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# Non-neoplastic hematological diseases in Brazil: profile of hospitalizations and main causes

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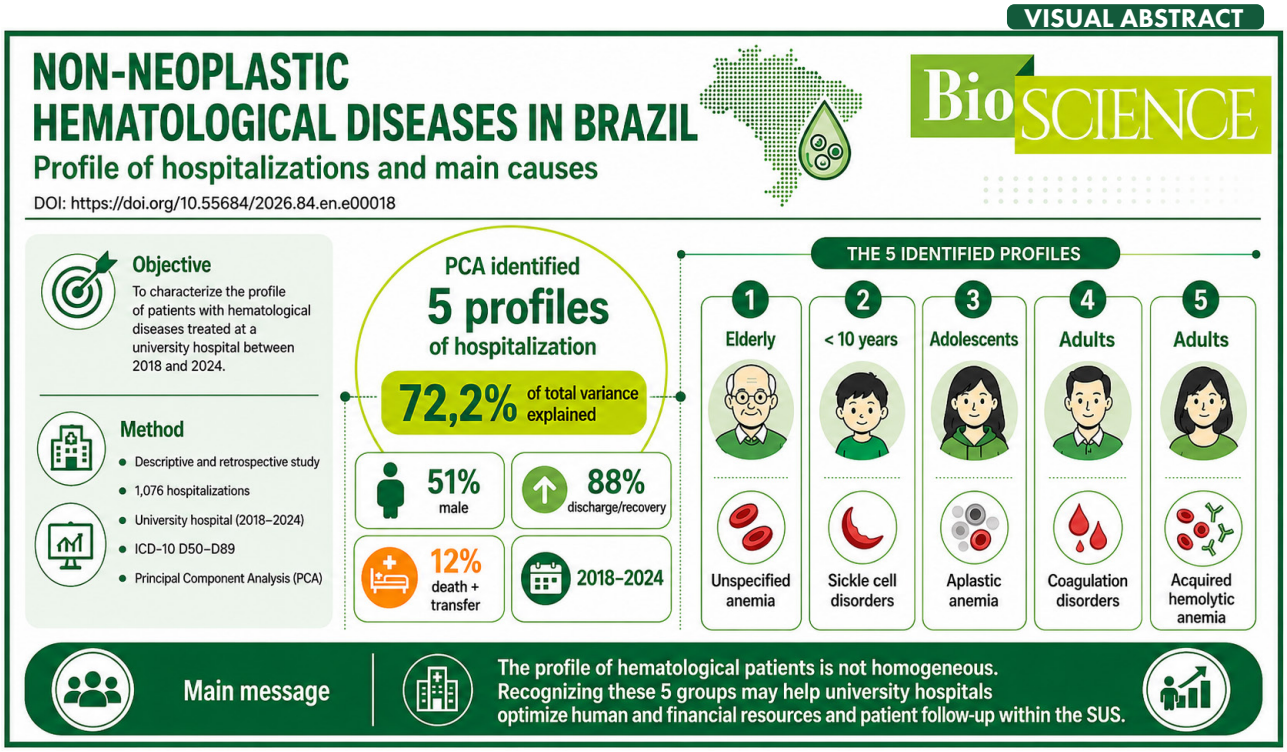
VISUAL ABSTRACT

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Conceptualization; formal analysis; methodology; investigation; Writing (proofreading and editing)

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**Central Message**
Hematological diseases are disorders that affect the blood, bone marrow, and lymphatic system, impairing the production or functioning of blood cells. They contribute to the morbidity and mortality of populations, negatively influencing the growth and development, especially of countries with few resources, and overloading health systems due to the need for continuous treatment.

**Perspective**
The profile of hematological patients is not homogeneous, and five groups can be identified, namely: Component 1 - Elderly with unspecified anemia; Component; 2 -children under 10 years of age with sickle cell disorders; Component 3 - adolescents with aplastic anemia; Component 4 - adults with coagulation defects; and Component 5 - adults with acquired hemolytic anemia. This characterization is important for university hospitals to optimize human and financial resources, as well as the follow-up of patients at the outpatient level and high complexity in the SUS.

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**ABSTRACT**

Introduction: Hematological diseases are disorders that affect the blood, bone marrow and lymphatic system, impairing the production or functioning of blood cells. They contribute negatively to morbidity and mortality, overloading health systems due to the need for continuous treatment

Objective: To characterize the profile of patients with hematological diseases treated at a university hospital between 2018 and 2024, through principal component analysis.

Method: This is a descriptive and retrospective study based on secondary data of hospitalized patients with hospitalization diagnoses classified in groups D50 to D89 of the 10th Revision of the International Classification of Diseases.

Results: A total of 1,076 hospitalizations for non-neoplastic hematological diseases were recorded. There was a predominance of men (51%). Recovery was high (88%), while deaths and transfers added up to 12%. In the principal component analysis, five groups were identified that together explain 72.2% of the total variance.

Conclusion: The profile of hematological patients is not homogeneous and the classification into five groups is important for university hospitals to optimize human and financial resources, as well as outpatient and high-complexity follow-up in the SUS.

Keywords: Hematological diseases. Medical records. Public health surveillance. University hospitals

## INTRODUCTION

Hematological diseases are disorders that affect the blood, bone marrow, and lymphatic system, impairing the production or functioning of blood cells. They can be inherited (e.g., sickle cell anemia, thalassemia), acquired (due to environmental, infectious, or immunological factors, such as leukemia and lymphomas), or due to other health problems (e.g., anemia due to chronic renal failure). These diseases contribute to the morbidity and mortality of populations, negatively influencing the growth and development, especially of countries with few resources, and overloading health systems due to the need for continuous treatment.[1]

The prevalence of hematological diseases, both globally and in Brazil, is conditioned by a multiplicity of interrelated factors, among which the limited access to early diagnosis, population aging (considering that hematological neoplasms have a higher incidence among the elderly), genetic elements (such as the occurrence of specific diseases in certain populations, exemplified by sickle cell disease), socioeconomic inequalities (including obstacles in accessing health services and differentiated exposure to environmental risk factors), and the insufficiency of quality epidemiological data in several nations. These aspects, taken together, impose significant barriers to the formulation and implementation of effective programs for the prevention and control of these conditions.[1-4]

In Brazil, according to data from the Department of Information and Informatics of the Unified Health System (DATASUS), there was a significant growth in the number of hospitalizations for hematological diseases between 2018 and 2024: from 6,620 to 130,093, with Paraná accounting for 6.7% of these hospitalizations. Thus, there was a significant increase in hospitalizations in Brazil (20%) and even greater in Paraná (22.2%) in the period analyzed. Despite the increase in the number of cases, the mortality rate in Paraná (3.16%) was lower than the national average (4.92%), which may indicate improvements in treatment or access to health care in the state.[5]

In Brazil and worldwide, the prevalence of hematological diseases varies widely, depending on the type of disease. Anemia represents the greatest challenge in terms of prevalence among hematological diseases, with a great impact on global public health, especially in low- and middle-income countries.[1,4,6,7] Among the factors that contribute to the higher prevalence of anemia, poor nutrition, iron deficiency, chronic diseases, and frequent blood loss (hemorrhages) stand out. According to the World Health Organization (WHO), anemia affects 30% of the global population2, and is most frequently observed in children under five years of age, women, and the elderly.[3] Some conditions, such as onco-hematological neoplasms and genetic diseases, are rarer and, although of low prevalence, have a high economic and clinical impact because they require complex treatment, often of high cost.

Thus, morbidity and mortality and the clinical-epidemiological characteristics of hematological diseases vary according to the type of disease, gender, age group, geographic region, and access to health services. The detailed analysis of these profiles is essential for the formulation of more effective strategies aimed at prevention and early diagnosis.

The present study aimed to perform an exploratory analysis of hospitalizations for non-neoplastic hematological diseases in a university hospital, covering the period from 2018 to 2024. Principal component analysis was used to identify and establish correlations between events or implicit characteristics in patients affected by these conditions.

## METHOD

This is a descriptive, retrospective, and quantitative study, based on the analysis of specific reports of patients hospitalized for non-neoplastic hematological conditions at the University Hospital of Western Paraná, State University of Western Paraná, and Epidemiological Surveillance Center, Cascavel, PR, Brazil, covering a period of seven years (2018 to 2024). The study was approved by the Human Research Ethics Committee – CAAE 60158922.5.0000.0107.

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Hospitalizations with diagnoses corresponding to codes D50 to D89 of the 10th revision of the International Classification of Diseases (ICD-10), including hematological diseases, were included.[8] Hospitalizations with ICD codes different from this interval were disregarded.

In the present study, the information was obtained from reports extracted from the Tasy hospital management system and collected in 2025. The variables analyzed were: year of hospitalization, age group of the patients, sex (female and male), clinical outcome (hospital discharge, transfer to another hospital unit or death), municipality of origin (Cascavel or other municipalities) and diagnosis related to hospitalization. The diagnoses were categorized into six subgroups, according to the classifications established in Chapter III (D50 – D89) of the ICD-108, namely: 1) other anemias and aplastic anemias; 2) coagulation defects, purpura and other bleeding conditions; 3) hemolytic anemias; 4) nutritional anemia; 5) other diseases of the blood and hematopoietic organs; and 6) disorders related to the impairment of the immune mechanism. For inclusion in the analysis, only patients whose information was complete in relation to the variables of interest of the study were considered.

### Statistical analysis

The data obtained were transcribed into Microsoft Excel spreadsheets. When analyzing the quantitative variables, classical statistical methods were used to calculate frequencies and percentages. To evaluate possible relationships between the variables, Principal Component Analysis (PCA)[9] was used, which allows patients to be grouped into distinct profiles based on sociodemographic and clinical variables. The PCA aims to reduce the dimensionality of the data (e.g., age, sex, disease type) to identify components that explain most of the variation. To this end, the database was structured as a matrix with 30 variable columns (gender, age group, among others). Each variable column contained 84 elements, corresponding to the number of months between 2018 and 2024. To avoid statistical distortions in the universe of variables, the data were adjusted to the distribution of values of a normal distribution pattern. In view of parameterized variables, the total variance was obtained, and presented in principal components. The Jamovi software was used in the ACP statistical option and Varimax rotation, for the analysis of the data matrix.[10]

## RESULTS

In the seven-year period (2018-2024), 1,076 hospitalizations for non-neoplastic hematological diseases were recorded. There was a significant increase in hospitalizations (130% in seven years), especially in the last three years, from 125 (2018) to 288 (2024), which may be related to increased detection or worsening of hematological conditions (Figure 1). Regarding biological sex, males (51%) predominated over females (49%). Regarding the predominant age group (Figure 2), young men (20 to 29 years) had a higher prevalence and among women, cases in advanced age groups (60+) predominated, suggesting a relationship with comorbidities or physiological states (e.g., postmenopause).

The origin of the patients covered 77 cities. More than half of the hospitalizations (59.3%) were from Cascavel, suggesting a greater supply of specialized services (tertiary care) and centralization of hospital referrals. In 40.7% of hospitalizations came from other cities in Paraná, highlighting the relevance of Cascavel as a regional health center. It is essential to highlight that the municipalities of Quedas do Iguaçu, Cafelândia and Toledo also recorded a high frequency of hospitalizations. However, these values were lower than those observed in the municipality of Cascavel.

The clinical profile, consisting of "Other anemias", was the most frequent group (37.2%), indicating the importance of various non-nutritional causes, followed by "coagulation defects and purpura", which represented almost 1/3 of the cases (Figure 3).

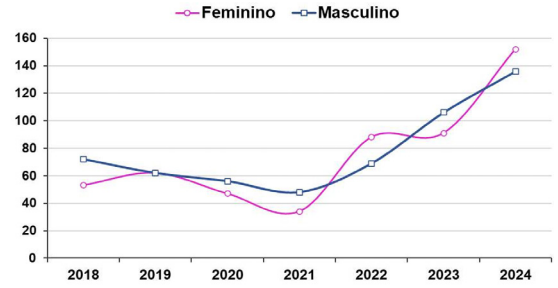


**FIGURE 1** — Number of hospitalizations by sex and year of hospitalization

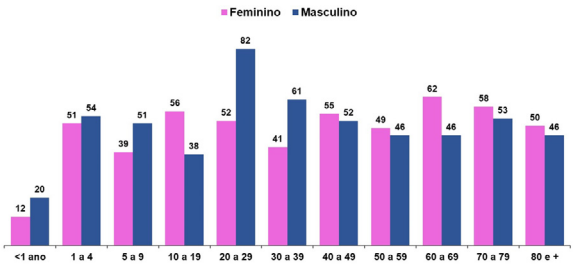


**FIGURE 2** — Number of hospitalizations by sex and age group

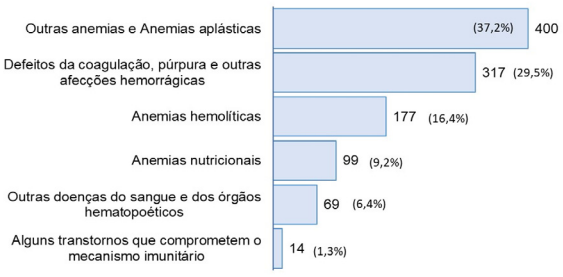


**FIGURE 3** — Number and percentage of hospitalizations for hematological diseases grouped according to ICD-10.

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In a more detailed analysis, the group called "other anemias and plastic anemias" (n = 400) was composed of 88% of unspecified anemias, 5% of acute post-hemorrhagic anemias, and 7% of aplastic anemia. In the group referring to coagulation defects, purpura and other hemorrhagic disorders (n = 317), 82.3% were related to purpura and other hemorrhagic conditions, 13.9% to other coagulation defects and 3.8% to hereditary deficiency of factor VIII. Regarding hemolytic anemias (n = 177), 84.7% resulted from hereditary hemolytic anemias, mainly associated with sickle cell disorders, while 15.3% were attributed to acquired hemolytic anemias. Among the cases of nutritional anemias (99), 87% had iron deficiency as the main cause, followed, to a lesser prevalence, by anemias caused by vitamin B12 or folate deficiency. In the group of "other diseases of the blood and hematopoietic organs" (n = 69), 63% were classified as other diseases miscellaneous, while 13% involved other disorders of the white blood cells and 9% referred to diseases of the spleen. Finally, the group of disorders affecting the immune mechanism was composed of conditions associated with immunodeficiencies.

Regarding the clinical outcome, there was a high recovery rate (88%), indicating the effectiveness of hospital management, while death (6%) and transfers added up to 12%, representing cases of greater severity.

In the Principal Component Analysis (PCA), five principal components were identified, which explain 72.2% of the total variance, as illustrated in Figure 4. The first component explained 28.2% of the variance, the second contributed with 14.6%, and the third with 13.1%. The other components presented smaller contributions, but still relevant. To determine the number of principal components, the eigenvalues greater than one were adopted as a criterion, following Kaiser's proposal.[11] The Table presents the variables and their respective contribution weights to the formation of the five main components.

**TABLE** — Analysis of principal components according to hospitalizations for hematological diseases. HUOP, 2018 to 2024

| Variables | Weight of components | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Aged 60 and over | 0.913 | | | | |
| Unspecified anaemia | 0.899 | | | | |
| Rattlesnake | 0.749 | 0.511 | | | |
| Death | 0.722 | | | | |
| Women | 0.715 | 0.322 | 0.403 | | |
| Iron deficiency anemia | 0.711 | | | | |
| High | 0.695 | 0.517 | 0.433 | | |
| Male | 0.619 | 0.434 | | | 0.370 |
| Other municipality | 0.564 | | 0.546 | | 0.405 |
| Under 10 years old | | 0.735 | | -0.371 | |
| Hereditary hemolytic anemia | | 0.677 | | | |
| Other blood disorders | | 0.636 | | | |
| From 20 to 59 years old | 0.418 | 0.434 | | 0.372 | 0.408 |
| Aplastic anemias | | | 0.852 | | |
| Purple | | 0.371 | 0.679 | | |
| From 10- 19 years old | | | 0.581 | | |
| Other coagulation defects | | | | 0.756 | |
| Immune Disorders | | | | -0.729 | |
| Acquired hemolytic anemia | | | | | 0.864 |

Note: The varimax rotation was used

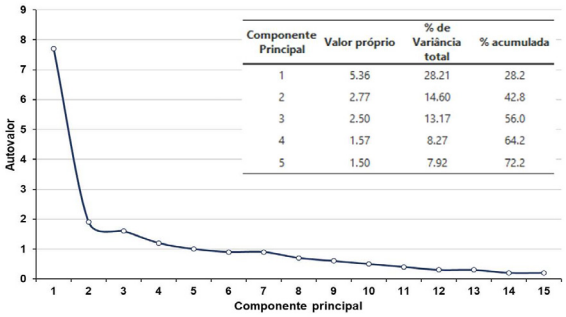


**FIGURE 4** — Number and percentage of hospitalizations for hematological diseases grouped according to ICD-10

## DISCUSSION

The objective of this study was to identify and interpret linear relationships between a set of variables of patients with non-oncological hematological diseases admitted to a teaching hospital, using PCA over seven years. In the analysis performed, the total variance was distributed in five main components, which, together, explain 72.2% of the total variation of the data (as illustrated in Figure 4). The Table details the contribution of each original variable to the formation of these five main components.

**Component 1**
**Elderly with unspecified anemia.**

The first main component, with an eigenvalue of 5.[36] and responsible for 28.2% of the variability in the data, highlighted that hospitalizations of patients diagnosed with unspecified anemia and iron deficiency anemia were mostly recorded among people aged 60 years or older. This behavior was consistent regardless of gender, municipality of origin, or hospitalization outcome (discharge or death).

Anemia stands out as a health problem, the incidence of which progressively increases with advancing age. Estimates indicate that this condition affects about 10% of people aged 65, affecting approximately 20% of adults aged 85 and over.[12] However, in hospital contexts, the prevalence of anemia in the elderly varies significantly between studies, ranging from 40% to 84%, suggesting that such variations may be related to the different criteria adopted to characterize anemia.[7:12-15]

To determine the appropriate treatment of anemia, it is essential to identify its underlying cause, which, in the elderly, may be due to chronic diseases, idiopathic anemia, or nutritional deficiencies.[13]

Anemia associated with chronic diseases is linked to several pathological conditions and, during hospitalization, is related to worse outcomes, including higher mortality, worsening of comorbidities, prolonged hospitalization, and reduced quality of life.[12,13,16]

Among the elderly, the prevalence of unexplained or idiopathic anemia stands out, affecting approximately 20% to 30% of individuals living in communities, 17% of hospitalized patients, and more than half of residents in long-term care

facilities. Studies indicate that between 5% and 15% of the elderly with this diagnosis can progress to myelodysplastic syndrome.[17]

In the geriatric environment, anemia is also recorded due to nutritional deficiencies, especially iron, vitamin B12 and folate.[17,18] Iron deficiency accounts for almost half of the cases of anemia associated with nutritional deficits in this population, and its etiology is predominantly due to chronic blood loss in the gastrointestinal tract.[16,19] An analysis based on data from the Hospital Information System (SIH), conducted between 2017 and 2021 in five municipalities of the 4th regional health district of the state of Paraná, identified that hospitalizations for anemia caused by iron deficiency accounted for 8% of the total, while other forms of anemia accounted for 82.1% of the identified cases.[20]

In this study, the predominance of unspecified anemia among the elderly was verified, a relevant finding, considering that the care took place in a university hospital with infrastructure, specialized staff and adequate laboratory resources for diagnostic elucidation. This fact may indicate difficulty in establishing a more accurate etiological diagnosis, possibly influenced by the presence of other conditions, as described in the literature. The possibility of outdated final diagnoses or inadequate completion of the International Classification of Diseases (ICD) should also be considered, which can lead to underestimation of cases classified by specific cause. Such aspects reinforce the importance of the quality of the information recorded in the system, which is fundamental for care, teaching and research. Finally, it was observed that iron deficiency anemia was the least frequent, in line with the profile described in the literature.

**Component 2**

**Children under 10 years of age with sickle cell disorders.**

The second main component, with an eigenvalue of 2.77 and responsible for 14.6% of the variance, indicated that the hospitalization of children under 10 years of age, originally from Cascavel, had as its main reason hereditary hemolytic anemia, often associated with discharge outcome with improvement. In this context, sickle cell disease stood out as the most prevalent condition among the conditions.

Sickle cell disorders affect millions of people worldwide. The absence of early diagnosis, the lack of guidance to families, limited access to preventive measures, the lack of effective government programs for the distribution of medicines, and inadequate care for complications contribute to the reduction of patients' life expectancy.[21] According to a global analysis carried out on the burden of sickle cell disease between 2000 and 2021, the number of carriers increased by 41.4%, and continues to be the 12th leading cause of mortality in children under five years of age.[19] In addition, there has been a significant reduction in the life expectancy of individuals affected by the disease, especially in the age group between 25 and 30 years.[21]

In Brazil, sickle cell disease is one of the most prevalent genetic conditions, especially among the black population, with unequal distribution among different regions of the country.[19] A survey conducted with 9,349 hospitalized patients in the regions of Bahia, Rio de Janeiro and São Paulo, between 2000 and 2002, indicated that 70% were young people under 20 years of age and that 90.8% of hospitalizations occurred in emergencies.[21] A recent study in Rio de Janeiro, carried out between 2015 and 2020, analyzed 254 deaths of children and adolescents, finding that 23% of these deaths were caused by sickle cell disorders, predominantly in individuals with brown and black skin and in the age group of 15 to 19 years.[22]

In this study, a higher prevalence of sickle cell disease was found in relation to other hereditary diseases. Although most patients identified themselves as white, cases were also recorded among brown people from other states and among immigrants from Haiti and Venezuela. The region has health services capable of offering rapid diagnosis and appropriate treatment, especially at the university hospital, whose efficient care has favored the recovery and discharge of these patients.

**Component 3**

**Adolescents with aplastic anemia**

The third main component, with an eigenvalue of 2.50 and explaining 13.1% of the variance, refers to hospitalizations for aplastic anemia and purpura in individuals aged 10 to 19 years, originating from municipalities in Paraná other than Cascavel.

Aplastic anemia is a rare and potentially fatal pathological condition that can affect individuals of any age. Adequate diagnosis, combined with effective therapeutic interventions, is a central element for the clinical management of the disease. An investigation conducted in five regions of Brazil revealed an annual incidence of 2.7 cases per million inhabitants.[23] Another study conducted in the state of Rio de Janeiro recorded a mortality rate from aplastic anemia of 19% among children and adolescents.[22] In addition, a comprehensive analysis conducted in Brazil between 2000 and 2019 examined [15,157] deaths due to bone marrow aplasia, based on the causes of death declared on death certificates. Of the total, 83.3% of the cases referred to individuals aged between 30 and 40 years, 50.6% of whom were men and mostly residents of the state of São Paulo. In 85.8% of the occurrences, the underlying cause of death was unspecified aplastic anemia, whereas the most frequent immediate causes were septicemia and acute respiratory failure.[24]

In this study, aplastic anemia was highlighted as a condition of significant relevance among adolescents, reinforcing the need for specific attention to this age group. However, available studies investigating aplastic anemia in hospitalized children and young

adults remain scarce, since most analyses address broader age groups or focus on the overall incidence of the disease.[23]

### Component 4
### Adults with coagulation defects

The fourth main component, characterized by an eigenvalue of 1.57 and accounting for 8.2% of the explained variance, revealed that hospitalizations associated with the diagnosis of other coagulation defects were predominantly associated with individuals in the 20-59 age group.

In Brazil, hospitalizations for coagulation defects include both hemorrhagic and thrombotic disorders, and can have a hereditary origin - such as hemophilia and von Willebrand's disease - or be acquired due to conditions such as liver disease, vitamin K deficiency or the use of certain medications. Hospitalizations for inherited disorders are less frequent, while those related to thrombotic conditions are more common among adults.

There is no specific information on the prevalence of hospitalizations exclusively for coagulation defects in adults. The available data generally address the prevalence of diseases more comprehensively or relate to associated conditions, such as thrombosis. This absence of precise numbers reflects the complexity in compiling public health data, often categorized by broad age groups or by more prevalent diseases.

Regarding hereditary coagulopathies, a survey carried out in 2016 identified 24,228 cases in Brazil. Of these, 41.78% referred to hemophilia A, 8.24% to hemophilia B, 32.24% to von Willebrand's disease, and 7.54% to rare coagulopathies. Most cases occurred in males (67.41%) and were concentrated in the Southeast region, followed by the Northeast, South, Midwest, and North regions of the country.[25] A study in Brazil on patients hospitalized for hemophilia in the period from 2020 to 2025 pointed to 2,864 hospitalizations, 84.6% of which were urgent, with a mortality rate in the period of 2.27, with higher rates in the Southeast region.[26]

### Component 5
### Adults with acquired hemolytic anemia

The fifth main component, characterized by an eigenvalue of 1.50 and representing 7.9% of the variance, indicated that hospitalizations for acquired hemolytic anemia occurred predominantly among individuals aged 20 to 59 years, from municipalities in the state of Paraná, other than Cascavel.

Autoimmune acquired hemolytic anemia (AIHA) is considered a rare condition; however, hospitalizations occur because it is an urgent condition. The disease can be caused by both immune and non-immune factors. It is most often diagnosed in women in their 40s, with an incidence rate of one case per 100,000 people. Among individuals under 20 years of age, the incidence is 0.[2] per million, with a peak in the preschool age group.[27,28] A study conducted in Brazil, covering a period of nine years (2010 to 2019), recorded an annual increase of 7% in deaths from hemolytic anemia. This growth was observed, for the most part, among white women over 55 years of age, in addition to standing out for the high mortality rates in the Southeast and Northeast regions.[29]

The results obtained are consistent with the literature regarding the age profile of the patients. However, other aspects identified require further investigation.

### Limitations

This study has limitations that should be considered. The data used were extracted from a secondary database (Tasy), which makes it impossible to completely ensure the absence of underreporting or typing errors. In addition, the information reflects exclusively the population served by the university hospital, which prevents the generalization of the results. Under certain conditions, the scarcity of studies in the literature reinforces the need for more research in the area. The findings of this study are valid and relevant, offering important subsidies for the formulation of public policies in the field of health. They highlight the importance of identifying and understanding the most prevalent hematological conditions, with the aim of not only developing therapeutic approaches that prioritize the efficacy and well-being of affected individuals, but also promoting improvements in the quality of care provided and implementing measures that minimize long-term complications.

## CONCLUSION

Hematological diseases encompass a wide range of conditions, some more common than others. The PCA allowed us to identify that the profile of hematological patients is not homogeneous, being divided into elderly patients with unspecified anemia, children under 10 years of age with sickle cell disorders, adolescents with aplastic anemia, adults with coagulation defects, and adults with acquired hemolytic anemia. This characterization is important for university hospitals to optimize human and financial resources. The exploratory analysis performed in this study has the potential to be extended to other hospitals, enabling a more comprehensive overview of the prevalence of hematological diseases in local, regional, or even national populations. This type of approach can support public policies, considering the different realities of human development in each region. The results obtained can also contribute to the formulation of policies aimed at improving the quality of health care for these patients at the various levels of care in the SUS, from outpatient care to high complexity.

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