

Ambulatory Care-Sensitive Hospitalizations Among Adults and Older Adults Analyzed by Diagnosis-Related Groups

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Abstract

Introduction: Hospitalizations for ambulatory care-sensitive conditions (ACSCs), identified through the Diagnosis-Related Groups (DRG) system, provide an important indicator of the quality and effectiveness of Primary Health Care (PHC). As the main entry point to Brazil's Health Care Network, PHC coordinates patient care, helps prevent acute complications of Chronic non-communicable diseases (NCDs), and reduces avoidable hospitalizations and healthcare costs.

Objective: To evaluate Hospitalizations for ambulatory care-sensitive conditions among adults and older adults, focusing on the leading causes of admission and hospital length of stay.

Methods: This epidemiological study analyzed secondary data from 916,676 hospital admissions involving adults and older adults (aged 18 years or older) treated in DRG-participating hospitals across all five regions of Brazil between 2018 and 2024. Descriptive analyses summarized the distribution of hospitalizations according to disease groups, causes of admission, and length of hospital stay.

Results: Noncommunicable diseases accounted for the largest proportion of hospital admissions during the study period. Cerebrovascular diseases, hypertension, and heart failure were the leading causes of hospitalization. These conditions also showed the highest hospitalization rates and contributed substantially to prolonged hospital stays.

Conclusion: Hospitalizations for ACSCs remain an important indicator of PHC performance. The findings reinforce the pivotal role of PHC in reducing avoidable hospitalizations, lowering healthcare costs, promoting population health, and upholding the right to health as a fundamental social right.

INTRODUCTION

Population aging has accelerated worldwide, and Brazil is undergoing a demographic transition in which the older population is growing faster than the younger population because of increased life expectancy and declining mortality rates ^[1]. According to the World Health Organization (WHO), one in every six people worldwide will be aged 60 years or older by 2030. By then, the global population in this age group is expected to reach 1.4 billion, representing a 40% increase compared with 2020 (1.0 billion). By 2050, the number of people aged 60 years or older is projected to double to 2.1 billion, while the population aged 80 years or older may triple, reaching 426 million ^[2].

Based on data from the 2000 Brazilian National Census and projections from the Brazilian Institute of Geography and Statistics (IBGE), older adults are expected to outnumber children by 2031 ^[3]. This changing age structure will likely increase the demand for health and hospital services, largely because aging is associated with multimorbidity and the progressive decline of physiological and functional capacity ^[4].

As the older population continues to grow, hospital service use has increased disproportionately worldwide, particularly in North America, Europe, Asia, and Oceania [4]. In comparison with younger adults, older adults are more likely to require emergency care, experience prolonged hospital stays, undergo readmissions, develop adverse outcomes, and consume greater healthcare resources, thereby increasing healthcare costs [4].

In Brazil, hospital admissions account for one of the largest expenditures within the Unified Health System (Sistema Único de Saúde – SUS). In 2019, spending on hospital and outpatient care represented nearly half of all public health expenditures (49.94%), greatly exceeding investments in Primary Health Care (PHC) [5]. At the same time, Brazil has experienced rapid demographic and epidemiological transitions, marked by population aging and the increasing burden of chronic noncommunicable diseases (NCDs). Between 2013 and 2019, the country's hospitalization profile changed considerably, with chronic diseases replacing acute conditions as the leading causes of hospital admission [5].

Primary Health Care (PHC) forms the foundation of Brazil's Health Care Network (HCN) and serves as the preferred point of entry into the Unified Health System (SUS). It delivers comprehensive, continuous, and longitudinal care through health promotion, disease prevention, health education, early diagnosis, and treatment, particularly for chronic noncommunicable diseases. Beyond its clinical role, PHC also reflects the constitutional principle that health is a fundamental social right and, therefore, a basic human right [6].

Hospitalizations for ambulatory care-sensitive conditions (ACSCs) refer to hospital admissions that could potentially be prevented through timely and effective primary care [7]. As these admissions largely result from conditions that respond to preventive care and appropriate clinical management, they have become an important indicator of PHC quality and performance. Common examples include heart failure, pneumonia, respiratory diseases, diabetes-related complications, and other chronic conditions that disproportionately affect older adults [7].

OBJECTIVES

Although ACSCs are widely used to assess PHC performance, relatively few studies have examined these hospitalizations from the perspective of the Diagnosis-Related Groups (DRG) system and their implications for healthcare delivery. A better understanding of these relationships may support healthcare planning and strengthen the organization of Health Care Networks. This study evaluated hospitalizations for ambulatory care-sensitive conditions among adults and older adults, with particular emphasis on the leading causes of admission and hospital length of stay.

METHODS

This epidemiological study analyzed secondary data on hospital admissions among adults and older adults between 2018 and 2024. The analysis used the Diagnosis-Related Groups (DRG) system, which classifies hospitalized patients according to their clinical characteristics and the resources required for

their care. By grouping patients with similar clinical profiles and comparable resource utilization, the DRG system links case complexity to healthcare costs and supports hospital performance assessment and resource management [8, 9, 10].

The DRG system applies to acute care hospitals, where the average length of stay is typically shorter than 30 days. It enables hospital managers to monitor healthcare delivery, plan budgets, control costs, and improve care processes.

The study included hospitals from all five regions of Brazil that routinely use the DRG system to manage and monitor hospital admissions.

The study population comprised 916,676 hospital admissions involving adults and older adults aged 18 years or older. Nurses affiliated with each participating hospital entered patient information into the DRG database after hospital discharge, transfer, or death. The study included admissions classified within the DRG system, involving adults and older adults whose hospital discharge occurred between 2018 and 2024. Records with incomplete information were excluded from the analysis.

The institutional DRG database provided all data in anonymized form. The study analyzed the following variables:

- Sociodemographic variables: age; sex; age group.
- Clinical and healthcare variables: DRG disease group; DRG classification (medical or surgical); length of hospital stay; number of procedures performed; number of secondary ICD-10 diagnoses; clinical severity; hospital outcome.
- Hospital admissions were also classified according to the Brazilian List of Hospitalizations for ambulatory care-sensitive conditions, established by Ministry of Health Ordinance No. 221/2008 [11]. Based on this classification, admissions were grouped into 19 diagnostic categories: anemia; angina; asthma; nutritional deficiencies; diabetes mellitus; pelvic inflammatory disease; cerebrovascular diseases; vaccine-preventable diseases and other ambulatory care-sensitive conditions; pulmonary diseases; pregnancy-, childbirth-, and puerperium-related conditions; epilepsy; infectious gastroenteritis and its complications; hypertension; skin and soft tissue infections; kidney and urinary tract infections;
- ear, nose, and throat infections; heart failure; bacterial pneumonia; gastrointestinal ulcer. Secondary diagnoses and healthcare-associated infections were classified according to the International Classification of Diseases, Tenth Revision (ICD-10). Procedures were coded using the official terminology adopted by both the Brazilian Unified Health System (SUS) and the private healthcare sector, together with hospital length of stay (days). The analysis also included discharge outcomes (survival or death), severe healthcare-associated infections, and DRG type (medical or surgical).

All statistical analyses were performed using R software. Descriptive statistics summarized the characteristics of hospital admissions. Categorical variables are presented as absolute and relative

frequencies, whereas continuous variables are expressed as means and standard deviations.

Consent to participate

This study was approved by the Research Ethics Committee (Comitê de Ética em Pesquisa) under CAAE: 09709118.0.0000.5149. This was a non-interventional, study based on data extracted directly from patients' medical records, with no direct contact with participants and no interference in clinical care. Since participants were no longer hospitalized at the time of data collection, obtaining signed informed consent was not feasible; accordingly, the Research Ethics Committee granted a waiver of informed consent.

Data confidentiality was ensured in accordance with Resolution 466/2012 of the Brazilian National Health Council, which guarantees the privacy of research subjects with respect to sensitive data, and all data were anonymized in the study database. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee, as well as with the 1964 Declaration of Helsinki and its subsequent amendments or comparable ethical standards.

RESULTS

Figure 1 shows the distribution of hospital admissions by disease group, sex, age group between 2018 and 2024. Overall, women accounted for a higher proportion of admissions for kidney and urinary tract infections, whereas men showed a higher proportion of admissions for angina, particularly between 45 and 74 years of age. Admissions for skin and soft tissue infections also occurred more frequently among men, especially in the younger age groups.

Across all age groups, admissions for asthma, inflammatory diseases of the female pelvic organs, vaccine-preventable diseases and other ambulatory care-sensitive conditions, pregnancy- and childbirth-related conditions, epilepsy, and ear, nose, and throat infections declined over the study period. In contrast, cerebrovascular diseases, hypertension, and heart failure consistently represented the largest proportion of hospitalizations throughout the study period.

Figure 1 - Distribution of hospital admissions by disease group according to age group, sex, and year of discharge (2018–2024).

Source: Prepared by the authors, 2024.

Figure 2 presents a heatmap showing the mean number of procedures, secondary ICD-10 diagnoses, and length of hospital stay according to disease group and sex. Within each column, darker colors indicate higher values. Men had higher mean numbers of procedures than women for most disease groups, except nutritional deficiencies, cerebrovascular diseases, and infectious gastroenteritis and its complications. Gastrointestinal ulcers showed the highest mean number of procedures in both sexes, whereas asthma had the lowest.

Pulmonary diseases and bacterial pneumonia were associated with the highest mean numbers of secondary ICD-10 diagnoses in both men and women. Among men, ear, nose, and throat infections had the lowest mean number of secondary diagnoses (2.42), while inflammatory diseases of the female pelvic organs had the lowest mean among women (1.31).

Regarding length of hospital stay, men had longer average stays than women across most disease groups, except for angina, asthma, and infectious gastroenteritis and its complications. Among men, the longest mean hospital stay occurred in admissions related to pregnancy, childbirth, and puerperium (17.54 days). Although this category primarily includes maternal conditions, it also encompasses congenital disorders, such as congenital syphilis and congenital rubella syndrome. Among women, the longest mean hospital stay was observed for vaccine-preventable diseases and other ambulatory care-sensitive conditions, with an average of 13.87 days.

Figure 2 - Heatmap of the mean number of procedures, secondary ICD-10 diagnoses, and length of hospital stay according to disease group and sex.

Source: Prepared by the authors, 2024.

Figure 3 presents a heatmap of the percentages of in-hospital mortality, severe healthcare-associated infections, and surgical DRGs according to disease group and sex. Bacterial pneumonia and nutritional deficiencies were associated with the highest in-hospital mortality rates in both women and men. The lowest mortality rates occurred among men admitted for angina (0.77%) and women hospitalized for pregnancy-, childbirth-, and puerperium-related conditions (0.01%). Among men, the highest proportions of severe healthcare-associated infections occurred in admissions related to pregnancy, childbirth, and puerperium (8.33%), a category that also includes congenital conditions such as congenital syphilis and congenital rubella syndrome, and nutritional deficiencies (6.99%). Among women, cerebrovascular diseases (4.85%) and heart failure (4.78%) showed the highest proportions of severe healthcare-associated infections. Men also had a higher proportion of surgical DRGs across nearly all disease groups, except nutritional deficiencies and pregnancy-, childbirth-, and puerperium-related conditions. The greatest sex difference was observed for diabetes mellitus, with surgical DRGs accounting for 25.07% of admissions among men compared with 14.61% among women. Among women, inflammatory diseases of the female pelvic organs had the highest proportion of surgical DRGs (54.88%).

Figure 3 - Heatmap showing the percentages of in-hospital deaths, severe healthcare-associated infections, and surgical DRGs according to disease group and sex

Source: Prepared by the authors, 2024.

DISCUSSION

This study characterized hospitalizations for ambulatory care-sensitive conditions among adults and older adults based on Diagnosis-Related Groups (DRG) data from hospitals across all five regions of

Brazil. During the study period, cerebrovascular diseases, hypertension, and heart failure accounted for the highest proportions of hospitalizations when admissions were analyzed according to disease group, sex, and age group between 2018 and 2024. In addition, hospitalizations for pulmonary diseases and bacterial pneumonia were associated with the highest mean numbers of secondary diagnoses (ICD-10 codes) in both men and women, indicating greater clinical complexity in these patients. Regarding length of hospital stay, the longest mean stay among men occurred in hospitalizations for vaccine-preventable diseases and other ambulatory care-sensitive conditions, with an average of 13.87 days. Among women, the highest percentages of hospitalizations were observed for cerebrovascular diseases (4.85%) and heart failure (4.78%). Furthermore, the proportion of surgical DRGs was higher among men for most disease groups, except nutritional deficiencies and pregnancy-, childbirth-, and puerperium-related conditions. The greatest difference between sexes was observed for diabetes mellitus, in which surgical DRGs accounted for 25.07% of admissions among men compared with 14.61% among women.

Considering the fundamental and coordinating role of Primary Health Care (PHC) within Brazil's Health Care Network (HCN), these findings demonstrate the high burden of hospitalizations for ambulatory care-sensitive conditions, particularly among adults and older adults. They also reinforce previous evidence recognizing these hospitalizations as an important indicator of the quality and effectiveness of primary care services ^[12,13]. The high frequency of hospitalizations due to chronic noncommunicable diseases, including heart failure, hypertension, and pulmonary diseases, may indicate weaknesses in longitudinal follow-up, clinical management, and care coordination, all of which are core responsibilities of PHC. Previous studies have shown that high rates of hospitalizations for ACSCs are closely associated with delayed access to healthcare, particularly because limitations within secondary care networks often prevent patients from receiving diagnostic tests and specialist consultations within a clinically appropriate timeframe. These barriers directly affect continuity of care and longitudinal follow-up in PHC. High rates of hospitalizations for ACSCs have also been associated with limited effectiveness of preventive interventions. Together, these challenges reflect inequalities in the organization of health services and differences in their capacity to respond to the healthcare needs of the population ^[12,13].

The longer hospital stays, higher numbers of procedures, and greater burden of comorbidities observed in several groups of hospitalizations for ACSCs suggest that many patients were admitted only after their conditions had progressed to more advanced stages ^[14,15]. This pattern may reflect missed opportunities for early intervention within Primary Health Care, allowing these conditions to progress and become more severe before hospitalization ^[14,15]. Previous studies have shown that effective PHC reduces the severity of chronic conditions before hospitalization becomes necessary, thereby lowering healthcare costs, reducing mortality, and decreasing the use of hospital resources ^[14,15]. Consequently, hospitalizations for ambulatory care-sensitive conditions can serve as indirect markers of PHC's capacity to provide comprehensive, continuous, and coordinated care.

Another factor that may contribute to weaknesses in longitudinal care and, consequently, to higher rates of hospitalizations for ACSCs is delayed healthcare seeking, which disrupts the expected continuum of

care. In the present study, the high proportion of hospitalizations due to noncommunicable diseases is consistent with the findings reported by Raupp et al. ^[16], who analyzed chronic diseases and their healthcare trajectories and found that Primary Health Care was predominantly accessed for postoperative procedures, such as wound care, rather than for continuous follow-up of chronic conditions. These findings reinforce that PHC should be integrated into the daily lives of individuals and communities, serving not only as the entry point to the healthcare system but also as a comprehensive, longitudinal, and responsive model of care capable of reducing hospitalizations for ambulatory care-sensitive conditions ^[16].

The differences observed according to sex, age group, mortality, and clinical severity across several groups of hospitalizations for ACSCs may indicate the need for more targeted strategies within Primary Health Care, particularly for populations at greater risk. As a health indicator, ACSCs help identify priorities for strengthening PHC while supporting the planning of health promotion initiatives, disease prevention strategies, and improvements in the management of chronic diseases ^[17,18]. Previous studies have consistently shown that reductions in hospitalizations for ambulatory care-sensitive conditions are associated with improvements in the quality of care and more effective integration across the Health Care Network (HCN), reinforcing the value of this indicator as a strategic tool for assessing both the effectiveness and quality of Primary Health Care services ^[17,18].

As hospitalizations for ACSCs are a health indicator that measures potentially avoidable admissions, continuous monitoring of this indicator can support the implementation of strategies aimed at reducing these hospitalizations, improving hospital bed management, and optimizing healthcare expenditures ^[18]. Consequently, hospitalizations for ACSCs may impose a substantial economic burden on health systems, particularly when patients require prolonged hospital stays and present with complex clinical conditions. Length of stay is one of the main determinants of hospital costs because longer hospitalizations require greater use of hospital beds, healthcare personnel, diagnostic tests, therapeutic procedures, and hospital supplies. This pattern is consistent with the longer average hospital stays observed in the present study ^[19].

Furthermore, hospitalizations for ACSCs may contribute to increased public healthcare expenditures, particularly in the context of the long-standing structural underfunding of Brazil's Unified Health System (SUS), which has historically challenged the implementation of the principles of universality, comprehensiveness, and equity ^[20,21].

A study conducted in Vietnam that evaluated the costs of hospital treatment for infectious diseases in children reported substantial variations in healthcare expenditures according to diagnosis and clinical severity, with treatment costs reaching up to seven times higher in the most severe cases. The study also demonstrated a direct association between longer hospital stays and increased treatment costs ^[22]. These findings are consistent with those of the present study, particularly regarding the prolonged average hospital stay observed among patients hospitalized for vaccine-preventable diseases and other ambulatory care-sensitive conditions, whose mean length of stay reached 15.18 days.

The findings reveal a high proportion of hospitalizations for ambulatory care-sensitive conditions, reinforcing the need for strategies aimed at reducing this indicator. From this perspective, investment in continuing professional education for healthcare personnel and the implementation of clinical protocols based on analyses of hospitalizations according to the most prevalent disease groups are particularly important. These initiatives strengthen the capacity of health systems to anticipate healthcare needs, monitor outcomes, respond effectively to emerging challenges, and continuously learn from practice, all of which are essential for improving health system performance.

Brazilian studies have shown that reductions in hospitalizations rates for ACSCs are associated with expanded coverage of the Family Health Strategy (FHS). Continuous monitoring of this indicator represents an important strategy because the necessary data are readily available, relatively inexpensive to obtain, and can be generated rapidly, enabling the analysis of both the clinical and sociodemographic characteristics of the population ^[23,24]. In addition, the decisions made by public health managers in response to the challenges posed by population aging have direct consequences for both the economic and social spheres, creating increasingly complex demands on Brazil's healthcare and social protection systems ^[25].

The findings obtained from the DRG system reinforce the importance of hospitalizations for ACSCs as a major cause of hospital admission and demonstrate their potential as a strategic tool for monitoring the performance of Primary Health Care. Analyzing variations in these hospitalizations makes it possible to identify critical weaknesses in the organization and responsiveness of the Health Care Network (HCN), particularly in the context of recurrent healthcare demands and population aging. Furthermore, the findings highlight the important role of nurses in measuring this indicator and using the resulting information to support strategies and interventions aimed at strengthening Primary Health Care, thereby promoting continuity of care across all levels of the healthcare system ^[26].

Among the limitations of this study, the sample may not fully represent the Brazilian healthcare system because it included only hospitals that use the DRG system. In addition, the analysis relied on secondary data from hospital admissions recorded between 2018 and 2024, which are subject to the limitations inherent to secondary databases, including underreporting and incomplete records. Nevertheless, considering the unique characteristics of each age group and clinical condition, the findings may assist healthcare managers and personnel in strengthening Primary Health Care by supporting preventive actions, continuous follow-up, and more equitable responses to the healthcare needs of adults and older adults across different regions of the country.

CONCLUSION

This study provides evidence to support the improvement of public health policies, the organization of care pathways, and the strengthening of Brazil's Unified Health System (SUS). The findings reaffirm the strategic role of Primary Health Care as the coordinator of care within the Health Care Network and reinforce the value of hospitalizations for ambulatory care-sensitive as an important indicator of PHC

quality and performance. Strengthening Primary Health Care is essential to ensure comprehensive, coordinated, longitudinal, and effective care. A well-organized PHC system integrated with the Health Care Network is fundamental to reducing avoidable hospitalizations and improving the quality of care delivered to the population.

Declarations

Declaration of conflicts of interest

The authors declare that they have no financial, commercial, professional, or institutional conflicts of interest that could have influenced the conduct of this study or the interpretation of its findings.

Ethics approval and consent to participate

The study was approved by the Research Ethics Committee of the Federal University of Minas Gerais (CAAE: 09709118.0.0000.5149). All procedures followed the ethical guidelines described in Resolution No. 466 of the National Health Council, dated 12 December 2012, which deals with research involving human subjects. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee, as well as with the 1964 Declaration of Helsinki and its subsequent amendments or comparable ethical standards. It should be noted that, as the data was collected directly from patient records, were exempted from signing the consent form.

Clinical trial number

Not applicable.

Author Contributions

The authors VALENTIM, R. N., CORREA, A. R., SILVA, C. S. O., SOUZA, A. A. D., OLIVEIRA, M. E. V., and AMORIM, C. V. contributed to formal analysis, writing the original draft, and manuscript review and editing. The authors PEDROSA, T. M. G., COUTO, Renato Camargo, and ABREU, A. C. were responsible for conceptualization, methodology, investigation, data collection, and manuscript review and editing. The author SILVA, T. P. R. contributed to methodology, manuscript review and editing, and supervision. The author MATOZINHOS, F. P. was responsible for conceptualization, methodology, investigation, data collection, formal analysis, writing the original draft, manuscript review and editing, and supervision. All authors contributed to the preparation and review of the graphical representations, and read and approved the final version of the manuscript.

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Consent to publish

Not applicable.

Competing Interests

The authors declare that they have no relevant conflicts of interest.

Data availability statement

The data generated and/or analyzed during this study are not publicly available due to ethical and confidentiality restrictions and cannot be shared publicly. The data may be available from the corresponding author upon reasonable request, subject to approval by the appropriate ethics committee and applicable data protection requirements.

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Figures

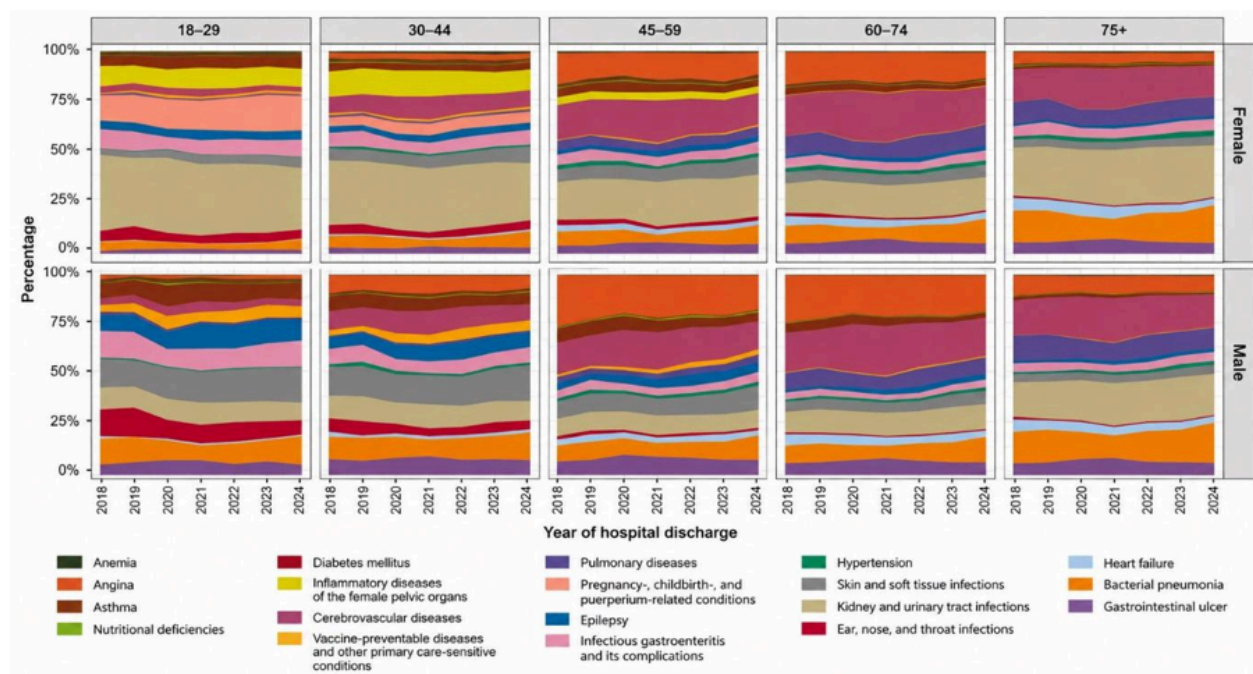


Figure 1

Distribution of hospital admissions by disease group according to age group, sex, and year of discharge (2018–2024).

Source: Prepared by the authors, 2024.

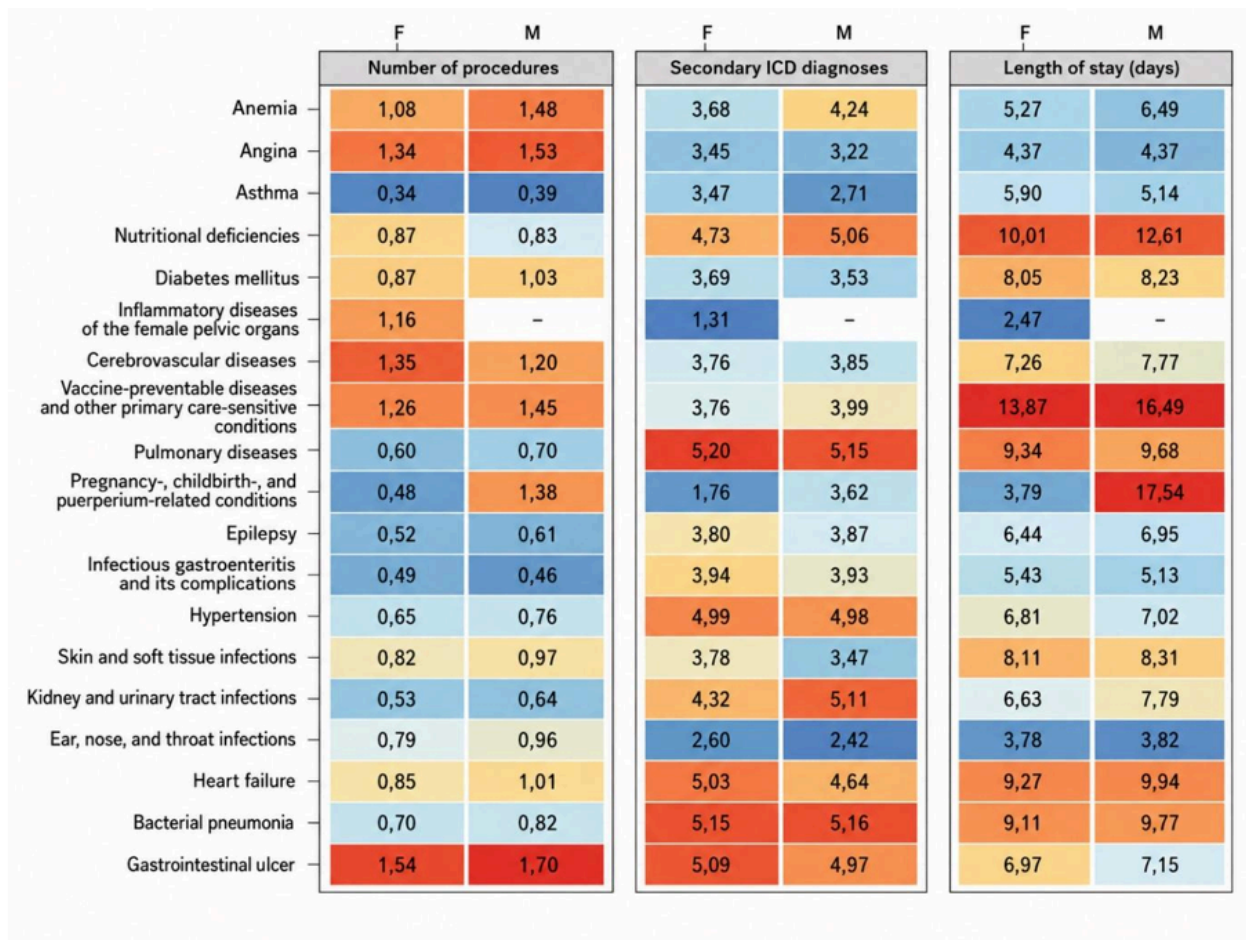


Figure 2

Heatmap of the mean number of procedures, secondary ICD-10 diagnoses, and length of hospital stay according to disease group and sex.

Source: Prepared by the authors, 2024.

	% of in-hospital deaths		% of severe HAIs		% of surgical DRGs	
	Female (F)	Male (M)	Female (F)	Male (M)	Female (F)	Male (M)
Anemia	1.92	2.59	1.90	2.21	0.98	1.83
Angina	0.79	0.77	2.34	2.01	33.31	45.18
Asthma	1.16	1.30	1.28	1.30	0.94	1.16
Nutritional deficiencies	12.49	13.88	4.75	6.99	4.92	3.34
Diabetes mellitus	4.47	3.34	3.65	3.55	14.61	25.07
Inflammatory diseases of the female pelvic organs	0.17	–	0.92	–	54.88	–
Cerebrovascular diseases	10.04	10.31	4.85	5.36	13.47	13.49
Vaccine-preventable diseases and other primary care-sensitive conditions	6.63	9.13	4.62	6.29	8.60	10.38
Pulmonary diseases	9.59	12.17	3.82	4.28	2.98	3.91
Pregnancy-, childbirth-, and puerperium-related conditions	0.01	8.33	0.21	8.33	0.31	0
Epilepsy	5.07	4.82	4.69	6.51	3.93	4.27
Infectious gastroenteritis and its complications	3.60	3.44	1.81	1.75	1.47	1.48
Hypertension	5.37	5.79	3.15	3.39	3.27	5.30
Skin and soft tissue infections	4.03	2.96	2.44	2.38	20.04	24.13
Kidney and urinary tract infections	4.94	6.37	1.96	3.03	4.76	7.37
Ear, nose, and throat infections	0.90	1.16	0.56	0.76	18.21	22.42
Heart failure	11.44	11.20	4.78	4.64	5.57	8.34
Bacterial pneumonia	15.41	16.55	3.65	4.54	3.30	4.88
Gastrointestinal ulcer	10.67	10.71	4.36	4.61	8.89	10.76

Figure 3

Heatmap showing the percentages of in-hospital deaths, severe healthcare-associated infections, and surgical DRGs according to disease group and sex

Source: Prepared by the authors, 2024.