether the clinical condition of aging patients is related to underlying diseases or adverse drug reactions (ADRs), while monitoring and encouraging the de-prescribing process. Thus, it is possible to develop an individualized care plan based on existing comorbidities and create patient safety strategies related to pharmacotherapy.

Study limitations

This study is limited by its small sample size and data collection from a single hospital, highlighting the need for further research to explore the use of PIMs in cardiac patients. Future studies should test the strategies proposed in the discussion to validate their effectiveness and support medication safety improvements.

CONCLUSION

This study found a 16.3% rate of PIM use among elderly cardiac patients. Hypertension was the comorbidity with a positive association (OR=1.6; p-value=0.3429), indicating hypertensive patients have a 1.6 times higher likelihood of using PIMs, though this result lacked statistical significance, likely due to the small sample size.

It is recommended to assess prescriptions, especially in hypertensive cardiac patients, to evaluate medication necessity. De-prescribing PIMs can be a viable alternative to reduce the likelihood of incidents and enhance medication safety.

In this regard, the BEERS criteria serve as a useful tool for identifying the presence of PIMs and the occurrence of drug interactions in older adults. Further studies are necessary to test de-prescribing strategies aimed at increasing safety in medication use.

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Author's contributions

Conceptualization, F.G.C., A.L.C.M., C.S.F., D.M.H. and R.M.N.; methodology, F.G.C., C.S.F. and D.M.H.; software, F.G.C.; validation, F.G.C.; formal analysis, F.G.C., I.A.S.A.A.S., C.S.F. and D.M.H.; investigation, I.A.S.A.A.S.; resources, F.G.C., C.S.F. and D.M.H.; data curation, F.G.C., I.A.S.A.A.S., C.S.F. and D.M.H.; manuscript writing, F.G.C., I.A.S.A.A.S., A.L.C.M., C.S.F., D.M.H. and R.M.N.; writing – review and editing, F.G.C., I.A.S.A.A.S., A.L.C.M., C.S.F., D.M.H. and R.M.N.; visualization, F.G.C., I.A.S.A.A.S., A.L.C.M., C.S.F., D.M.H. and R.M.N.; supervision, F.G.C., C.S.F. and D.M.H.; project administration, F.G.C., C.S.F. and D.M.H.; financing acquisition, F.G.C., C.S.F. and D.M.H. All authors read and agreed with the published version of the manuscript.