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ASSESSING THE SUSTAINABILITY OF THE PORTUGUESE NATIONAL HEALTH SERVICE

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Master Thesis

presented as partial requirement for obtaining a Master's Degree in Data Science and Advanced Analytics

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação
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by

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Master Thesis presented as partial requirement for obtaining the Master's degree in Data Science and Advanced Analytics, with a specialization in Data Science

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STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration. I further declare that I have fully acknowledged the Rules of Conduct and Code of Honor from the NOVA Information Management School.

Lisbon, 17 December of 2023

ABSTRACT

This study evaluates the sustainability of Portugal's national healthcare system, providing a comprehensive analysis of its current status. It is guided by the concept of sustainability, which involves addressing present health needs while conserving resources for future generations. The assessment is based on an index reflecting the system's performance over the entire year of 2023, focusing on all Portuguese citizens and the care provided. Additionally, the study aims to highlight areas for improvement and strengths, raise awareness, and offer recommendations for enhancement.

The methodology for calculating the sustainability index incorporates five indicators that assess the system's core attributes: activity, debt, expense, quality, and accessibility. These indicators are derived from a combination of technical data from official records and subjective assessments through user surveys. After gathering the data, processes such as normalization, weighting, and aggregation are used to generate the final result.

Although the system maintains an acceptable level of sustainability, the result was 84.8, showing a slight decline and recording the lowest value to date. Accessibility was identified as the most concerning factor, indicating that some citizens still struggle to access healthcare. Furthermore, significant discrepancies were observed between user perceptions and actual performance. Lastly, a comparison of each attribute over the years is explored, with evaluations spanning from 2018 to 2023.

KEYWORDS

Sustainability; Healthcare; Assessment; Sustainability Index

Sustainable Development Goals (SDG):



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LIST OF ABBREVIATIONS AND ACRONYMS

SDGs	Sustainability Development Goals
SNS	Portuguese National Health Service (Serviço Nacional de Saúde in Portuguese)
LHU	Local Health Units
ACSS	Central Administration of the Health System
DGO	Directorate-General for Budget

1. INTRODUCTION

The ambiguity surrounding the term sustainability allows for various perspectives and interpretations, risking its potential to become meaningless without a clear understanding of its different implications. Sustainability can be defined as “meets the needs of the present without compromising the ability of future generations to meet their own needs” in the (Commission on Environment, 1987). Additionally, (Milne & Gray, 2013) and (Mensah & Enukwesi, 2019) underlie sustainability as the balance of the three major pillars, which are environment, social, and economic. Ensuring that all three factors intersect is crucial for achieving full sustainability. On the other hand, (Ben-Eli, 2018) sees sustainability as a dynamic equilibrium in the process of interaction between the population and the carrying capacity of its environment to ensure that resources are used efficiently and responsibly, without causing harm to the planet or depleting natural resources.

Sustainability is commonly linked with the idea of growth, development, and improvement (Fischer et al., 2022), making it a central theme in global discussions regarding the future. It attracts attention from a wide range of stakeholders, including corporations, governments, systems, brands and others. The concept sustainability depends on the system in scope, relying on their priorities and approaches. For instance, (Delli Paoli & Addeo, 2019) and (Lafortune et al., 2018a) focus on the spectrum of the 17 development goals created by the United Nations (UN) in 2015. These goals, as outlined by (Kuhlman & Farrington, 2010), were created to provide a shared blueprint for peace and prosperity, both for the people and the planet. The Sustainable Development Goals (SDGs) address critical areas, including education, climate action, gender equality, peace, economic growth, reduced inequalities, and other important topics. By setting specific targets and indicators, the SDGs aim to eradicate poverty, protect the environment, and ensure that all people enjoy peace and prosperity by 2030.

This paper focus on Portugal's national health system, known as *Serviço Nacional de Saúde* (SNS) in Portuguese. Established in 1979 following the Portuguese Revolution of 1974, with the goal of ensuring universal access to healthcare services for all residents, regardless of their financial means. The SNS plays a crucial role in providing comprehensive healthcare services across the country, including medical consultations, hospital care, emergency services, and preventive healthcare. Its creation marked a significant step towards reducing health disparities and promoting public health in Portugal.

The definition of sustainability in the healthcare system aims to ensure continuous access to high-quality healthcare for everyone, both now and in the future. This involves striking a balance between addressing current health needs and preserving resources for future generations. Achieving sustainability requires not only treating illnesses but also preventing them, promoting healthy lifestyles, and using healthcare resources wisely and efficiently.

Five critical factors must be considered when evaluating the sustainability of the SNS, the system's **activities** reflect its effectiveness in addressing health matters. Also, examine the **expense**, meaning the total costs incurred by the healthcare services. It considers whether the system can manage its **debts** without compromising the quality and accessibility of healthcare services. **Quality** is divided into perceived quality, evaluated from the citizens' perspective, and technical quality, derived from objective data and clinical outcomes. Finally, **accessibility** involves the availability and easy access to healthcare services, also categorize into perceived and technical. The perceived values are an assessment of the system from the users' perspective by measuring additional dimensions such as satisfaction, trust, price, and effectiveness (Islam et al., 2021).

These five factors collectively provide a comprehensive framework for assessing the performance and sustainability of the SNS, addressing key dimensions of efficiency, affordability, quality and accessibility. While other factors may also influence the healthcare system, these five factors are deemed most critical due to their direct impact on patient outcomes, system effectiveness, and long-term viability. Therefore, they construct the evaluation process to provide a focused and comprehensive assessment of the SNS's performance.

In recent years, Professor Pedro Simões Coelho from Nova Information Management School (NOVA IMS) has developed a comprehensive methodology to evaluate the sustainability of the SNS. This evaluation provides a final value known as the sustainability index, which measures how well the SNS performs in terms of sustainability in health. In other words, assessing whether the system meets the needs of the population. The paper thoroughly explains the detailed calculation process of this index, providing a step-by-step justification for each methodological choice to ensure clarity in the index's calculation and interpretation.

As referred previously, the index is determined by five key metrics: activity, debt, expense, quality, and accessibility. Each factor is analyzed in depth, with clarification of their impact and relevance to the overall sustainability of the SNS. This research paper provides a detailed analysis of each metric, as well as an assessment of the strengths and weaknesses of the health service, identifying potential priority areas for action. Additionally, the highlights the evolution of the SNS by comparing current results with previous years, focusing on changes over the past five years and evaluating improvements. Lastly, a dedicated chapter offers a personal evaluation of the index, suggesting possible improvements and providing critical opinions to enhance the assessment.

The research questions guiding this paper are:

1. Is SNS sustainable through the lens of accessibility?
2. How do users perceive the quality and accessibility within the SNS?

2. LITERATURE REVIEW

The purpose of this literature review is to provide a comprehensive overview of the healthcare system status in 2023 starting with a chapter on the challenges it faces. The review details some changes implemented in response to these challenges, aimed to improve the system including a new strategy for the winter season. Afterwards, addressing the gap of the sustainability index, offering examples of previous calculated indexes that use similar methodologies and explaining their differences. The final section presents a critical analysis of the index calculation, suggesting potential improvements and proposing new indicators that could enhance the assessment of the SNS.

2.1. CHALLENGES FACED

Healthcare systems worldwide face numerous challenges in delivering optimal care, ranging from vaccination programs to addressing financial constraints and resource allocation. These issues impact the effectiveness and efficiency of healthcare services, influencing overall population health. This chapter briefly explores these critical challenges, highlighting the complexities and the need for innovative solutions to ensure equitable and sustainable healthcare.

The first major issue is the COVID-19 pandemic which began in 2019. In Portugal the impact was felt in the beginning of 2020, amplified existing challenges and increased the demand for resources. Hospitals saw an exponential rise in patient numbers, especially in intensive care units, necessitating rapid adjustments in capacity. Healthcare professionals suffered extraordinary workloads, the risk of infection, and significant emotional stress. The focus on managing COVID-19 cases led to the postponement or cancellation of other medical services, including treatments for chronic diseases, routine check-ups and preventive care, negatively affecting patients who needed help beyond the pandemic. Four years later, the repercussions are still evident, from strained resources and equipment shortages in hospitals and clinics to a backlog of medical issues that have created a continuous cycle of shortages and delays. From elective surgeries to routine appointments, delays have worsened with new cases requiring attention. Extended delays in treatment have led to more complex and severe cases, making them harder and more expensive to manage. Patients experience longer waiting times, reduced access to specialized care, and overall lower quality of services.

Moreover, there are some funding and financial challenges. The SNS relies on government funding, which is subject to economic changes and budgetary constraints. These financial constraints have direct impact on the availability and quality of healthcare services. Lack of money leads to reduced staffing and limitation of medical supplies.

Focusing on the quality of healthcare receive, the key impact metrics are illustrated in the **Error! Reference source not found.** below retrieved from (Coelho, 2024). The first quadrant highlights the strengths, such as the quality of professionals and the excellence of the

information they provide. Conversely, the fourth quadrant identifies areas requiring immediate improvement, including ease of access to care and the long waiting periods between booking appointments and receiving medical services.

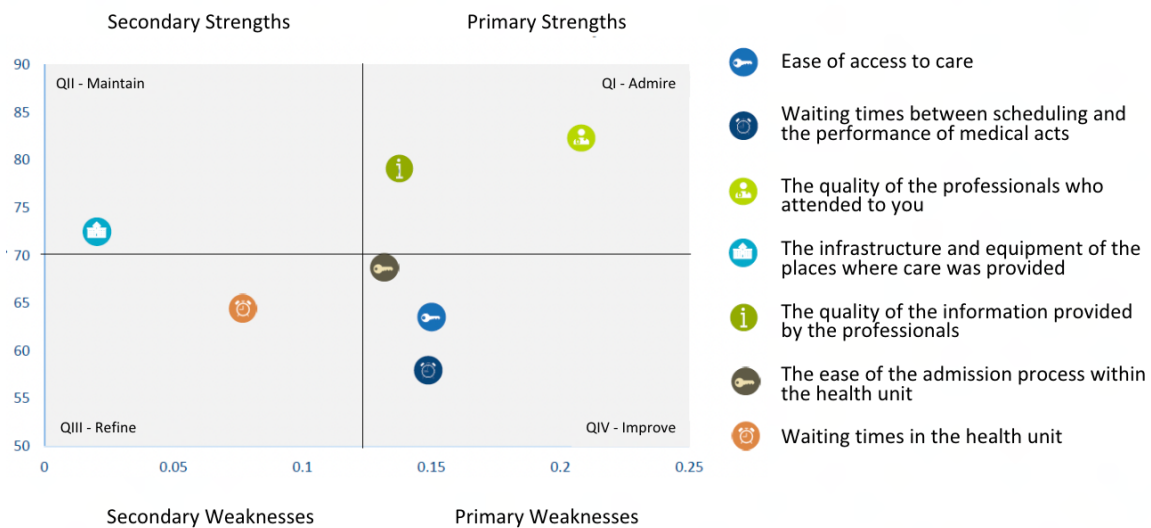


Figure 2.1 - Importance in the Quality of Healthcare Receive

Related to the workforce, doctors, nurses and other health workers, SNS has a lack of healthcare professionals related to the dissatisfaction created by demanding work hours, high patient loads, burnouts and low payments. These factors result in job dissatisfaction and migration of staff searching for better opportunities and better working conditions (Abrantes & Simões, 2017). Either in the private sectors or other countries in Europe, where a higher payment can be offered. Oddly, the number of professionals in the workforce is higher than ever before and is growing over the years. However, is felt the absence of sufficient staff, that cannot meet the needs of the population, that is aging and increasing.

Despite this, it is important to note that healthcare professionals are delivering high-quality care and demonstrating great competence, as reflected in available data, shown in **Error! Reference source not found.** The dedication and skill of these professionals are clearly making a positive impact, even in the face of significant workforce shortages

In addition, the access to healthcare services in Portugal varies significantly by region. Rural and remote areas often need to travel long distances to access medical services, which can be challenging for elderly and chronically ill patients. As well as for individuals that encounter financial constraints, language barriers or absence of information about available services. Addressing these obstacles is crucial for achieving equitable healthcare access.

2.2. NEW MODIFICATIONS

The latest plan presented by the Ministry of Health outlines a comprehensive seasonal health response for the winter of 2023/2024 (Ministério da Saúde, 2023). This strategic document addresses various challenges across healthcare institutions and introduces concrete measures to follow. Given the important role of the SNS in Portugal's healthcare, it is prominently featured throughout the document. Principal key areas to address include enhancing the SNS24 landline service and ensuring high vaccination coverage.

A significant transformation is underway with the establishment of 31 new Local Health Units (LHU) since the beginning of 2024, marking a substantial increase from the existing 8 units. These LHU are designed to manage healthcare facilities within specific geographical areas, contributing to a more localized and integrated healthcare approach. This restructuring, guided by *Decree-Law No. 52/2022* (Diário da República, 2023) and the new Statute of the SNS, aims to enhance the integrated management of resources and promote collaborative, community-focused healthcare. The SNS will be organized into 39 LHU, coexisting with three Portuguese Oncology Institutes and the Cascais Hospital under a public-private partnership.

Additionally, new tools for clinical risk stratification will be implemented to optimize healthcare system effectiveness and resource allocation. This means that healthcare providers will be better equipped to identify and prioritize patients based on the severity of their conditions, ensuring that those who need urgent care receive it promptly, while also efficiently managing resources.

The Ministry of Health's strategic plan is a strong effort to improve Portugal's healthcare system, making it more resilient and responsive, especially during the winter. By focusing on local health management, better resource allocation and advanced clinical tools, the plan aims to address healthcare challenges and improve patient outcomes. For the research paper, the data collection for the index pertains to the year 2023, meaning recent changes won't immediately impact the index. However, the goal is to enhance the index in the coming years.

2.3. SUSTAINABILITY INDEXES

The upcoming section explores various sustainability indices, examining their parameters and methodologies. These models, not specifically related to Portugal or healthcare, provide valuable insights into analogous frameworks. The objective is to contribute and support the development of the evaluation model for the SNS used in this study.

A sustainability index is a metric designed to evaluate and compare the sustainability performance of companies, countries, or other entities. These indexes assess various aspects of environmental, social, and economic performance, aiming to provide a comprehensive view of sustainability practices and impacts. They serve as essential tools for investors, policymakers, and researchers to understand and promote sustainable development. There are several metrics to consider for the calculation, depending on the system in scope.

For instance, one of the most famous sustainability indexes globally is the **Dow Jones Sustainability Index (DJSI)**. The DJSI evaluates the sustainability performance of the largest companies listed on the Dow Jones Global Total Stock Market Index. The selection criteria for the DJSI are based on long-term economic, environmental, and social criteria. Every year conducts a Corporate Sustainability Assessment (CSA), which includes around 80 to 120 industry-specific questions covering both qualitative and quantitative data. Companies are scored out of 100 based on their responses, with different sustainability criteria weighted according to their relevance to the industry. Typically, economic factors account for approximately 25%, environmental factors another 25%, and social factors the remaining 50%.

Another prominent sustainability index is the **FTSE4Good Index Series**, developed by FTSE Russell. This index measures the performance of companies demonstrating strong Environmental, Social, and Governance (ESG) practices. Companies are screened for inclusion based on ESG criteria, with specific exclusions for sectors such as tobacco, weapons, and coal. FTSE Russell assigns ESG ratings to companies based on their performance in over 300 indicators across 14 themes. These themes are grouped into environmental (40%), social (40%), and governance (20%) factors, which are later used to calculate a company's ESG rating. The FTSE4Good Index emphasizes specific themes within ESG criteria, allowing for a more focused analysis of key issues, and its strict exclusion policy impacts its composition and focus.

The **Sustainable Development Goals (SDG) Index**, measures country performance against the United Nations Sustainable Development Goals (SDGs). The SDG Index in the methodology outlined by (Lafortune et al., 2018b) uses 109 indicators to cover the 17 SDGs. Related to SDG3: Good Health and Well-Being, that aims to ensure healthy lives and promote well-being for all ages, encompasses 14 indicators related to mortality rates, infections, diseases, vaccines, number of smokers and overall well-being.

The selection of these indicators is set by several criteria. Indicators must be globally relevant and applicable across different countries, allowing for direct performance comparisons and the definition of quantitative performance thresholds. They must represent valid and reliable

measures, be up-to-date and be published promptly. The data series should represent the best available measures and come from official national or international sources or other reputable sources like peer-reviewed publications, excluding self-reported national estimates. Data must be available for at least 80% of the 149 United Nation Member States with a national population greater than one million.

The data collection process encompasses various approaches, ranging from official sources to non-official ones, including questionnaires and publications. For instance, where data prove insufficient or missing, a combination of multiple data sources and imputations is necessary to ensure comprehensive data coverage. (Lafortune et al., 2018b) uses a blend of data sources, comprising 65% official and 35% non-official sources, with prominent contributors such as OECD, WHO, UNICEF, and the World Bank. In the study, data were gathered primarily from official sources such as EUROSTAT, using the most recently updated source for each indicator. Said indicators were selected based on their ability to provide data for at least 90% of Member States, resulting in the inclusion of 102 indicators while omitting SDG6 and SDG14 due to insufficient data availability.

To mitigate the impact of outliers, which can distort the results of a composite index, (OECD and JRC, 2016) suggests censoring data at the 2.5th percentile as the minimum value for normalization. Following this recommendation, (Lafortune et al., 2018b) applied this censoring approach to the lower bound of our data. Before calculating the global index, first the values were normalized for each indicator. Every indicator has its own value and measure, making direct comparisons challenging, therefore, a normalization process is crucial to ensure comparability across different indicators. Each variable was rescaled on a scale from 0 to 100, with 0 representing the worst performance and 100 representing the technical optimum. Min-max normalization was used to obtain the new normalized values. Afterwards, these normalized values were aggregated by applying weights to reflect the importance of each indicator. This weighted aggregation ensures that indicators considered more significant have a greater impact on the overall index, providing a more accurate picture of overall performance. Each SDG is given equal weight in the final index score, ensuring a balanced evaluation across all goals. The result is a score from 0 to 100 in each indicator and can be interpreted as the percentage of achievement. The difference between 100 and the score is therefore the distance in percentage that needs to be completed to achieving the goals. It can be highlighted that Portugal stands in number 18 with a sustainability index of 80% and has a moderate improvement related to the health sector (United Nations, 2023).

Other index calculations use similar approaches, varying the indicators and methods to aggregate values. While these analyses are useful, they typically offer general comparisons between countries and broad information on various topics without providing detailed or specific insights. For Portugal, there is a lack of detailed information, and the methodologies used are often inadequately explained or unavailable.

The goal of my thesis is to provide a detailed and unique perspective on the index calculation, offering a specific methodology tailored to assess Portugal's National Health System and its unique needs. By using key indicators, my aim is to provide a thorough and accurate analysis.

2.4. POSSIBLE IMPROVEMENTS

To improve the evaluation of the sustainability index for healthcare systems, some enhancements can be made to ensure a more comprehensive, accurate, and reliable assessment. Currently, the index relies on a limited number of specific factors, which may not fully capture the complexity and diversity of elements that influence healthcare sustainability. One of the key improvements is the inclusion of additional metrics that reflect broader dimensions of health and operational sustainability.

Expanding the index to include mental health indicators would address a growing area of concern. As mental health becomes increasingly recognized as a critical component of overall well-being, metrics such as access to mental health services, integration into primary care, and mental health outcomes would provide a more complete picture of healthcare system sustainability. Additionally, addressing staff well-being and occupational health is essential, given that healthcare staff play a pivotal role in maintaining the functionality and sustainability of the system. Metrics that measure burnout rates, job satisfaction, staff turnover, and access to occupational health services would help highlight the importance of supporting healthcare workers in achieving long-term sustainability.

In addition to broadening the scope of the metrics, it might be worth reconsidering how different perspectives are weighted within the index. Currently, user perceptions and technical performance are weighted equally, which may not always reflect their actual significance. While patient perceptions are important, they might not always carry the same weight as the technical accuracy of treatments and outcomes. A more tailored weighting system could better reflect the importance of technical performance in the overall index.

The process of refining the index would also benefit from improved data analysis. Removing outliers from the dataset is one potential improvement that could enhance the accuracy and reliability of the results. Extreme values influence the overall assessment, leading to conclusions that may not reflect the true state of healthcare system sustainability. Implementing methods to handle these extreme values would ensure that the evaluation reflects the real picture of the healthcare system's sustainability.

3. METHODOLOGY

The methodology of this study is designed to create a comprehensive index that accurately reflects the sustainability of Portugal's healthcare system. Conducted over the entire year of 2023, this study focuses exclusively on Portuguese citizens. The assessment is based on the analysis of five key factors: activity, expense, debt, quality, and accessibility. Each factor is evaluated using different metrics and approaches tailored to capture the most relevant data for that particular aspect of the healthcare system.

The data for these indicators is sourced from various sources, such as the Central Administration of the Health System and the Directorate-General for Budget (ACSS and DGO in Portuguese respectively). Additionally, some data is gathered through questionnaires administered by the SNS, capturing the experiences and perspectives of healthcare users. Figure 3.1 provides a breakdown of the percentage of data retrieved from each source, ACSS and DGO are categorized as official data sources, while questionnaires are classified as non-official data sources.

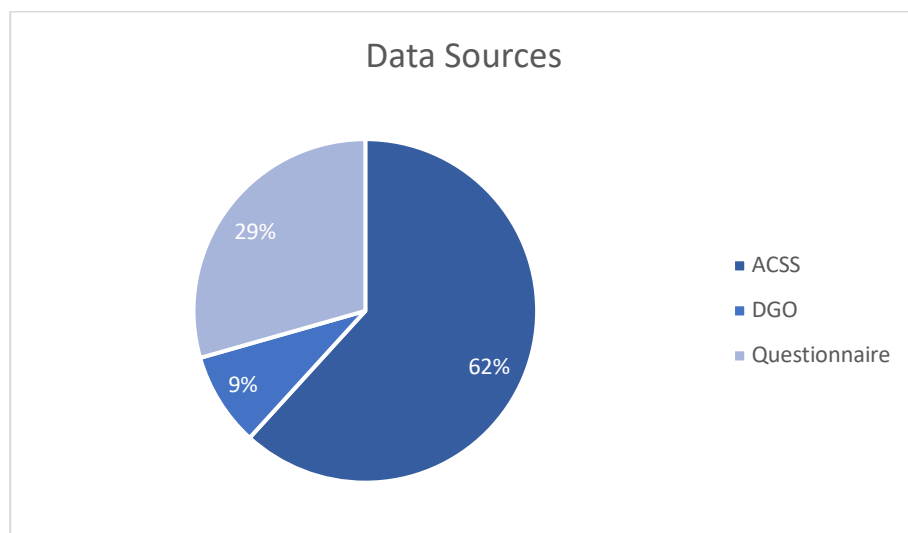


Figure 3.1 - Different Types of Data Sources

The selection of indicators was guided by expert criteria, ensuring that each metric is relevant and meaningful for evaluating the national health system. In total, 35 indicators were chosen, 10 related to activity, 3 to expense, 1 to debt, 12 to quality, and 9 to accessibility. Figure 3.2 illustrates the distribution of these indicators across the key areas and their respective data sources. Indicators for expenses and debt were sourced from DGO, while all other technical metrics were provided by ACSS. Perception-based indicators were gathered through questionnaires

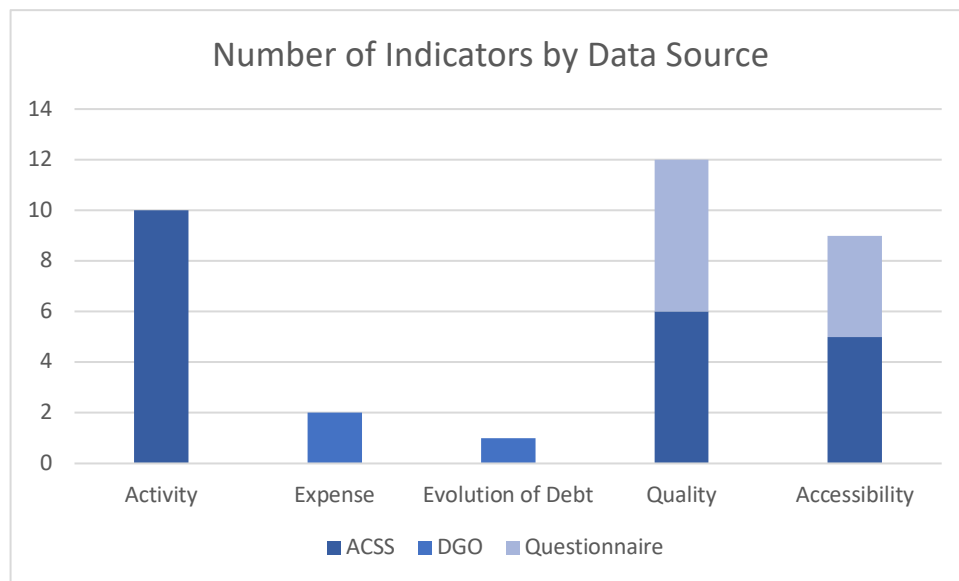


Figure 3.2 - Number of Indicators by Data Source

Importantly, no outliers are removed from the data, as every value is considered significant for a comprehensive assessment. This approach ensures that even the lower-end values are considered, providing a more accurate and complete picture of the healthcare system's performance.

The resulting index provides a measure of the sustainability of Portugal's healthcare system, integrating both technical metrics and user perceptions for a comprehensive evaluation. This sustainability index determines whether the national healthcare system is meeting its goals and highlights areas for future improvement.

3.1. ACTIVITY

The system's activity can also be seen as a measure of the efficiency of the SNS, which means assessing its impact on citizens health and quality of life. The efficiency of the institution is determined by the calculation of the standard patient measure, which involves simplifying the diverse activities of hospitals into a common unit of measurement, that helps to compare different healthcare providers more easily.

This standard patient metric is derived from the combined contributions of primary care and hospital care. Primary care is the first point of contact for basic healthcare needs, focusing on preventive care and general health concerns. It is provided by general practitioners, family doctors, and pediatricians in community settings such as clinics. Hospital care, on the other hand, deals with complex medical issues requiring specialized equipment and expertise. It includes services like emergency care, surgery, and inpatient treatment, delivered in hospital settings by multidisciplinary teams of healthcare professionals.

Data was gathered through monthly monitoring out of 42 hospital institutions included in the benchmarking process provided by ACSS, twenty-one are Hospital Centers, ten are Hospitals, eight are LHU, and 3 are Cancer Institutes. These institutions are represented by 42 Boards of Directors, of which 38 are Public Business Entities and 4 are Public-Private Partnerships.

To begin the calculation for primary care, it is necessary to first retrieve the average prices for the values listed in

Table 3.1. Since these values are not directly comparable, each one is normalized by dividing it by the cost of a discharged patient. This normalization process converts the values into uniform units, allowing the results to be interpreted as percentages relative to the cost of one discharged patient, the highest measure.

Table 3.1 - Prices related to Primary Care

Prices	Description
Discharged Patient	The total price of one discharged patient per day
Average Consultation	The average price of consultations in Primary Care

Next, using Table 3.2, we look at the number of occurrences for the different metrics. It's important to note that medical consultations, nursing consultations, and per capita consultations are all types of consultations, so their occurrences should be summed to obtain the total number of consultations. To calculate the value of the standard patient, the normalized prices are multiplied by the number of occurrences for each indicator.

Table 3.2 - Metrics related to Primary Care

Metrics	Description
Users	Reflect the overall demand for primary care services and the population served by primary care providers.
Medical Consultations	Indicate the frequency of interactions between patients and primary care physicians, showing how often patients seek medical advice and treatment.
Nursing Consultations	Highlight the role of nursing staff in patient care, including health education, chronic disease management, and routine check-ups.
Per Capita Consultations	Provide an average measure of healthcare access and utilization on a per-person basis, indicating the level of primary care engagement within the community.

Similarly, for hospital care, use Table 3.3 to find the relevant prices and Table 3.4 for the relevant indicators. After normalizing these values, multiply them to obtain the final measure.

Table 3.3 - Prices related to Hospital Care

Prices	Description
Discharged Patient	The total price of one discharged patient per day
Average Consultation	The average price of consultations
Average Emergency's	The average price of emergency's visits
ICM Internment (Ambulatory)	The average price of ICM Internment

Table 3.4 - Metrics related to Hospital Care

Metrics	Description
First Consultations	Measure the number of new patient cases, reflecting the hospital's capacity to attract and handle new patients.
Subsequent Consultations	Indicate ongoing patient care and the management of chronic or complex conditions requiring multiple visits.
Emergency Visits	Show the demand for urgent care services and the hospital's ability to handle acute health crises.
Discharged Patients	Represent the number of patients treated and released, indicating throughput and capacity utilization.
Average Length of Stay	Provide a measure of efficiency and patient satisfaction, reflecting how quickly patients receive care.
Ambulatory Surgeries	Indicate the volume of surgeries performed without overnight hospital stays, reflecting the hospital's efficiency and capacity for

	minor procedures. It is carried out on an admission and discharge basis within a period of less than 24 hours
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The Total Standard Patient combines the volume of healthcare activities from both primary and hospital care settings, equally weighting both. Each unit of the Total Standard Patient represents the resources needed for one discharged patient per day, based on the baseline cost expressed in millions.

3.2. EXPENSE

In the section forward the data was retrieved from DGO, that provides an overview of the government's budget implementation, detailing revenue collection, expenditure, and the overall financial performance of various government entities and programs. The report is divided into key sections, including Central Administration and Social Security, Regional Administration and Local Administration. Within the Central Administration, specific subsectors are highlighted, among them the Portuguese National Health Service. The report presents financial data for these sectors, such as revenue, expenditure, and year-on-year variations, offering a comprehensive view of budgetary execution. The retrieved data is denoted in millions of euros.

Regarding the SNS, total revenue refers to the sum of all income generated by a healthcare institution from its various operations and services over a specific period. This income can include patient fees, insurance compensations, government funding, and other sources. Total expenditure encompasses all costs incurred by the healthcare institution during its operations over the same period. This includes salaries, medical supplies, equipment, maintenance, administrative costs, and other operational expenses.

The balance is the difference between total revenue and total expenditure, indicating whether the entity is operating within its means or accumulating debt. A negative balance (deficit) occurs when expenditure exceeds revenue, signaling a financial shortfall that must be addressed through increased revenue or reduced expenses. Ideally, the balance should be as close to zero as possible, aiming to reduce the deficit.

Lastly, deducted expenditure is a more specific financial measure that adjusts the total expenditure by accounting for changes in matured debt. Essentially, this calculation deducts the increase in matured debt (debt that has come due for payment) from the total expenses. It is used to reflect the net effect of debt payments on the financial statements, showing how much of the expenditure is directed towards reducing the principal debt or covering accrued interest. This concept helps in understanding how much of the budget is being consumed by debt obligations as opposed to other operational or capital expenditures.

In summary, the metrics evaluated to the expense are demonstrated in Table 3.5.

Table 3.5 - Metrics related to Expense

Expense	Description
Total Revenue	Sum of all income generated by a healthcare institution from its various operations and services.
Total Expenditure	Encompasses all costs incurred by the healthcare institution
Expenditure Deducted	Measure the adjustment of the total expenditure by accounting for the change in matured debt

3.3. EVOLUTION OF DEPT

Regarding the debt incurred by the healthcare system, Debt due to Suppliers is used as the only metric of assessment, displayed at Table 3.6. It represents the amount of money the healthcare institution owes to its suppliers for goods and services received but not yet paid for, including medical supplies, equipment, pharmaceuticals, and other.

Table 3.6 - Metrics related to Debt

Debt	Description
Debt due to suppliers	Debt Due to Suppliers represents the amount of money the healthcare institution owes to its suppliers for goods and services received but not yet paid for.

While there are other types of debt, this study focuses on supplier debt because it reflects the current financial obligations that are actively impacting the system. Debts that have already been repaid do not influence the index, as they do not represent ongoing financial pressure.

3.4. QUALITY

Quality in healthcare involves providing the best possible care, encompassing various elements such as the competence of healthcare workers, the accuracy and clarity of the information they provide, the quality of machinery and equipment, and all other resources. Quality can be divided into perceived and technical aspects, which aim to capture both objective measures and subjective experiences for a comprehensive evaluation of healthcare services.

Starting on **technical metrics**, various validated indicators were considered by a group of experts, including:

Table 3.7 - Metrics related to Technical Quality

Technical Quality	Description
Percentage of Hip Fractures with Surgery Performed Within the First 48 Hours	The proportion of hip fracture patients who receive surgery within 48 hours of admission.
Mortality from Stroke	The death rate among patients who suffer either hemorrhagic or ischemic stroke.
Ambulatory Surgeries	The number of surgeries performed on an outpatient basis without requiring an overnight hospital stay.
30-day Readmission Rate	The percentage of patients readmitted to the hospital within 30 days of discharge.
Prevalence of Falls	The frequency of patient falls within the healthcare facility.
Incidence of Pressure Ulcers	The rate of patients developing pressure ulcers while in the care of the healthcare facility.

For each metric, an average is calculated, followed by normalization to convert all values into comparable units. The normalized values are then multiplied by their respective weights, reflecting the importance of each metric in the overall assessment.

The **perceived values**, essential for capturing the user's perspective, were obtained through a meticulous data collection process. Conducted in February 2024 and targeting individuals residing in Portugal aged eighteen or older. The universe for this study encompassed a population of 8,657,240 individuals. From this vast pool, a representative sample of 500 respondents was selected for interviews utilizing the Random Digit Dialing (RDD) method.

RDD, a widely adopted technique in survey research, involves the generation of random digits to form telephone numbers for potential participants. This technique helps ensure that the sample is representative of the population being studied, as it reduces biases that might arise from using lists of known phone numbers.

During the interviews, participants were presented with a questionnaire designed to evaluate various aspects of the healthcare system on a scale ranging from 1 to 10. Additionally, respondents were provided with the option to select "don't know" if they lacked experience or familiarity with a specific aspect. The questionnaire encompassed the following key evaluation questions:

Table 3.8 - Metrics related to Perceived Quality

Perceived Quality	Description
Overall quality	In general analysis how do you evaluate the quality of healthcare you received
Ease of Access to Care	How simple it is to schedule appointments or gain admission to a healthcare facility, including waiting times within the hospital.
Waiting Times Between Scheduling and Completion of Medical Procedures	Duration from when a procedure is scheduled to when it is actually performed.
Quality of Professionals	Competence, skill, and professionalism of doctors, nurses, and therapists attending to patients.
Infrastructure and Equipment Quality	Condition and availability of medical facilities and equipment used for patient care.
Quality of Information Provided by Professionals	How well healthcare providers communicate with patients, including explaining diagnoses, treatments, and care plans.

Calculating the average score for each indicator by summing the scores given by respondents and dividing by the total number of responses. A higher average score indicates a more favorable perception of that aspect, while a lower score indicates a less favorable view. Finally, these averages are used to determine the overall perceived quality.

The final value related to the quality is the average of both values, taking 50% for the perceived quality and 50% for technical quality.

3.5. ACCESSIBILITY

Accessibility in healthcare is crucial for ensuring equitable and timely access to services for all individuals, starting even before patients arrive at the hospital. It involves factors such as the proximity of healthcare facilities, whether people have hospitals nearby, and whether they feel adequately supported throughout their healthcare journey.

The evaluation of accessibility was the most recent metric added to the assessment process, with the technical aspect introduced in 2021 and the perceived aspect following in 2022.

Accessibility can be evaluated through both perceived and technical aspects, offering a comprehensive understanding of how healthcare is delivered by users' perspectives. Both are calculated using the same method as for quality, as previously explained. For the **technical values**, an average is calculated for each metric shown in Table 3.9, followed by normalization. Afterwards, are combined into a single value using equal weights.

Table 3.9 - Metrics related to Technical Accessibility

Technical Accessibility	Description
First Appointments in Adequate Time	Measures how quickly patients can get their first appointment.
Enrolled in Local Integrated Care (LIC) within 180 Days	The percentage of patients enrolled in LIC within 180 days.
Percentage of Emergency Episodes Attended Within Expected Time	The proportion of emergency cases attended to within the standard expected time frame.
Occupancy Rate of Available Capacity in Home Hospitalization	The usage rate of home hospitalization services.
Enrolled in Local Integrated Care (LIC) within 270 Days	Similar to the 180-day metric but with a longer time frame, showing the percentage of patients enrolled in LIC within 270 days.

For the **perceived values**, the same format questionnaire was conducted using a scale from 1 to 10 differing the questions in evaluation, given by Table 3.10:

Table 3.10 - Metrics related to Perceived Accessibility

Perceived Accessibility	Description
Ease of Scheduling	How straightforward it is for patients to book appointments, exams, or procedures.
Waiting Times Between Scheduling and Medical Procedures	Similar to the earlier metric, the delay from scheduling to the actual procedure.
Ease of the Admission Process	How smoothly and quickly patients can be admitted to the healthcare facility.
Waiting Time from Arrival to Departure	The total time spent at the healthcare facility, from arrival to discharge.

Then, calculating the average score for each indicator by summing the scores given by respondents and dividing by the total number of responses formulate the perceived value. The score for accessibility is determined by both technical and perceived accessibility, each holding equal importance with a weight of 50%.

3.6. INDEX RESULT

The index is a combination of all previous calculated metrics together, that provides an overall performance of the SNS, given by I in the following equation:

$$I = \frac{\text{activity}}{\text{expense} + \text{debt}} \times \text{quality} \times \text{accessibility}$$

Equation 3.1 – Aggregating Metrics

The first component of the equation, activity divided by the sum of expense and debt, can be seen as a ratio of cost-effectiveness of the healthcare, also called productivity. Activity denotes the total operational outputs while the denominator aggregates the total financial costs and obligations incurred. Thus, this ratio measures the amount of activity generated for each unit of financial input. To further refine our assessment, this value is multiplied by quality and accessibility factors to provide the inclusion on those additional dimensions.

The final step in calculating the sustainability index for 2023 involves comparing it to the index from the previous year of 2022, dividing one by the other. This comparison gives a percentage that indicates how the sustainability index has changed year-over-year. The result represents the percentage of the sustainability index regarding the previous year's performance. When the index surpasses 100%, it means an improvement compared to the previous year, while values below 100% indicate a decline.

4. RESULTS AND DISCUSSION

This chapter evaluates the results of various metrics for 2023 and the final sustainability index, comparing them with data from previous years. The analysis includes a detailed comparison of data from 2018 to 2023, highlighting weaknesses within the SNS and providing explanations for the observed trends.

Starting with **activity**, as shown in Figure 4.1, the total standard patient calculation for 2023 was 2,82 million. Compared to the previous year, there was a modest increase of 1.3% indicating that the healthcare system has slightly enhanced its level of activity. However, the values from recent years remain relatively consistent, with no significant changes observed.

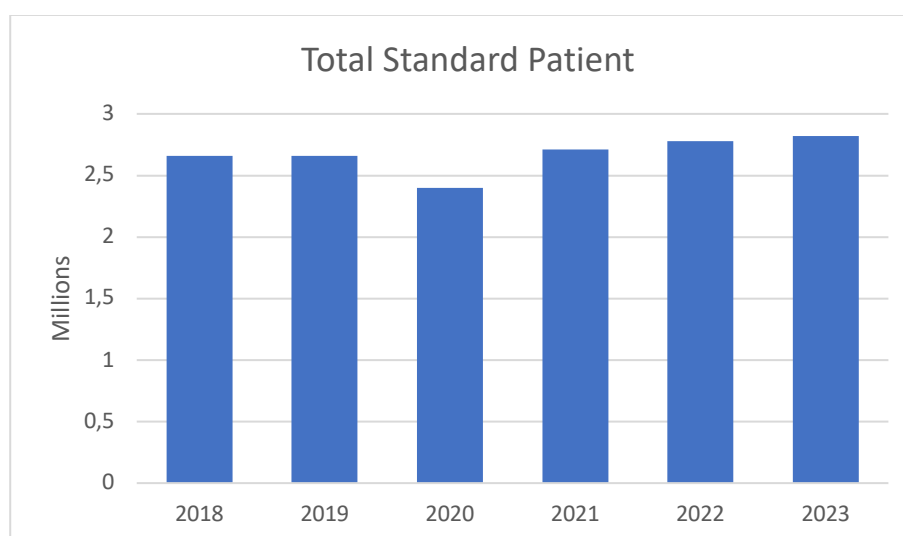


Figure 4.1 - Evolution of the Standard Patient Activity

The **expense** exhibit in the Figure 4.2 presents three key results within the scope of our financial analysis: the total amount of financing was 13.63 million euros; the total expenditure was 14.06 million euros; and the expenditure deducted was 13.93 million euros. The resulting balance, calculated as the difference between financing and total expenditure, shows a deficit of approximately 0.43 million euros, representing a decrease of 59% compared to the previous year. This significant reduction is an impressive change, indicating that the deficit is narrowing, taking a more sustainable financial position.

Additionally, the variation in overdue debt was -0.13 million euros, indicating a reduction in the amount of unpaid debt compared to the previous period. When comparing these values to the previous year, there was an increase of 12.6% in financing, 6.8% in total expenditure, and 6.2% in expenditure deducted. This trend suggests that although funding has increased, it was still surpassed by the rising healthcare costs, clearly demonstrating the sector's escalating financial needs and expenses. All financial values are expressed in millions of euros.

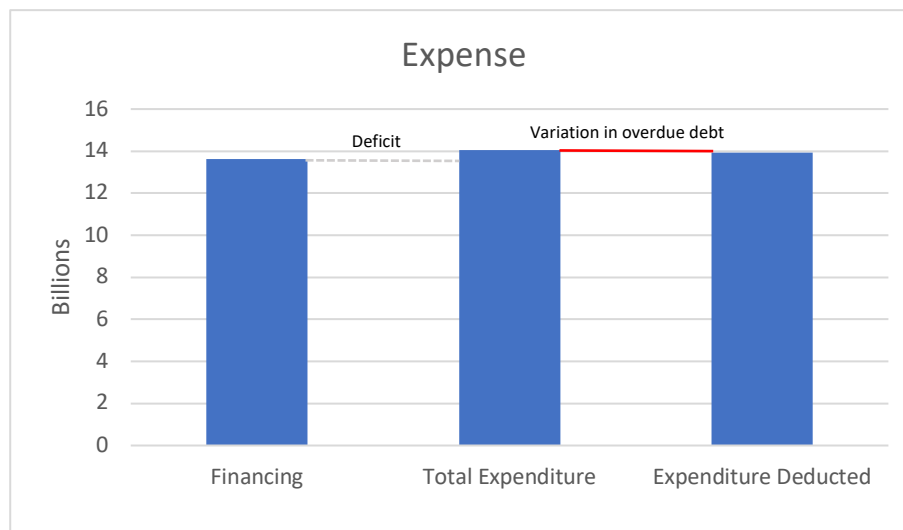


Figure 4.2 - Results of Financing, Total Expenditure, and Deducted Expenditure

Debt to suppliers decreased by 23% compared to 2022, reaching a total of 0.45 million euros. When compared with scores from 2019 in Figure 4.3, there's a decrease along the years, with 2023 showing the lowest value so far. This is a positive development, indicating that the debt to suppliers is trending downward.

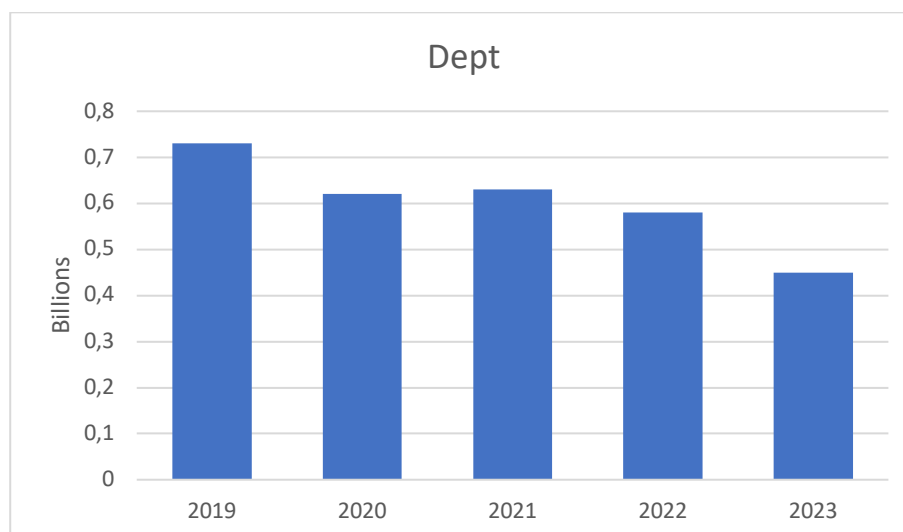


Figure 4.3 - Evolution of Healthcare System Debt

Productivity, is the total activity divided by debt and expenses, representing the standard patient per one million euros of expense. As shown in the Figure 4.4 below, the productivity values have been steadily decreasing over time, which is a concerning trend. For 2023, the value decrease being the lowest value so far. This decline indicates that, for the same level of expenditure, the healthcare system is becoming less efficient, resulting in fewer services or outputs relative to the costs incurred. Sustained decreases in productivity suggest potential issues in resource allocation, cost management, or overall operational efficiency that need to be addressed to prevent further deterioration.

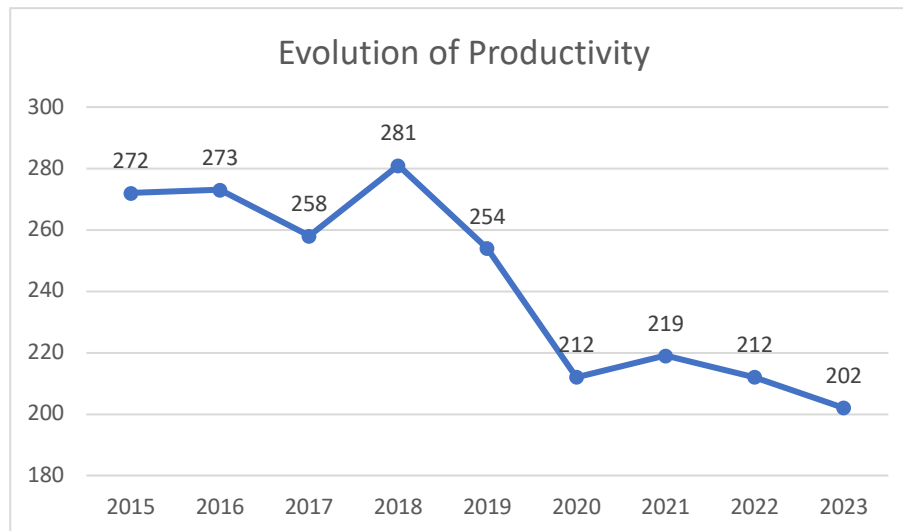


Figure 4.4 - Evolution of Healthcare System Productivity

The decline in the productivity of the SNS can be largely attributed to the fact that expenses have risen, while healthcare services have not grown at the same pace. In other words, the system is spending more, but the corresponding increase in activity or services hasn't followed, leading to a drop in overall efficiency. This suggests that resources may not be allocated effectively throughout the system, resulting in fewer services being delivered despite increased or even unchanged costs.

The perceived quality improved to 74, marking a 2.4% increase although technical quality decreased to 66,5 with a 2.78% changed, illustrated in Figure 4.5 and Figure 4.6, respectively. These values have remained relatively stable over the years, without significant variation.



Figure 4.5 - Evolution of Healthcare System Perceived Quality



Figure 4.6 - Evolution of Healthcare System Technical Quality

When comparing perceived and technical quality in Figure 4.7, it is evident that perceived quality is higher, suggesting that users have a more favorable view of the quality of care than the actual technical performance of healthcare services. This indicates a disconnect between patient satisfaction and the objective assessment of healthcare service performance. Notably, 2022 was the year when these two metrics were closest, with a gap of nearly 6%. However, they have diverged again in the latest year. Compared to the initial years, there is a clearer understanding of these metrics.

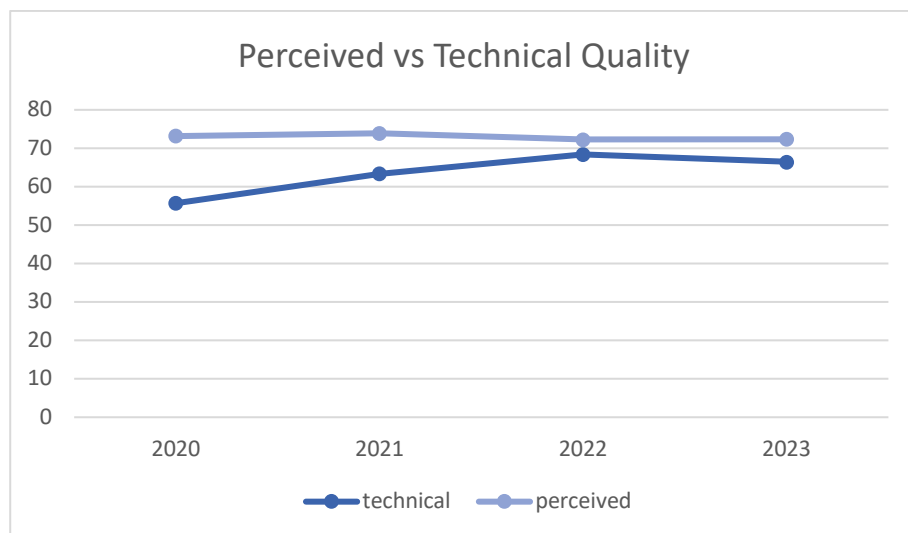


Figure 4.7 - Comparison Between Perceived Quality and Technical Quality

Accessibility, a recently added indicator, shows fewer promising results. The Figure 4.8, shows the perceived accessibility that had a value of 64,3 in 2023. Presenting a not meaningful decrease of 0.6% from 2022. Figure 4.9 reveals the technical accessibility with 49,7 and with a decrease of 3.7%. These low values, especially the technical accessibility failing to meet even half of the scale, indicate significant barriers in healthcare access.

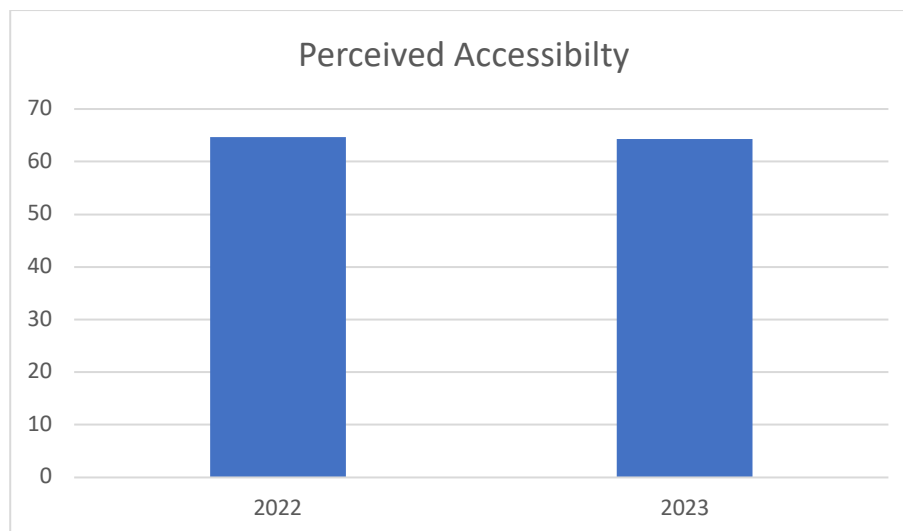


Figure 4.8 - Evolution of Healthcare System Perceived Accessibility

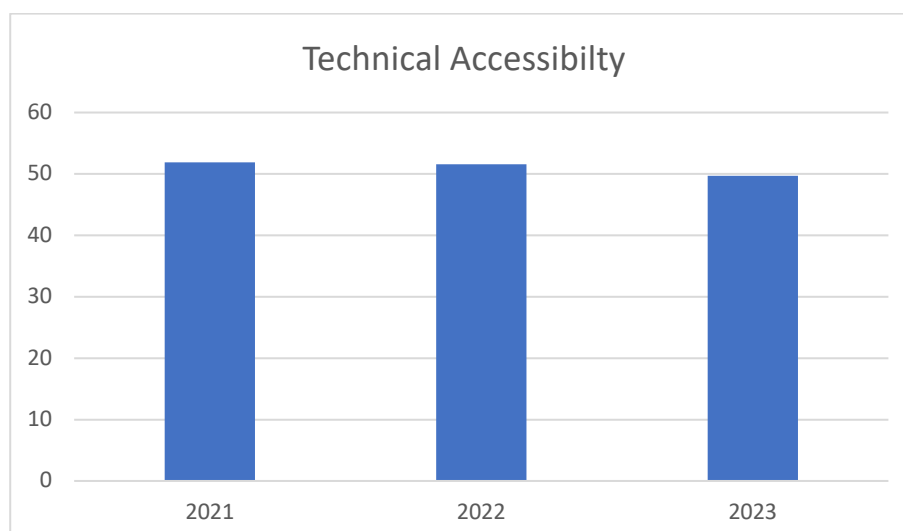


Figure 4.9 - Evolution of Healthcare System Technical Accessibility

The low accessibility scores in healthcare are primarily due to regional disparities across Portugal. Individuals living in rural and remote areas face significant challenges, often having to travel long distances to reach medical facilities. Additionally, long waiting times for both urgent surgeries and routine consultations worsen patient conditions and delay essential treatments. This is aggravated by a shortage of healthcare professionals, which is inadequate to meet the rising demands of the population, leading to a backlog of cases that the system struggles to manage.

To address these challenges, can be implemented regional healthcare reforms, such as expanding the ULS (Local Health Units), could help distribute healthcare resources more equitably across regions, reducing the travel burden for patients in more isolated areas. In 2024, 31 new ULS units were added throughout the country to address this issue, marking a

significant step forward. This expansion is expected to continue in the coming years, further improving access to healthcare.

Investing in telemedicine is another crucial step. Offering online consultations for simple health issues could speed up care for non-urgent matters and reduce the number of patients crowding hospitals. Increasing the availability of family doctors would also streamline the process, ensuring that more people have regular access to medical care, which in turn would relieve pressure on hospitals.

Additionally, a proposal discussed at the 12th Conference on Sustainability in Health, where these results were shared, suggests dividing hospitals into two distinct sections: one focused on urgent, high-priority cases, and the other dedicated to more treatable, everyday health issues. This separation would allow hospitals to manage their resources more effectively and provide timely care to those in critical need. By implementing these strategies, the healthcare system could become more efficient, reduce waiting times, and significantly improve access to care for everyone.

The comparison between technical and perceived accessibility, shown in Figure 4.10, is limited by the short timeframe of only two years, and the considerable gap between the metrics. Nonetheless, it suggests that users remain somewhat optimistic about accessibility despite technical shortcomings.

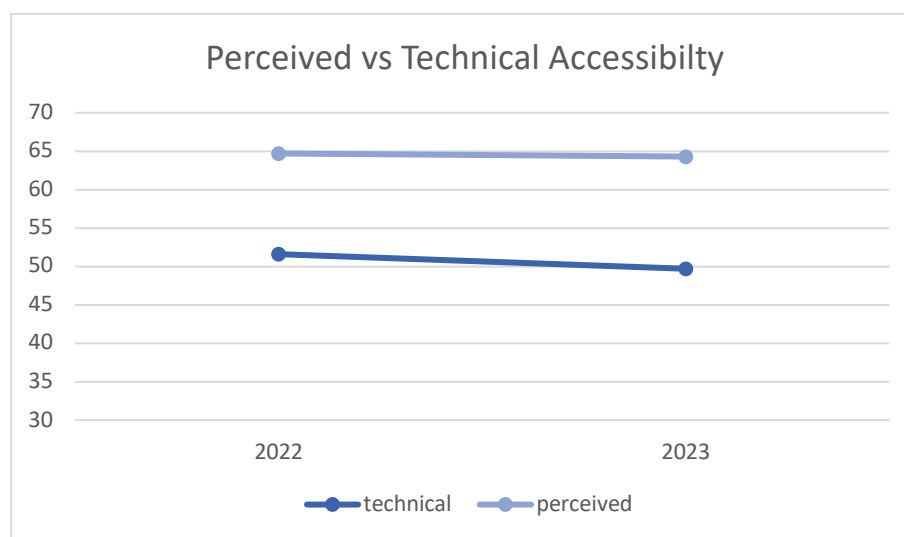


Figure 4.10 - Comparison Between Perceived Accessibility and Technical Accessibility

In both accessibility and quality, the significant gap between perceived and technical performance needs to be addressed. One key reason for this discrepancy is that users often lack an overall understanding of the healthcare system's functioning, which limits their ability to fully grasp its technical shortcomings. Instead, they tend to rely on personal experiences, which, while sometimes negative, may not be viewed as serious enough to affect their overall perception. When it comes to quality, users often have limited awareness or understanding of the technical aspects of healthcare performance, leading them to judge quality based on

surface-level experiences rather than objective measures. Additionally, since healthcare services are free, it is common for users to hold a more positive opinion, appreciating the fact that they do not have to pay for care, which may overshadow concerns about accessibility or quality.

The sustainability index, shown in Figure 4.11, has been calculated annually. Initially since 2015, taking similar results with slight variations but in recent years a decline has been observed. For the year 2020, the actual index was recorded as 83.9, however, for future comparisons would not be meaningful due to the disruption of the pandemic. Therefore, an alternative predicted index that excludes COVID-19 impacts was provided for better accuracy in future assessments. Over the past three years, the index has consistently fallen, dropping approximately 10% each year. The value for 2023 represents the lowest recorded so far, with an index of 84.8, showing a 15.2% decrease indicating a significant reduction compared to 2022.

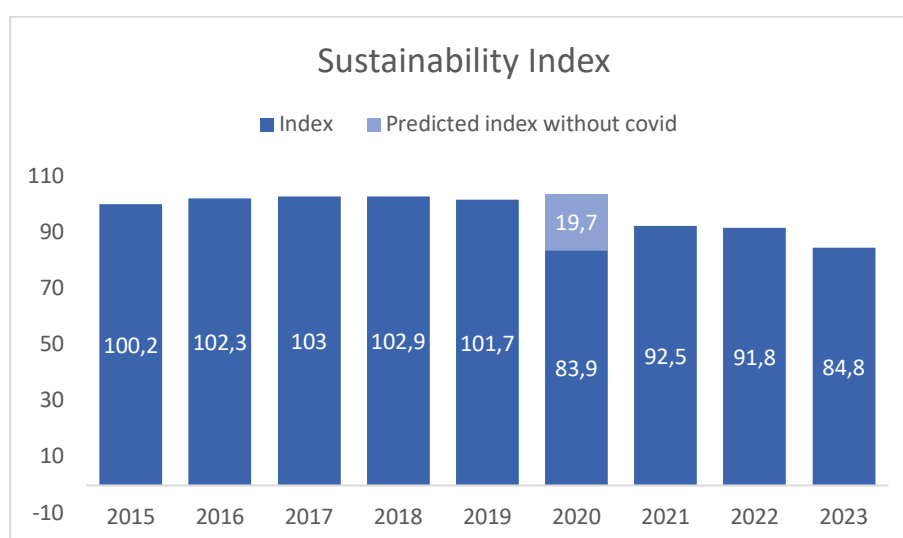


Figure 4.11- Evolution of Healthcare System Sustainability Indexes

For further assessment, Table 4.1 compares key metrics between 2018 and 2023 - the overall sustainability index, debt, activity, and perceived quality. These metrics were part of the 2018 calculation, making them relevant for longitudinal comparison. Other indicators, such as technical quality and accessibility were recently added and not included.

Table 4.1 - Comparison of Key Metrics Between 2018 and 2023

Description	2018	2023
Sustainability Index	102,9	84,8
Debt	10,07	14,06
Activity	2,66	2,82
Perceived Quality	67	74

Over the past five years, the sustainability index has undergone notable shifts. Since the index is calculated in comparison to the previous year, there is no direct correlation between 2018 and 2023. However, the overall trend shows a linked decline across the years.

Debt has increased by 4 million, reflecting growing financial pressures on the healthcare system. Conversely, activity has risen by 6%, a positive sign of increased healthcare service delivery. Perceived quality has also improved by 10.4%, suggesting better patient experiences.

In summary, the analysis reveals both progress and challenges within the healthcare system. While activity and perceived quality have improved, technical quality and accessibility have declined, emphasizing areas that need focused attention and improvement. The sustainability index's decline reflects broader systemic issues that must be addressed to ensure a resilient and efficient healthcare system.

Some justification for the observed decrease in the index can be attributed to several factors. First, the scope of the index expanded recently to include not only technical accessibility (added in 2021) but also perceived accessibility (added in 2022). Considering this recent changes this is the second year the index uses both dimensions, so the comparison with previous years might not be entirely straightforward. The inclusion of accessibility, which has shown to produce low results, significantly impacts and lowers the overall index score.

Moreover, at the 12th Conference on Sustainability in Health the decline was explained by the ongoing impact of the COVID-19 pandemic. Even though four years have passed since the pandemic began, there are still clear challenges with strained resources, financial pressure, and a shortage of healthcare professionals. The health system is struggling with a large backlog of needs, highlighting the urgent need for a thorough rebuilding and the immediate launch of an emergency plan. Immediate action is especially needed in improving accessibility, which has already been identified as a major issue.

5. CONCLUSIONS AND FUTURE WORKS

This study has developed a detailed approach to assess the sustainability of Portugal's national healthcare system for the year 2023. The research focused on evaluating various key areas of the system, including activity levels, expenses, debt, quality of services, and accessibility to healthcare. By integrating all these aspects into a single sustainability index, we have gained a more complete and in-depth understanding of how sustainable the SNS currently is.

The findings indicate that the SNS is, overall, sustainable. This conclusion is supported by a positive sustainability index, which suggests that in most areas, the system is performing well. To answer the research questions posed at the beginning of this study, the first question explores the sustainability of the SNS from the perspective of accessibility. Among the various metrics that construct the index, the most pressing concern is the insufficient level of accessibility. This decline indicates that, while the healthcare system remains strong, there are still important areas for improvement, particularly in making healthcare services more accessible to the public. Improving access to healthcare should be a priority in the future to ensure that the system continues to meet the needs of all population.

Additionally, the study found that there is generally a positive public perception of the healthcare system, which helps answer the second research question regarding how users perceive the quality and accessibility within the SNS. Public perception often exceeds what the actual performance metrics indicate. This reveals a gap between what users expect and the service they are receiving. Therefore, it is essential to align user expectations with the actual delivery of healthcare services to ensure that satisfaction levels are grounded in real performance.

The study also acknowledges certain limitations, particularly those related to the changes that took place in 2023 described in the literature review. These changes are expected to impact future assessments of the healthcare system's sustainability. One major change is the integration of 31 new healthcare units into the system, which provides a valuable opportunity to examine their impact specially on the assessibility and consequently on the overall sustainability index. Moving forward, further research will be necessary to explore how these new units affect various aspects of healthcare delivery.

Moreover, improving the sustainability index requires the inclusion of broader metrics, such as mental health services and staff well-being, to provide a more comprehensive assessment of the healthcare system. Additionally, reconsidering how different factors are weighted within the index and enhancing data analysis methods, such as handling outliers, will result in a more accurate reflection of the system's sustainability. These steps will ensure that the index more effectively captures the complexity and real state of healthcare system sustainability.

In conclusion, this thesis offers a clear and well-rounded assessment of the current state of Portugal's healthcare system, highlighting both its strengths and areas for improvement. The findings not only provide insight into the present sustainability of the SNS but also point toward necessary actions to ensure its long-term viability. The recommendations presented here aim to guide future research and initiatives that will lead to a healthcare system that is more inclusive, accessible, and sustainable for all residents of Portugal.

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