Hospitalizations for Ambulatory Care-Sensitive Conditions in Brazil and Portugal: A Comparative Study

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Abbreviations in English

ACSC	Ambulatory Care Sensitive Conditions
AHRQ	Agency for Healthcare Research and Quality of the United States
CIHI	Canadian Institute for Health Information
COPD	Chronic Obstructive Pulmonary Disease
DRG	Diagnosis Related Groups
ED	Emergency Department
EU	European Union
FHU	Family Health Unit
GDP	Gross Domestic Product
HCQI	Health Care Quality Indicators
ICD	International Classification of Diseases
LHU	Local Health Unit
NHS	National Health System of England
OECD	Organisation for Economic Co-operation and Development
PHC	Primary Health Care
PPP	Purchasing Power Parity
PQI	Prevention Quality Indicators
RR	Relative Risk
SP	Statistics Portugal
WHO	World Health Organization
YPLL	Years of potential life lost

Abbreviations in Portuguese

ACES	Agrupamentos de Centros de Saúde [*Groups of primary care centres*]
ACS	Agentes Comunitários de Saúde [*Community Health Agents*]
ACSS	Administração Central do Sistema de Saúde [*Central Administration of the Health System*]
ARS	Administração Regional de Saúde [*Regional Health Administrations*]
BI-CSP	Bilhete de Identidade dos Cuidados de Saúde Primários [*Identity Card of the Primary Health Care*]
DAB	Departamento de Atenção Básica [*Primary Health Care Department*]
DATASUS	Departamento de Informática do Sistema Único de Saúde [*Brazilian Health System´s Information Technology Department*]
ESF	Estratégia Saúde da Família [*Family Health Strategy*]
IBGE	Instituto Brasileiro de Geografia e Estatística [*Brazilian Institute of Geography and Statistics*]
MCSP	Missão dos Cuidados de Saúde Primários [*Primary Health Care Mission*]
NASF	Núcleos de Apoio à Saúde da Família [*Family Health Support Centers*]
PAB	Piso da Atenção Básica [*Basic Health Care Package*]

PACS	Programa de Agentes Comunitários de Saúde [*Community Health Agents Program*]
PMAQ	Programa de Melhoria do Acesso e da Qualidade da Atenção Básica [*Program for the Improvement of Access and Quality of Primary Care*]
PMM	Programa Mais Médicos [*More Doctors Program*]
PNAB	Política Nacional da Atenção Básica [*National Primary Care Policy*]
RNCCI	Rede Nacional de Cuidados Continuados Integrados [*Integrated Continued Care National Network*]
SIH-SUS	Sistema de Informações Hospitalares do SUS [*Hospital Information System database*]
SNS	Serviço Nacional de Saúde [*National Health System of Portugal*]
SUS	Sistema Único de Saúde [*Unified Health System of Brazil*]
UBS	Unidade Básica de Saúde [*Basic Health Units*]
UCC	Unidades de Cuidados na Comunidade [*Units of Care in the Community*]
UCSP	Unidades de Cuidados de Saúde Personalizados [*Customized Health Care Units*]
ULS	Unidade Local de Saúde [*Local Health Units*]
URAP	Unidades de Recursos Assistenciais Partilhados [*Units of Shared Care Resources*]
USF	Unidade de Saúde da Família / Unidade de Saúde Familiar [*Family Health Unit*]
USP	Unidades de Saúde Pública [*Public Health Units*]

Summary

Background: Ambulatory Care Sensitive Conditions (ACSC) are health conditions for which adequate management, treatment and interventions delivered in outpatient setting could avoid the need of hospital admission. Hospitalizations for ACSC have been used to assess access, quality, and performance of the Primary Health Care (PHC). Portugal and Brazil have carried out reforms in their PHC delivery system in the last years, with similar organizational characteristics and objectives. While inter-country comparison provides opportunities for cross-country learning, ACSC have limitations as an indicator for quality of care. The aim of this thesis was to analyze the dynamics of hospitalizations for Ambulatory Care Sensitive Conditions in Brazil and Portugal.

Methods: Firstly, a literature review was conducted to identify the conceptual, methodological, contextual and policy dimensions and factors that need to be accounted for when comparing hospitalizations for ACSC across countries. Secondly, hospitalizations for ACSC in Brazil and Portugal were compared in the dimensions of occurrence, rates, causes, sociodemographic characteristics, costs of hospitalizations and economic impact, geographic distribution and variations, and identification of spatial clusters. The data for this comparison was obtained from administrative databases of all hospitalizations in public hospital in each country for the year 2015. ACSC were classified according to the methodology by the Agency for Healthcare Research and Quality. Thirdly, a longitudinal analysis was carried out to investigate if expansion of PHC reform in Brazil and Portugal (using coverage of Family Health Units as proxy) was associated to hospitalizations for ACSC. This analysis was conducted for the period 2007 and 2016 using the same administrative databases, and possible associations analyzed using Spearman's correlation analysis, Kruskal-Wallis tests, and linear regressions.

Results: The inter-country comparison of hospitalizations for ACSC can suggest health policy implications and potential points of improvements to reduce these events; however there are factors in the dimension of methods, population and health system that need to be accounted for. Hospitalizations for ACSC accounted for around 7 and 10% of all hospitalizations in Brazil and Portugal in 2015, respectively. Both countries have similarities in standardized rates and which conditions were more common, and differences in crude rates and age distribution. Each hospitalization for ACSC had an estimated cost of US$ PPP 1,919 and 4,278 in Brazil and Portugal, respectively. Both countries presented expressive geographic variations in rates of hospitalizations for ACSC. These indicate room of

improvement and efficiency gains in Brazil and Portugal. Rates of hospitalizations for ACSC between 2007 and 2016 decreased in Brazil and increased in Portugal; although there were indications that expansion of PHC reform may be associated to reductions in ACSC hospitalizations, these results only applied for specific conditions and geographic areas within each country, and for some conditions results were discordant between the two countries.

Conclusions: It is important to reduce ACSC hospitalizations given the impact these events represent for health systems and for society. The existing literature on inter-country comparison of hospitalizations for ACSC agree that strengthening PHC and promoting access provides opportunities to reduce these events. There was no robust evidence of the association between expansion of PHC reforms in Brazil and Portugal and reduction of hospitalizations for ACSC, indicating that the PHC reforms did not produce the same results neither within or between countries and not for all conditions. Findings indicate that focused actions can be more effective to reduce such events, with examples in both countries serving as valuable clues for the learning process and improvement.

Keywords: Ambulatory care sensitive conditions, primary health care, quality of health care, inter-country comparison

Resumo

Enquadramento: Ambulatory Care Sensitive Conditions (ACSC*) [Condições sensíveis ao cuidado em ambulatório]* são condições de saúde para as quais o cuidado, tratamento e intervenção adequados realizados em contexto ambulatorial poderiam evitar a necessidade de internamento hospitalar. Os internamentos por ACSC têm sido utilizados para avaliar o acesso, a qualidade e o desempenho dos Cuidados de Saúde Primários (CSP). Portugal e o Brasil realizaram reformas em seus CSP nos últimos anos, com características e objetivos organizacionais semelhantes. Embora a comparação entre países ofereça oportunidades de aprendizagem entre países, as ACSC têm limitações como indicador de qualidade do cuidado. O objetivo desta tese foi analisar a dinâmica dos internamentos por ACSC no Brasil e em Portugal.

Métodos: Em primeiro lugar, foi realizada uma revisão da literatura para identificar as dimensões conceituais, metodológicas, contextuais e políticas e os fatores que precisam ser considerados ao comparar os internamentos por ACSC entre países. Em segundo lugar, os internamentos por ACSC no Brasil e em Portugal foram comparados nas dimensões de ocorrência, taxas, causas, características sociodemográficas, custos de internamento e impacto econômico, distribuição e variações geográficas e identificação de clusters espaciais. Os dados para essa comparação foram obtidos em bancos de dados administrativos de todas os internamentos em hospitais públicos de cada país para o ano de 2015. ACSC foram classificadas de acordo com a metodologia da Agency for Healthcare Research and Quality. Em terceiro lugar, uma análise longitudinal foi realizada para investigar se a expansão da reforma dos CSP no Brasil e em Portugal (utilizando a cobertura de Unidades de Saúde da Família como proxy) estava associada aos internamentos por ACSC. Esta análise foi realizada para o período de 2007 e 2016 usando os mesmos bancos de dados administrativos e as possíveis associações analisadas usando a análise de correlação de Spearman, testes de Kruskal-Wallis e regressões lineares.

Resultados: A comparação de internamentos por ACSC entre países pode sugerir implicações para as políticas de saúde e pontos de melhorias potenciais para reduzir esses eventos; no entanto, existem fatores na dimensão dos métodos, população e sistema de saúde que precisam ser considerados. Os internamentos por ACSC representaram cerca de 7 e 10% de todas os internamentos no Brasil e em Portugal em 2015, respectivamente. Ambos os países têm semelhanças nas taxas padronizadas e quais condições eram mais

comuns, e diferenças nas taxas brutas e distribuição por idade. Cada internamento por ACSC teve um custo estimado de US$ PPP 1.919 e 4.278 no Brasil e em Portugal, respectivamente. Ambos os países apresentaram variações geográficas expressivas nas taxas de internamentos por ACSC. Estes resultados indicam espaço para melhorias e ganhos de eficiência no Brasil e em Portugal. As taxas de internamentos por ACSC entre 2007 e 2016 diminuíram no Brasil e aumentaram em Portugal; embora houvesse indícios de que a expansão da reforma dos CSP possa estar associada a reduções nas internações por ACSC, esses resultados se aplicam apenas a condições e áreas geográficas específicas de cada país, e para algumas condições os resultados foram discordantes entre os dois países.

A redução dos internamentos por ACSC é importante devido ao impacto que esses eventos representam para os sistemas de saúde e para a sociedade. A literatura existente sobre a comparação de internamentos por ACSC entre países concorda que o fortalecimento dos CSP e a promoção do acesso oferecem oportunidades para reduzir esses eventos. Não houve evidência robusta da associação entre a expansão das reformas dos CSP no Brasil e em Portugal e a redução dos internamentos por ACSC, indicando que as reformas dos CSP não produziram os mesmos resultados nem dentro ou entre os países e nem para todas as condições. Os resultados indicam que as ações focadas podem ser mais eficazes para reduzir tais eventos, com exemplos em ambos os países servindo como pistas valiosas para o processo de aprendizagem e melhoria.

Palavras-chave: Condições sensíveis ao cuidado em ambulatório, cuidados de saúde primários, qualidade dos cuidados de saúde, comparação entre países

Chapter 1. Introduction

Ambulatory care sensitive conditions (ACSC) are health conditions for which the adequate management, treatment and interventions delivered in community-based health care setting could potentially prevent the need of hospital admission. For this reason, ambulatory care sensitive hospitalizations have been extensively used in health care research to assess access, quality and performance of the primary health care (PHC) delivery within the broader health system, as timely and effective primary care could reduce the risk of hospitalization.

PHC has the potential to be highly effective and efficient in promoting health and well-being for individuals, families and communities by addressing the broader determinants of health. Therefore, studies that analyze the dynamics of ACSC hospitalizations can provide new insights on how to strengthen care provided at the PHC level. Because ACSC hospitalizations are potentially avoidable, the reduction of these events could bring positive results for health systems and populations. While the analysis of ACSC hospitalizations on a country produces important information to assess performance of its health system, the comparison of different countries provides the opportunity of contrasting experiences, prompting cross-country learning, expanding policy options and identifying trends in performance. Brazil and Portugal have historic ties that reflect in the same official language; both countries have also carried out reforms in their PHC delivery system with similar organizational characteristics. On the other hand, these countries present different socioeconomic and demographic characteristics, and the literature provides evidence of the relevance these factors have on ACSC hospitalizations.

The objective of this thesis is to analyze the dynamics of hospitalizations for Ambulatory Care Sensitive Conditions in Brazil and Portugal.

The thesis is organized in seven chapters. This first chapter introduces the subject of study and indicates the structure of the thesis. Chapter 2 provides background for the work developed, by discussing the conceptualization of ACSC hospitalizations, its determinants, its use in health care assessment and the reasoning behind the selection of Brazil and Portugal for this thesis. Chapter 3 describes the objectives of the thesis. Chapter 4 describes the materials and methods used. Chapter 5 is composed of sections reporting the results. Chapter 6 discusses the key findings of the work performed, its limitations and potential for future works. Finally, chapter 7 presents the conclusion of the thesis.

Five sections of this thesis were published as full-length articles: one article providing background about the Primary health care reforms in Brazil and Portugal (Section 2.6) and four articles presenting the thesis results (in Chapter 5).

The five published articles composing this thesis are:

Primary health care reforms in Brazil and Portugal

Authors: João Victor Muniz Rocha, José Luiz Telles, Bruno Heleno, Thiago Augusto Hernandes Rocha, Núbia Cristina da Silva, Patrícia Barbosa, Rui Santana.

Journal: *Public Policy Portuguese Journal, 2020*
ISSN 2183-8992

Hospitalization for ambulatory care sensitive conditions: what conditions make inter-country comparisons possible?

Authors: João Victor Muniz Rocha, Rui Santana, Juan Eduardo Tello

Journal: *Health Policy Open, 2021*
DOI: 10.1016/j.hpopen.2021.100030

Comparative research aspects on hospitalizations for ambulatory care sensitive conditions: the case of Brazil and Portugal

Authors: João Victor Muniz Rocha, João Sarmento, Bruno Moita, Ana Patrícia Marques, Rui Santana.

Journal: *Ciência e Saúde Coletiva, 2020*
DOI: 10.1590/1413-81232020254.13502019

Direct and lost productivity costs associated with avoidable hospital admissions

Authors: João Victor Muniz Rocha, Ana Patrícia Marques, Bruno Moita, Rui Santana.

Journal: *BMC Health Services Research, 2020*
DOI: 10.1186/s12913-020-5071-4

Avoidable hospitalizations in Brazil and Portugal: identifying and comparing critical areas through spatial analysis

Authors: João Victor Muniz Rocha, Carla Nunes, Rui Santana.

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DOI: 10.1371/journal.pone.0219262

Chapter 2. Background

2.1 Motivation of the study

The right to the highest attainable standard of health is one of the fundamental rights of every human being, as defined in the World Health Organization (WHO) Constitution- 1946 (1). The right to health has been reaffirmed in the Universal Declaration of Human Rights- 1948 (2), the Declaration of Alma-Ata- 1978 (3) and in the Declaration of Astana- 2018 (4), among other important documents agreed by the health community. With the understanding of health as a human right, states are responsible to fulfil it; in fact, most countries either recognize the right to health or have provisions regarding health care in their national constitutions (5,6).

With the responsibility of achieving and/or maintaining good performance of their health systems, countries face many challenges: notably, countries have the difficult mission of providing good quality and affordable health care services at the same time that ensures efficiency and economic sustainability of the health system (7,8). On the demand side, pressures on health systems increase by ageing populations, the rising prevalence of multi-morbidity, long-term chronic conditions and preventable illnesses that require multiple complex interventions, and higher living standards (9,10). Hence arises the challenge of reconciling the rising demands with increasing health expenditures.

Hospitals are key health care providers (11), traditionally representing a significant concentration of health resources, professional skills and medical equipment (12). They also play an important role in terms of their share of health spending. According to data by the Organisation for Economic Co-operation and Development (OECD), health care provided in hospitals accounted for nearly two-fifths of all health expenditure in the European Union (EU) in 2016 (11). For the majority of EU countries, inpatient care accounted for at least half of all hospital expenditure (11). To contain costs in hospital care while ensuring provision of high-quality care is crucial to face the challenge of increasing health expenditures (13). For lower income countries, the share of health expenditure for inpatient care is smaller; such contrast may be related to differences in medical technology, how health systems have developed institutionally and differences in health needs of populations, as people in lower income countries have lower demands for noncommunicable and age-related diseases (14).

Given the mission of ensuring efficient use of hospitals, that inpatient care accounts for a significant share of health expenditures, and the role of PHC in health care provision,

emerges the importance of addressing hospital admissions that could have been avoided beforehand. The discussion that some hospitalizations could have been prevented started more than 50 years ago (15–17) and it is still ongoing. Commonly denominated “Ambulatory Care Sensitive Conditions”, these are pathologies for which the hospital admission could be potentially avoided or fully prevented by care provided in the outpatient setting, such as primary health care or ambulatory care levels. It is important to make the clarification that a hospitalization deemed potentially avoidable does not imply the hospital admission itself was ultimately unnecessary; what it means is that, preceding the hospitalization, there was the unmet opportunity to act on the needs of the patient.

The public health relevance of the analysis of ACSC hospitalizations is noteworthy; from an economic efficiency point of view, it is favourable to prevent a high-cost event if there is opportunity to resolve it in a setting with lower associated costs. Although it is not possible to determine how many outpatient visits are necessary to avoid one inpatient bed day, the differences in costs of care between these levels of care (18) are enough to assume the economic advantages of avoiding hospitalizations. ACSC hospitalizations are sources of inefficiency of health systems: OECD considers avoidable hospital admissions as an efficiency indicator, as the reallocation resources from hospital to the PHC might result in better health outcomes at lower cost, and possible benefits of reallocating resources from care to prevention (19).

The discussion of tackling potentially avoidable hospitalizations is crucial not only in terms of the avoidable costs these events represent and the economic sustentability of health systems: at the patients’ side, a hospitalization brings significant disruptions for their personal lives and wellbeing; their families and close relationships are impacted by experiencing the patient in a situation of distress; and they are also at risk for health care-associated infections (20). From a societal point of view, to provide care in a person-centred setting (as PHC pursues to be) with lesser interference to the personal life of the patient (as outpatient care is when compared to a hospital admission) is preferred.

It is discussed that a high share of avoidable hospitalizations are partially associated to the lack of continuous care (13,21); a fragmented provision of health care, centred on the disease, is not adequate to deal with demands of ageing populations, increased multi-morbidity and rising share of patients with chronic conditions (9,22). Integrated care is then promoted, as it can provide care according to patients’ health needs in a coordinated manner, and to have better performing PHC is key to improving integrated and continuous

care (9,13). To strengthen PHC is considered by WHO as a core strategy to work towards universal health coverage, which is crucial to ensure the right to health (23), although universal coverage does not guarantee universal access (24). A strong PHC can assist health systems becoming more efficient, responsive and equitable (25–30), and hospitalizations for ambulatory care sensitive conditions have been deemed as useful indicators of PHC quality and access.

Analysis on ACSC hospitalizations are used as part of health care assessment processes in countries such as Brazil (31), Canada (32), England (33), France (34), Portugal (35) and the United States (36). There are differences among countries on how this information is monitored and used, and which bodies are responsible for it (e.g., Ministry of Health, Health institutes, health care providers).

Brazil and Portugal have implemented and expanded reforms with the aim of strengthening PHC by improving and promoting access, efficiency, quality, and continuity of integrated care. The reforms were initiated according to the needs of the population and the positive results of innovative experimental projects on health services delivery. Both countries share similarities in the organization of primary care, and the establishment of Family Health Units (FHU) is one of the most visible aspects of the reforms. There is evidence of some positive results associated to the reform in both countries; as well as serious obstacles in PHC services delivery.

Brazil and Portugal need to obtain efficiency gain in health services delivery, as the two countries have endured recent economic crisis and need to maintain the quality of care while controlling the expenses. Brazil´s total expenditure on health was 6.2% of gross domestic product (GDP) in 2016 (37); the country has one of the lowest proportion of public spending on health in Latin America and the Caribbean and among upper middle-income countries (38); debt servicing as a proportion of the federal budget and allocations for social security have been concurrently increasing, therefore compromising the availability of funds for health (38). The challenges Brazil's Health System faces are exacerbated by economic and political crisis and long-term austerity measures.

Portugal´s total health expenditure represented 8.9% of GDP in 2016 (37), with public expenditure accounting for 66% of total health expenditure (39). The country has high level of indebtedness, with debts to suppliers and other accounts reaching €3.3 billion in 2018 (40). To contain the debt accumulation by public health institutions and to achieve financial sustentability are major challenges faced and have hindered improvements by the

Portuguese health system (39). It is argued that new models of health care provision for people with long-term chronic conditions and tackle system inefficiencies are crucial to achieve financial sustainability (41).

Avoidable hospitalizations can represent inefficiencies in health services delivery: in 2018, 12.2% of all hospitalizations registered in the Brazilian public health system were for ACSC (42). It was estimated that the proportion of hospitalization costs for ACSC in relation to total hospitalization costs was 17.4% in 2017 (43). In 2014, Brazilian municipalities had mean rate of 10.4 ACSC hospitalizations per 1,000 population (44). Between 2006 and 2015, Portuguese municipalities had mean rate of 11.2 ACSC hospitalization per 1,000 population (45); the proportion of ACSC hospitalization costs in relation to total hospitalizations was 15.7% in 2017 (46). Such values from Brazil and Portugal signal that, from a perspective of efficiency in a context of limited economic growth and weak public budgets, to reduce these potentially avoidable events indicates substantial possible gains to be achieved by both countries.

Considering the aforementioned discussion, to compare experiences on strengthening PHC and to explore ways to reduce avoidable hospitalizations is a highly relevant public health topic with benefits for individuals, society, health systems and countries.

2.2 Conceptualization of ACSC

For some conditions, it is widely discussed that the hospitalization could potentially be avoided using the knowledge, technologies and practice existing at the outpatient level of care. This group of conditions include those that can be prevented through vaccination; acute episodic illness that can be controlled with medication or other medical interventions available in primary care; and chronic conditions that can be managed by medicines, self-management or lifestyle interventions, and the effective care can prevent flare-ups. The concept of ACSC and its use to assess access was introduced in the United States in the 1990s by Billings et al. (47).

Back in the 1970s, early attempts to assess quality of health care through clinical outcomes were conducted by identifying what were considered unnecessary diseases and disabilities, and unnecessary ultimately deaths, according to what was available by the health care (48,49). Such outcomes represented a signal that the quality of care should be improved. Following this approach for health care assessment, Billings & Teicholz (50) introduced the idea of determining the extent to which hospitalizations were “preventable” or “avoidable” if

the patients had received appropriate and timely outpatient care. The idea of assessing ambulatory care through such avoidable hospitalizations (according to a list of conditions) was then introduced in 1993 (47).

In this work by Billings et al. (47), the potential impact of socioeconomic differences on rates of hospitalizations in New York City was analyzed. The authors found that, for selected ACSC, the hospitalization rates were higher in lower income neighborhoods than in higher income ones. These results were interpreted as lower income areas having barriers to timely and effective outpatient care, therefore using ACSC as an indicator for access to care. This study used a modified Delphi approach consisting of a medical advisory panel to define what medical diagnosis would compose the ACSC list. The examination of such admissions, using hospital discharge data, was then expanded in the United States (51–53), and further research has followed internationally.

Some ACSC lists developed worldwide include Caminal et al (54), Brown et al. (55), Canadian Institute for Health Information (CIHI) (32), Page et al (56), Purdy et al (33), Alfradique et al (57), Freund et al (58), Sundmacher et al (59) and the United States Agency for Healthcare Research and Quality (AHRQ) (60). The Delphi approach to define ACSC is a common method employed (54,57,59), as the definition of which hospitalizations are sensitive to ambulatory care depends on the organization of the health system as a whole (61,62). Experts of a country (general practitioners, specialists, health managers, researchers) can evaluate if the health services available at the outpatient level have the potential to avoid the need of hospitalization for certain conditions.

Some criteria to determine if a disease is considered ACSC and should be used for evaluation purposes have been developed and employed by some of the lists mentioned above. The Solberg and Weissman criteria is commonly used, and it includes: (i) the existence of previous studies, (ii) clarity in the definition and coding of diagnoses, (iii) relevance for public health (assessed if the hospitalization rate is at least 1/10,000 population), (iv) if the diagnosis is potentially avoidable by timely and effective ambulatory care and (v) the necessity of hospitalization (63,64).

Some of the conditions commonly identified as ACSC include asthma, angina, bacterial pneumonia, congestive heart failure, complications of diabetes, gastroenteritis, hypertension, kidney/urinary tract infection and vaccine-preventable conditions (measles, rubella, and tetanus).

Taking some of these conditions to exemplify the concept of avoidability of ACSC: measles is a highly contagious viral condition that is transmitted by direct contact with secretions and by airborne respiratory droplets. Symptoms include high fever, coryza, cough and rashes. Some serious complications (blindness; encephalitis; ear, nose and throat infections; dehydration) can cause death. It is a preventable condition by immunization and a vaccine was first developed in 1963 (65). The vaccine is cost-effective (65) and its administration is done outside the hospital setting.

The list developed by Caminal et al (54) for Spain did not include measles in it, as it did not fulfil all of the Solberg and Weissman criteria (63,64). Measles incidence rates in Spain had been lower than 1 per 10,000 inhabitants since 2001 (66), which was the year Caminal et al (54) developed the list. However, the outbreaks in Europe in 2011 (67) and 2018/19 (68) may prompt a revision of the conditions to be analyzed. Measles was included in the Brazilian list cited above (57): the hospitalization rate at the time of the study for all vaccine-preventable conditions combined was 0.2 per 10,000 inhabitants (the Brazilian list did not implement exclusion criteria based on hospitalization rates).

Pneumonia is an acute infectious condition that affect the lungs and it is caused by different agents, including viruses, bacteria and fungi. This condition is present in the majority of ACSC lists and analysis performed worldwide. Differently than measles, vaccines that could prevent pneumonia have lower efficacy and do not work against all agents (69). The diagnosis of pneumonia is usually based on physical signs and chest radiography. In the ambulatory setting in the United States, for example, it is frequently diagnosed without the radiography, according to the American Thoracic Society (70). Cases can be treated with inexpensive oral antibiotics provided at the community level, although severe cases of pneumonia may require hospitalization. The chances of severity are associated to conditions such as immunocompromised state or some chronic diseases, as well as behaviors such as alcohol abuse and smoking.

Other condition commonly defined as ACSC is diabetes. This is a chronic disorder in which the body does not produce enough insulin, or cells do not respond to the insulin produced, leading to high blood sugar. What causes type 1 diabetes is currently not known and thus, it is not preventable (71); on the other hand, type 2 diabetes is largely preventable, with lifestyle factors such as overweight and obesity, unhealthy diet, lack of physical activity and smoking related to increased risk (71). The vast majority of people with diabetes have the type 2.

One key aspect for effectively managing diabetes, regardless of the type, is the early detection. The diagnosis can be established by measuring glucose in the blood of the patient (71). The burden of diabetes can be reduced through behavioral interventions to promote better dieting and physical activity, medications to manage blood glucose levels, and counselling. These public health measures should be available at the PHC level (71,72). The referral for specialist care is required for detection and treatment of complications, through comprehensive eye examinations (and laser and surgical treatment if needed), complex kidney function tests and angiological and neurological assessment. Hospitalizations are needed for management of complications of diabetes: acute cardiovascular disease, diabetic coma, kidney failure and infected foot ulcers. The treatment of diabetes does not necessarily prevents all these complications, but early and adequate management can reduce their progress and severity (71).

It is important to make clear the distinction between the terms avoidable/preventable and inappropriate/unnecessary/unjustified. A patient with diabetes, who did not have his/her blood levels controlled, did not take insulin/medicines, and did not have their feet checked, may have complications which lead to neural damage and infections, with may lead to lower extremity amputation. In this case, the hospitalization could have been avoided/prevented by procedures done in the outpatient setting. The opportunity to avoid the hospitalization beforehand was missed, and the clinical situation of the patient reached a point where the ultimate hospital admission was necessary. In contrast, a patient with bronchitis with mild symptoms, no signs of pneumonia and no comorbidities, can recover at home. If the patient is hospitalized, the hospital admission was unnecessary and the gatekeeping process for hospital care was not adequate. The terms avoidable/preventable and inappropriate/unnecessary/unjustified are not interchangeable.

Other important distinction to be acknowledged is between avoidable hospital admissions and avoidable emergency department visits (ED). This thesis discusses only episodes in which the patient was admitted to the hospital, while avoidable ED visits encompasses different types of episodes. The discussion and conclusions regarding ACSC hospitalizations cannot be indiscriminately applied to the emergency setting, as avoidable ED visits also includes clinically divertible attendances (when a patient could be treated at other settings of the health care system) and clinically unnecessary attendances (when a patient did not require any clinical care) (73). Although ASCS lists have been used to identify

avoidable ED visits in some studies (74,75); the need to develop a specific ACSC definition for ED context has been identified (76).

Because a considerable proportion of ED visits are avoidable, to reduce them is key to ensure efficient use of emergency care (13). Although improving emergency care is a pressing matter for many countries (13,73), this thesis' analysis was restricted to hospitalizations. While the analysis of avoidable ED visits have many caveats regarding its terminology, definition, and identification methods (73,77), the field of ACSC hospitalizations is more developed with a higher level of consensus across experts.

Given the conditions discussed previously as examples, it is clear that not all hospitalizations for such conditions are avoidable. As prevention and treatment/management also varies across conditions, there are different degrees of avoidability of hospitalization among them. In addition, there are known relationships between commonly considered ACSC: for example, hypertension is associated to higher risk of diabetes complications (71), while pneumonia is a common complication of measles (65). Therefore, it is notably challenging to reach consensus on what conditions are ACSC in a specific setting and how to analyze such event. Nonetheless, it is expected that care provided at the outpatient level can reduce rates of hospital admissions. High impact organizations largely agree on the conceptualization of ACSC (often denominated as *avoidable hospitalizations*) and its usefulness as a health care quality indicator.

> *"ACSC are an example of acute, chronic, or vaccine-preventable conditions that can serve as markers for assessing health services delivery performance. Examples of ACSC include chronic obstructive pulmonary disease (COPD), diabetes, asthma and angina, and can be described as those conditions where it is possible, to a large extent, to prevent acute exacerbations and reduce the need for hospitalizations through strong primary health care-based services delivery."*
>
> Source: World Health Organization Regional Office for Europe- WHO (21)
>
> *"Avoidable hospitalizations are those conditions that could have been avoided if proper ambulatory care had been received and can thus be seen as a measure of access to appropriate medical care. While not all admissions for ambulatory care sensitive conditions are avoidable, it is assumed that appropriate prior ambulatory care could prevent the onset of this type of illness or condition, control an acute episodic illness or condition, or manage a chronic disease or condition."*

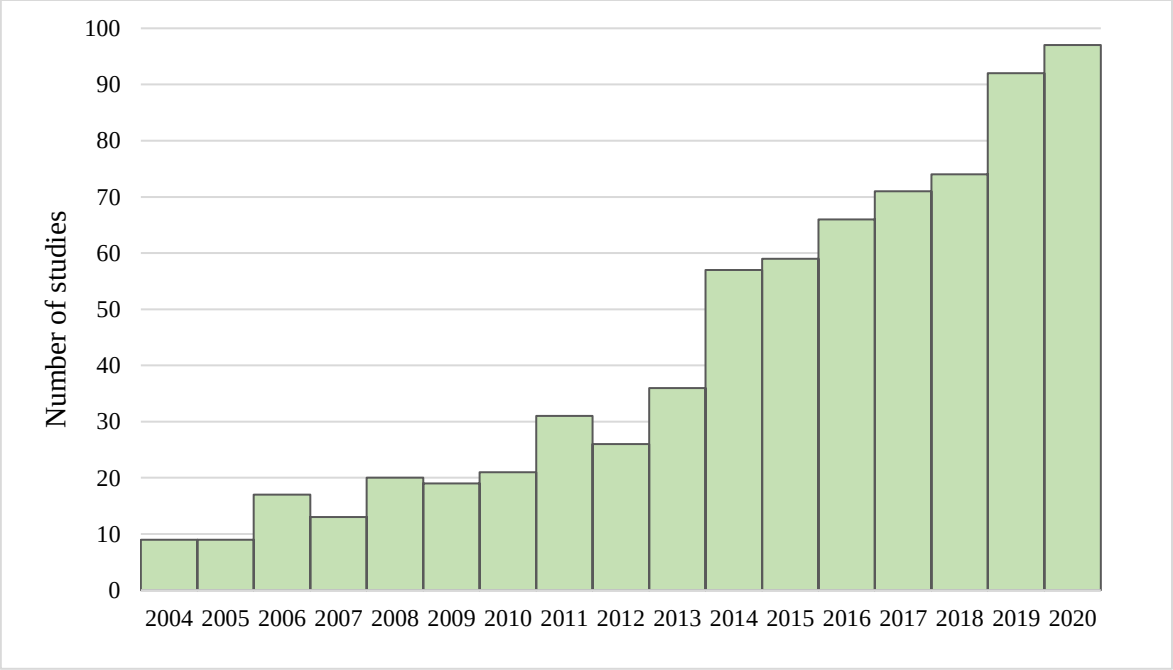
Source: Organization for Economic Co-operation and Development- OECD (72)

"ACSC are conditions for which good outpatient care can potentially prevent the need for hospitalization, or for which early intervention can prevent complications or more severe disease."

Source: Agency for Healthcare Research and Quality- AHRQ (78)

The interest on ACSC has also been increasingly growing in the academic world. As a scientific objective of study, Figure 1 shows a substantial increase in the number of published papers indexed in the electronic database PubMed with the terms "ambulatory care sensitive conditions" or "avoidable hospitalizations" in their titles and/or abstracts in the last 20 years. While there were few studies published in 2004 and for 2005, in 2019 and 2020 there were over 90 publications on this theme per year. Although the quality of the studies in Figure 1 has not been assessed, it is noticeable the growing attention ACSC has been receiving in research. This analysis did not include studies published in journals not indexed on PubMed, not published in English, or with terms other than "ambulatory care sensitive conditions" or "avoidable hospitalizations".

Figure 1. Published studies with the terms "ambulatory care sensitive conditions" or "avoidable hospitalizations" in their titles and/or abstracts, PubMed, 2000 to 2020.



Source: Retrieved from PubMed.gov (source: https://pubmed.ncbi.nlm.nih.gov/advanced/). Query box: *("ambulatory care sensitive conditions"[Title/Abstract]) OR ("avoidable hospitalizations"[Title/Abstract]*). 28 January 2021

2.2.1 Comparing ACSC hospitalizations between countries

Health systems in many countries have similar goals (e.g., achieve economic efficiency, assuring and increasing population's wellbeing) while facing similar challenges (e.g., demographic changes, limited resources). Inter-country comparisons provide a benchmark in which policy-makers can identify which areas they are performing above or below expectations (79). There are challenges in carrying out inter-country comparisons of health systems in general, among which is the limited availability of comparable data (79).

The comparison of ACSC hospitalizations between countries offers the possibility of exploring different strategies in health services delivery. In addition to the challenge of limited comparable data, differences in conceptualization of ACSC hospitalizations can hamper comparative efforts. A clear example of unclarity over the concept of this indicator is in the name it is referred to in different settings: in Brazil these are denominated *Internações por Condições Sensíveis á Atenção Primária* [Hospitalizations for Primary Health Care Sensitive Conditions]; AHRQ uses the term Ambulatory Care Sensitive Conditions; OECD uses the term Avoidable Hospitalizations. While the reasoning behind these denominations are the same, the different designations might yield varied interpretations of results.

Table 1 shows the percentage of total hospitalizations that were classified as ACSC for different countries obtained from a variety of studies. These values are not directly comparable between countries, as each study used different methodologies, conditions, definitions of ACSC and time of analysis. However, values allow illustrating that the impact ACSC hospitalizations represent in the total hospital production across different countries is considerable.

Table 1**.** Representativeness of ACSC in total of hospitalizations for selected countries

Country	ACSC as % of total hospitalizations	Year	Sources
Argentina	18%	2009	Guanais et al. 2012 (80)
Australia	9%	2001-2002	Page et al. 2007 (56)
Brazil	12%	2016	Pinto & Giovanella 2018 (81)
Colombia	22%	2008	Guanais et al. 2012 (80)
Costa Rica	11%	1997-2010	Guanais et al. 2012 (80)

Country	ACSC as % of total hospitalizations	Year	Sources
Ecuador	17%	2001-2010	Guanais et al. 2012 (80)
England	16%	2008-2009	Tian, Dixon & Gao 2012 (82)
Germany	20%	2012	WHO 2015 (83)
Italy	8%	2001-2008	Rosano et al. 2013 (84)
Kazakhstan	27%	2014	WHO 2015 (85)
Latvia	14%	2013	WHO 2015 (86)
Mexico	13%	2004-2008	Guanais et al. 2012 (80)
Paraguay	18%	2000-2017	Lerea, Tullo & López, 2019 (87)
Portugal	12%	2012	WHO 2016 (88)
South Korea	9%	2014	Kim et al. 2019 (89)

These results indicate that there is room for improvement in use of hospital services by reducing ACSC hospitalizations; such reduction is beneficial both for the health system and for the society. Not all hospitalizations classified as ACSC are avoidable; therefore, to reach zero hospitalizations for ACSC in a country is virtually not possible. It is also unfeasible to determine what would be an optimal value of ACSC hospitalizations in a country, given the limitations of the indicator, and there were found no studies that try to estimate such value.

Nonetheless, although the reduction of ACSC hospitalizations brings benefits, it also encompasses many challenges, not only due to its concept characteristics (not all hospitalizations are avoidable) but also because ACSC hospitalizations are multifactorial: factors under and outside the control of health systems may impact these events.

2.3 Factors associated to ACSC hospitalizations

2.3.1 Health system factors

There is evidence of the association of ACSC hospitalizations with features of health care. High rates of ACSC hospitalizations can be associated with inequities in access to health care, deficiencies in the coverage of the health system, poor coordination between PHC and other levels of care and low capacity of PHC in preventing, diagnosing, treating and managing these conditions in a timely and effective manner (21,36,82,90). Studies have

identified different gaps in health care that contribute negatively to health outcomes, namely higher rates of ACSC hospitalizations (91,92).

Reviews of the literature have confirmed the expected relationship of lower access to PHC and higher rates of ACSC hospitalizations (93,94), as access to quality outpatient care plays a crucial role in disease prevention and management. Studies have found significant geographic variation in rates of ACSC hospitalizations in countries like Switzerland (95), South Korea (96) and Finland (97), to name a few. These variations indicate inequalities in access and quality of PHC, measured in different manners. These three studies, along with analysis in other contexts (98–100), have found higher rates of ACSC hospitalizations associated to rural or isolated areas, with the reasoning that these areas have deficits in availability of health care providers and supply of health workforce, as well as harder access to transportation.

Some studies provided evidence that that physician supply and existence of PHC centers are inversely associated to ACSC hospitalizations (93,99,101,102). However, a systematic review on the association between medical workforce and ACSC hospitalizations had inconclusive findings, as reviewed studies got mixed results (61). Similarly, another systematic review have found mixed results in the association of out-of-hours care and ACSC hospitalizations (103). On another topic, a systematic review has found that most of the studies analyzed identified stronger continuity of care in PHC being associated to lower risk of ACSC hospitalizations (104); this effect of continuity of care has also been evidenced in other contexts (102,103,105–108). High coordination between primary and hospital care has also been associated to reductions in avoidable hospitalizations (62,109). Integration of care can reduce ACSC hospitalizations through the identification of patients' needs in the contexts of both vertical and horizontal coordination of care (110).

A reason behind some mixed results when analyzing the association of PHC and ACSC hospitalizations is the existence of other determining factors beyond outpatient care. For example, some studies argue that access to hospital care (either by it being free of charge or by high number of hospital beds) can lead patients to hospital based care, leading to higher rates of ACSC hospitalizations (108,111,112).

For the determinants at the health system level associated to ACSC hospitalizations, there is the possibility of intervening with management tools and interventions, such as a strategic human resources management, reorganization of the health services, training and development programs for health professionals, telehealth and econometric analysis in

health and health care dynamics (109,110,113). There is evidence of some practices and interventions that had a positive effect on reducing admissions, e.g., high-intensity telemedicine programs (114,115), use of electronic health record (116), enhanced primary care and specialist communication (117) and pay-for-performance schemes (118,119). Other possible interventions to reduce admissions for ACSC found in the literature include hospital at home as an alternative to admission, assertive case management in mental health and strengthening integration between primary and secondary care (110).

2.3.2 Sociodemographic and economic factors

There are factors associated to ACSC hospitalizations that are outside the control of health systems. The demographic composition of the population, for example, is also relevant on ACSC analysis, as older people are at higher risk of potentially avoidable hospitalizations (103,120,121). The ageing process that the world is experiencing has severe implications for health systems, which must deal with increasing health demands from the population. The rising on the burden of chronic diseases also put pressure on health systems, as there is evidence of association of ACSC hospitalizations and the presence of multiple chronic conditions (103,122), as well as with comorbidities in general (103,123,124), mental health conditions (125,126), intellectual disabilities (127) and physical limitations (128). Such associations reflect the obstacles that health care have to deal with regarding multidisciplinary care (122).

Other factors are at the population level, regarding disease prevalence, living and working conditions and socioeconomic and cultural characteristics of the population (58,129,130). While those are not easily controlled, they can be as relevant as the factors under the practice and policy scope of health systems.

Regarding these factors outside the control of health services delivery, there is evidence of association of higher ACSC hospitalization rates with deprivation and lower socioeconomic status (103,120,126,131–133). The concepts *deprivation* and *socioeconomic status* are usually defined by different combinations of other social dimensions, which have also been associated to ACSC hospitalizations: income level (96,121,124,134–137), lower education (98,103,134) and unemployment (99,138). The adjustment for socioeconomic variables is a key aspect in the analysis of these events (93), although this can be challenging given the complex framework of ACSC determinants. Such studies indicate the importance of taking social factors into account when assessing ACSC hospitalizations and discussing interventions for reductions.

2.4 Health care assessment using ACSC

Defining health care quality and ways of assessing it have been constantly discussed and developed globally. Regarding medical care, the development of evidence-based medicine has been supported by different research designs such as cohort studies with long-term follow-up and randomized clinical trials to explore the efficacy of treatments. However, the assessment of health care systems is more complex and has been subject to discussions (139,140). Donabedian (141) developed a model to assess quality of health services, that included three main domains: structure of the service (organization and inputs), the process of care, and outcomes for the patient. Donabedian (141) also lists some obstacles for assessing ambulatory care, including the lack of information about the patient's medical and social history and the unclear definition of what is the measurable outcome of the outpatient care.

For the constant improvement of health care services, it is necessary to develop and implement assessment indicators and mechanisms. For PHC, there are several studies and national guidelines of health care assessment proposed in different countries, with substantial variability regarding content of indicators and domains (structure, process, outcomes) (142). Despite the complex framework of ACSC determinants, it is a valuable tool for outpatient health care assessment.

ACSC has been strongly discussed at the academic level and adopted by different institutions internationally. A working document by WHO discusses that avoidable hospitalizations are inversely correlated with the health services delivery performance, summarizing evidence of its use as an indicator for such performance in the dimensions of access, quality, coordination and efficiency (21). The access to ambulatory care involve both geography (availability of health centers and providers, distribution of human resources and population access to transport), and health system organization (universal access and accessibility for different social groups) (21,143). For the quality dimension, avoidable hospitalizations indicate the abilities of the health system in health promotion, prevention and diagnostic of conditions and treatment of diseases (32,78). The coordination of care indicates longitudinal and continuous care for patients, with integration of ambulatory care with other sectors, including social care (62,110). The efficiency of health services delivery can be analyzed by estimating how much resources could be saved by reducing avoidable hospitalizations (82,144).

The OECD initiated in 2001 the Health Care Quality Indicators (HCQI) project. It aimed to measure and compare the quality of health care in different countries, through a set of indicators at the health systems level (145). The conceptual framework for health system performance defined quality of care in terms of effectiveness, safety and patient responsiveness for different health needs. Since then, results of the HCQI project have been routinely used in intercountry analysis by the OECD (146) and promoted in collaborations with the WHO, the European Commission, research organizations and universities (147).

Avoidable hospitalizations are included in the list of indicators analyzed by OECD, under the argument that high rates of these events point to possibilities to improve quality and to reach substantial cost savings, given that better primary care is provided (72). To use ACSC as an indicator for access and quality of the health care provided at the outpatient level can be considered convenient, as administrative databases are usually readily available, allowing a rapid assessment. OECD recognizes that there are controversies in using ACSC hospitalizations as a quality indicator, as it is not straightforward to define an appropriate level of hospitalization rates for all conditions, because not all events are avoidable (72).

The AHRQ has developed quality indicators for health care, with the Prevention Quality Indicators (PQI) module consisting of ACSC (the other modules being Inpatient Quality Indicators and Patient Safety Indicators) (78). Each PQI consists of admission rates for a specific condition; those were selected based on discussion of evidence in the dimensions of face validity, precision, minimum bias, if it fosters true quality improvement, and prior use (a detailed description of these dimensions for each PQI can be found at the AHRQ'S Guide to Prevention Quality Indicators) (78). When summarizing evidence for the PQI, AHRQ recognized that many of the conditions have practice guidelines associated with them, and that rates can be correlated with each other, with common underlying factors influencing most of the rates. They also list some obstacles for its use, including the complex relationship of ACSC hospitalizations and socioeconomic status (78).

The National Health System of England (NHS) has been reporting data on ACSC hospitalizations as part of the NHS Outcomes Framework since its introduction in 2004 (142,148).

In Brazil, the ACSC list developed is available for PHC evaluation purposes at the municipal, state and national level (31). The list has an emphasis on conditions that can be managed in primary care (and not any ambulatory care service) and it includes several infectious diseases not included on lists developed in richer countries (112,149). Analysis of ACSC

Hospitalizations in Brazil have been used to assess the impact of nationwide programs that aimed to improve quality of PHC (150–152).

In Portugal, avoidable hospitalizations are included in the pay-for-performance contractualization process for primary health care centers and Local Health Units [*Unidades Locais de Saúde- ULS*] (35), with financial repercussions. Local Health Units (LHU) provide primary and hospital care to a specific population, with the aim of promoting multidisciplinary collaboration and integration across different levels of care. FHU and LHU in Portugal are financed through mixed models in which avoidable hospitalizations are included; it is recognized that improvement in the follow-up of chronically ill patients and in the articulation between entities of the National Health System can lead to the reduction of these events (153).

2.4.1 ACSC hospitalizations and dimensions of analysis

There are different measures that can be used to analyze ACSC hospitalizations: absolute number, rate, and proportion of all hospitalizations can capture relevant information on health care access and performance, health-related events, and trends during a specific time period. The analysis of health indicators facilitate monitoring of health objectives and goals (154). To characterize the ACSC hospitalizations in terms of most common causes provides valuable information on for which conditions there are possible bottlenecks or shortcomings in health services delivery, and consequently there should be development/improvement of access, health promotion and disease prevention programs and other health interventions. The characterization according to sociodemographic variables is important for formulating objectives and interventions for reaching these groups.

ACSC hospitalizations represent inefficiencies in health services delivery, and the analysis of their costs allows to quantify the impact these events represent for health systems and society. It also produces estimations on how much could be saved by reducing ACSC hospitalizations in a setting, which is crucial to many health systems given the challenges they face in reaching and assuring economic efficiency.

Geographic variations in health care use can reflect differences in patient health needs, but also due to variations in medical practice styles and unequal access to health care services (155). The analysis of geographic distribution and variations of ACSC hospitalizations indicate if there is room to reduce these events within a country; the analysis of areas with

substantial higher rates identifies where policies to reduce unwarranted variations are the most needed.

2.4.2 Criticism of ACSC as indicator for PHC performance

Some recent studies have disputed the usefulness of ACSC as an indicator of quality of PHC. It has been discussed that ACSC do not capture all the components of health care quality, such as patient-centredness (156); or that there are too many underlying factors beyond the scope of PHC (156,157). One study compared hospitalizations according to ACSC lists and to event audit performed by physicians and/or administrators, finding disagreements between which hospitalizations were potentially avoidable (158). The analysis of ACSC hospitalizations has been more suitable at the macro level (159,160), with limitations of assessment at the individual level (157). For example, the hospitalization may happen due to the lack of social support for the patient, rather than for clinical reasons (161). It is largely agreed that ACSC as an indicator of quality of care does not apply to the individual experience of the patient and the medical practice, but it is intended to assess the impact of public health policies and programs in a macro perspective (160,162).

Some of the lists cited before have been developed in the early 2000s and the lack of updates may not reflect the advances and novelties in the prevention, treatment and management of ACSC in the outpatient setting. To understand the limitations of this indicator is crucial to reach the maximum of potential possible in using ACSC hospitalizations to assess performance of PHC.

The onus of reducing ACSC hospitalizations does not and should not lie solely on PHC, because the framework of determinants of these hospitalizations is complex and is not completely under the control of health systems. Instead of interpreting high rates of avoidable hospitalizations for the purpose of denouncing PHC as inefficient, it should serve to demonstrate the potential gains in health efficiency and health outcome in promoting good quality PHC on its components.

2.5 Primary health care

The Declaration of Alta-Ata of 1978 defined Primary Health Care as the first level of contact of individuals, family and community with the national health system; where health care is provided through practical, scientifically sound and socially acceptable methods and technology made universally accessible (3). Since then, PHC has been established as a core policy for the WHO, which has guided countries to expand and consolidate PHC aiming

the development of their health systems (26). In 2018, the Astana declaration on PHC was elaborated, 40 years after the Declaration of Alma-Ata. This new declaration reaffirms the critical role of PHC in addressing health needs of the population, with quality, equity and efficiency (4).

The WHO defines PHC based on three components:

> *"Meeting people's health needs through comprehensive, promotive, protective, preventive, curative, rehabilitative, and palliative care throughout the life course, strategically prioritizing key health care services aimed at individuals and families through primary care and the population through public health functions as the central elements of integrated health services;*
>
> *Systematically addressing the broader determinants of health (including social, economic, environmental, as well as people's characteristics and behaviours) through evidence-informed public policies and actions across all sectors; and*
>
> *Empowering individuals, families, and communities to optimize their health, as advocates for policies that promote and protect health and well-being, as co-developers of health and social services, and as self-carers and care-givers to others."*
>
> Source: WHO (163)

PHC promotes health equity, social justice, comprehensiveness, integration and continuity of care, and participation of communities, while moving away from the idea of resolving health problems through hospitalizations (26). The centralization of health care under the hospital based approach results in the excessive use of resources and technology, as well as considerable costs related to medication and iatrogenesis (26,28). International studies show that, when compared to resolving health problems through hospital care, PHC is associated with better health equity, higher patient satisfaction, reduced health care spending, better continuity and comprehensive care, improved health outcomes and less hospitalizations (28,112,164).

2.5.1 PHC reforms and ACSC hospitalizations

The development and strengthening of PHC and outpatient services are encouraged in different countries given its advantages, especially when compared to how expensive and demanding hospital care can be. Brazil and Portugal have reformed their PHC as a public

health policy, aiming to improve access, efficiency and quality of PHC, providing continuous care and increasing the satisfaction of patients and professionals. In both countries, the PHC is the first point of contact of users with the health system, providing health promotion, disease prevention and health management (39,165).

The analysis of ACSC hospitalizations in Brazil and Portugal could indicate if access, efficiency and quality of PHC have been improving, as preconized in their PHC reforms. Besides similar objective, the PHC reforms in both countries also had similar organizational characteristics, most notably the establishment of multiprofessional teams, providing community-oriented care and with the possibility of pay-for-performance schemes. In this sense, the analysis of ACSC hospitalizations in light of PHC reforms yield the potential for mutual learning and to rethink national policies in light of comparative evidence.

2.6 Primary health care reforms in Brazil and Portugal

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Introduction

The Declaration of Alta-Ata of 1978 defined Primary Health Care (PHC) as the first level of contact of individuals, family and community with the health system; where health care is provided through practical, scientifically sound and socially acceptable methods and technology made universally accessible (3). Since then, PHC has been established as a core policy for the World Health Organization (WHO), which has guided countries to expand and consolidate PHC aiming the development of their health systems (26). In 2018, the Astana declaration on PHC was elaborated, 40 years after the Declaration of Alma-Ata. This new declaration reaffirms the critical role of PHC in addressing health needs of the population, with quality, equity and efficiency (4).

The PHC can be understood as the provision of accessible and integrated health services by health professionals responsible for managing most of the population's health needs, developing a sustainable partnership with patients, exercised within the family and

community context and with emphasis in actions capable of minimizing or avoiding acute episodes resulting from complications linked to chronic diseases (28).

Brazil and Portugal have reformed their PHC in the last years, with similar organizational characteristics and objectives. Both countries have reorganized their health systems around PHC as a public policy. Brazil and Portugal have universal access to integral health guaranteed by their Constitutions and provided by national health systems and by the private sector. The public health services are offered and financed by the government through tax payments. The main objective of this study was to compare the PHC reform experience of Brazil and Portugal. The specific objectives were as follow:

- Describe the history and the process of implementation of the PHC reforms;
- Describe and compare the organization of PHC according to resourcing, planning of services, performance assessment and financing;
- Review and present empirical results associated to the PHC reforms, in the dimensions of health outcomes, economic impact, access and satisfaction of population and professionals;
- Review and discuss obstacles faced by PHC in both countries.

A review was employed to address these topics through different study designs, including legal policy documents, national and international research articles and grey literature. The results were presented in a descriptive manner, following the dimensions proposed by the specific objectives. It is expected that the analysis and comparison of both countries historic experience, organization, positive results and obstacles can allow the identification of key aspects associated to desirable health outcomes, prompting cross-country learning and expanding policy options.

Background

The Brazilian PHC history

PHC in Brazil has its origin in the Health Centers in São Paulo in the 1920s (166,167). These centers had a defined population covered and offered actions in health education, promotion and disease prevention. In the 1960s, there was an expansion of health centers linked to the State Health Secretariats, with actions directed mainly at maternal and child care and at infectious diseases (167). During the military period, initiated in 1964, the government's decision was to expand and strengthen private health services (168–170), which limited

access to health for a portion of the population. Financial resources were reallocated from health to social security, as the public health sector was deemed inefficient (170), which lead to a market-based health vision aiming at profits. Some measures were taken to provide medical assistance to the vulnerable population, with the private and public-funded systems running side-by-side (170).

The 1970s are defined as the origin of the Brazilian sanitary reform, which criticized the low funding, the lack of coordination and the limits of access to care in the system (166,170,171). Subsequently, the first experiences of community medicine emerge, with the support of the universities and participation of the municipalities in the development of PHC (166). In 1985 the military period comes to an end and a public health system begins to be developed during the 8th National Health Conference.

In 1988, a new federal constitution was enacted, establishing the Unified Health System *[Sistema Único de Saúde- SUS]*, the National Health System of Brazil. The SUS is organized by the principles of universality, decentralization, integral care and community participation. Public health actions and services are part of a regionalized and hierarchical network. The decentralization proposed for the SUS ensure accountability in provision of health services and permits more independence to the municipalities, while expanding federal supervision and resources (168,172). The decentralization aims at greater resolution to the system. The decision-making process operates according to an institutionalized structure of bipartite (state) and tripartite (federal) committees. This structure defines the responsibility of each level and facilitates consensus among them. Since its creation in 1990, the SUS has made consistent progress towards delivering universal and comprehensive health care to the Brazilian population, helping to reduce inequalities in health care access and the achievement of better outcomes, but not without facing challenges (173).

The decentralization contributed to the expansion and strengthening of PHC, since the delegation of responsibility for health to municipalities led to the expansion of PHC centers. At the same time, several local experiences of PHC models have been developed in various parts of the country (167). One of the most significant experiences was developed in the Northeast region (168,174). In this pioneering model, community health agents joined physicians and generalist nurses, who formed a team that worked with populations defined territorially (167). The positive results of this model for epidemiological indicators led the Ministry of Health, in 1991, to extend it across Brazil under the name of Community Health Agents Program *[Programa de Agentes Comunitários de Saúde- PACS]*. In 1994, the

Ministry of Health institutionalized the Family Health Program as the official public policy for PHC in Brazil. Subsequently in 2002, the program is defined as Family Health Strategy *[Estratégia Saúde da Família- ESF]*.

The PHC reform in Brazil, through the ESF, has launched one of the largest community-based primary care programs in the world (175). The objective of the ESF is defined as:

> "*To contribute to the reorientation of the care model based on basic care, in accordance with the principles of the SUS, imparting a new dynamic of action in the PHC centers, with defined responsibilities between health services and the population*" (176)

The Portuguese PHC history

Until the 1940s, the health situation in Portugal was fragile and a response from the state was necessary (177). In 1946, the Federation of Pension Funds was created, offering medical care nationwide. Its creation allowed the expansion of the provision of care in form of social insurance. In 1971, early health centers were established in Portugal, later known as "first generation" (178,179). These centers developed activities such as vaccination and maternal and child health (178–180).

In 1979 the National Health System of Portugal was created *[Serviço Nacional de Saúde-SNS]*. The Constitution guarantees the right to health protection for the population. There are fees charged when accessing the health system to rationalize the use of consultations and procedures, with exemption rules for specific populations (lower socioeconomic status, pregnant women, people under 18 years, firefighters, blood donors, among others) (181,182). The SNS has administrative and financial autonomy. The central management is the responsibility of the Ministry of Health. At the regional level, the management is the responsibility of the Regional Health Administrations *[Administração Regional de Saúde-ARS]* of the five health regions of the country. Other bodies are responsible for local management.

After the creation of the SNS and the legal recognition of the medical career of general practice, second generation health centers emerged. These integrated institutions devoted to preventive care and public health services (the first-generation health centers), with structures that provided curative outpatient clinical care in the community, named Social Health Insurance Services [*Serviços Médico Sociais das Caixas de Previdência*]. At that time, PHC reached widespread coverage in the national territory (178). However, the model

of care management and organization were insufficient to meet the needs of the population and the professionals' expectations (179,180). There were experimental projects of organization and remuneration seeking to improve access and quality. The Alfa Project (1996) promoted teamwork and autonomy, based on health accountability. The Experimental Remuneration Regime (1998), which allowed voluntary membership of teams, introduced a new remuneration system associated with the amount of work and quality of performance.

The success of these experiences served as the basis for a strategic reform of primary care in Portugal starting in 2005. The Primary Health Care Mission *[Missão dos Cuidados de Saúde Primários- MCSP]* was created (Council of Ministers Nº 157/2005) to carry out the project of launching, coordinating and monitoring the reconfiguration of health centers and implementation of the Family Health Units *[Unidades de Saúde Familiar- USF]* and of the Groups of Primary Care Centres *[Agrupamentos de Centros de Saúde- ACES].* The experimental projects provided management autonomy to professionals in the local level, therefore the decentralization became an important goal of the PHC reform. It was expected that the decentralization would be consolidated with the creation of the ACES and their management autonomy to decide and implement actions according to available resources and needs of the population.

The objective of this reform was to improve accessibility, efficiency, quality and continuity of care, increasing the satisfaction of the population and professionals (183). The PHC reform comprises:

> "*The creation of legal and operational instruments to recenter the Portuguese health system in PHC and the development of an organizational matrix that will lead to the reconfiguration of health centers aimed at achieving health gains and improving accessibility*" (Decree-law Nº 298 of 22 of August of 2007)

Organization of the PHC

PHC in Brazil

Mendes (2011) points out that the effective management of chronic conditions cannot be done through a hospital-centred care model and primarily focused on acute episodes. Brazil has been facing the consequences of the epidemiological transition process, with the increase in the volume of chronic diseases, such as diabetes, circulatory diseases and cancer (185). The Brazilian situation does not differ from that observed in the rest of the

world. It is estimated that between 40 and 50% of Brazilians over 40 years old are hypertensive and six million are diabetic (185). The disease burden modification process in Brazil required alternatives to be analyzed to provide more effective health care. In this context, PHC has taken a prominent position, as it modifies the logic of health service delivery by changing the focus on actions, prevention and health promotion.

In Brazil, the family health model seeks to act on the social determinants of health through integrated health actions, focused on prevention and health protection, with community participation (166,167,186). Through the territorialization of the population, health teams define their activities according to local needs. The actions and activities of primary care and the establishment of the teams are responsibility of the municipalities.

New guidelines of the National Primary Care Policy *[Política Nacional da Atenção Básica- PNAB]* approved in 2017 determine that the family health team is composed of at least one physician, preferably of the specialty of family medicine and community; one nurse, preferably specialist in family health; auxiliary and/or technician nurse and community health agents *[Agentes Comunitários de Saúde- ACS]*. The ACS are residents of the community where the ESF teams work (therefore they have knowledge of the local reality), are hired as municipal employees and are trained to carry out their duties, which include to register the population, to conduct home visits, to perform disease prevention activities and to plan, manage and evaluate developed actions jointly with other members of the team. The number of ACS should be defined according to epidemiological and socioeconomic data of the population (the former version of the PNAB (2011) determined that the number of ACS per team could be a maximum of 12, with a maximum of 750 persons per ACS).

Other professionals can be added to the team, according to the needs and characteristics of the organization of the local health services, such as agents to combat endemics and oral health professionals: dental surgeon, preferably family health specialist; and auxiliary or oral health technician. All professionals are supposed to have exclusive dedication to their teams. Each ESF team should be responsible for a population of 2,000 to 3,500 people. Starting in 2008, ESF teams also started to count with Family Health Support Centers [*Núcleos de Apoio à Saúde da Família- NASF*], in which professionals from different backgrounds provide support to a specific group of ESF teams, according to the community needs defined by the local manager.

Health facilities that provide PHC services through SUS are called Basic Health Units *[Unidade Básica de Saúde- UBS]*, and the ESF is the strategy used to expand and

consolidate primary care. There are other alternative models of primary care, being more common the traditional model, characterized by the lack of focus in the family, usually without territoriality and with the medical work focused on general practice, pediatrics, gynecology and obstetrics (167). Moreover, in the traditional model, the presence of ACS is not required in the minimum composition of the teams (187).

Health financing in Brazil is tripartite, involving resources from the Union, states and municipalities. With the introduction of Basic Operational Standards and the creation of the Basic Health Care Package *[Piso da Atenção Básica- PAB*], the transfer of federal resources to municipalities became regular and automatic. The financial resources of PHC are composed of a fixed and a variable component. The fixed component consists of a national value, which varies from R$ 23 to R$ 28 per inhabitant per year, based on the groups in which the municipalities are distributed. The definition of groups is made according to social and economic indicators. The variable component consists of specific incentives conditioned to the adhesion and implementation of certain programs and actions determined by the Ministry of Health, being important to mention among them the ESF, PACS, Oral Health teams, NASF, among others (Ordinance Nº 204, of 29 of January of 2007). Starting in 2003, the Brazilian government has institutionalized the performance assessment of the PHC. Among the existing programs, there is the Program for the Improvement of Access and Quality of Primary Care *[Programa de Melhoria do Acesso e da Qualidade da Atenção Básica- PMAQ-AB]*, which evaluates the performance of health teams and induces the improvement in quality of health services. The PMAQ-AB is currently on its third cycle, being responsible to evaluate nearly 42,000 primary care teams.

PHC in Portugal

The PHC reform in Portugal integrates a top-down and a bottom-up approach. The top-down vector consists of the MCSP administration and the restructuring of the Central Administration of the Health System [*Administração Central do Sistema de Saúde - ACSS*]. The bottom-up vector consists of the involvement of professionals in the formulation of the reform and the voluntary character of the adhesion of professionals to USF.

The USF provide individual and family health care through multiprofessional teams, with organizational, functional and technical autonomy, integrated in a network with other functional units. The teams have a voluntary constitution and operate in health centers run by the state. The teams consist of three to eight physicians (who must have a specialty in general and family medicine, and are responsible for 4 to 12 patient lists, with 1,500 people

in each list), approximately the same number of nurses, and fewer number of administrative staff. USF professionals are hired as civil servants. The users are registered to the teams of their geographic region, and each USF must have between 4,000 and 18,000 registered users, according to the geodemographic characteristics of the population covered and the number of available professionals. USF have internal regulations, information systems and clinical management processes.

ACES were established in 2008. ACES are health services with administrative autonomy, formed by several functional units. The purpose of ACES is to provide primary care to the population of a given geographical area, which should be between 50,000 and 200,000 people. The ACES have no financial autonomy; the Ministry of Health allocates public funds to the ARS, which finances the ACES through contract-programs, defining quantitative and qualitative objectives. The ACES establish an annual action plan with the USF and finance their services. This contratualization process includes the performance monitoring and assessment of activities, according to a list of indicators in different dimensions (188).

USF are categorized into three development models, with different levels of organizational autonomy and levels of compensation and incentives to professionals (Decree Law Nº 28, of 22 of August of 2007). Model A corresponds to a phase of learning and improvement of the work, being an indispensable stage for the adaptation to a new culture. In this model, the individual remuneration of professionals is mostly composed of the fixed salary, with the possibility of receiving financial incentives based on the contracting of services and objectives; these incentives must be invested in the USF (in infrastructure, equipment or training). Model B indicates a higher level of organizational maturity, in which professionals have higher demands in performance. In addition to individual compensation and staff incentives (as in Model A), staff can receive individual financial incentives based on a series of indicators contracted both at individual and team levels. The choice of indicators is made according to population characteristics and the performance of other USF, and should be challenging but also achievable (189). Model C is experimental and has not yet been implemented in any USF. This model allows the participation of the private sector.

The ACES include other functional structures with multiprofessional teams, with organizational and technical autonomy and intercooperation with the other functional units. The Customized Health Care Units *[Unidades de Cuidados de Saúde Personalizados - UCSP]* have a structure identical to the USF and provide personalized care to the enrolled population in the dimensions of accessibility, continuity and universality. These units are

characterized by vertically hierarchical work, without incentive mechanisms and less autonomy than USF (190). The Public Health Units *[Unidades de Saúde Pública - USP]* develop epidemiological surveillance actions, elaboration of information and plans in public health and coordination of programs and projects for prevention, promotion and protection of health. The Units of Care in the Community *[Unidades de Cuidados na Comunidade - UCC]* provide home and community health care, as well as psychological and social support, especially to the most vulnerable population. The Units of Shared Care Resources *[Unidades de Recursos Assistenciais Partilhados - URAP]* have professionals from different backgrounds (social workers, physiotherapists and organizational therapists, among other) to provide support to all functional units. These units lack planning for allocation of resources and professionals, falling behind in the contratualization process (191).

Comparing organizational characteristics

Table 2 summarizes some organizational characteristics of the PHC introduced by the reforms in Brazil and Portugal. The establishment of USF is one of the most visible aspects of the organization of PHC in both countries. The experiences that anticipated and boosted the PHC reform in Portugal were mostly based on the autonomy of USF teams and compensation schemes that reward performance, and these are important attributes of the current PHC organization of the country. Portugal established different models that USF can achieve, according to level of development, autonomy and associated compensation. In Brazil, the different modalities of ESF and their financial transfers are based on the population covered and development level of the municipality (Ordinance Nº 822, of 17 of April of 2006).

In Brazil, the PACS experience in the early 90s introduced one of the main components of the ESF, which is the extensive and effective use of ACS as part of the ESF teams. There are no professionals in the Portuguese USF which could be considered equivalent to ACS. The ESF teams in Brazil are responsible for activities and health prevention and promotion, elaboration of plans and activities and home community care. In Portugal, USF teams are mostly responsible for medical services, as there are other PHC functional units providing other PHC-related services. Among these functional units in Portugal there are the URAP which provide support to teams, comparable to the NASF in Brazil. In Portugal the USF teams are grouped voluntarily and the physicians must be specialists in general and family medicine. In Brazil this is not mandatory, although it is preferred. In both countries the USF coexists with traditional PHC health centers.

The health systems in Brazil and Portugal are decentralized. In Brazil there are defined responsibilities for the federal, state and municipal level. Municipalities are responsible for planning and executing health activities, as well as establishing ESF teams through individual selection processes. In Portugal the ACES were created to manage the PHC in specific geographic areas, that can comprise several municipalities or areas in the same municipality. A recent law established the municipalization process for social areas in Portugal (including health), in which competences are transferred for local authorities (Assembly of the republic- Law Nº 50/2018). The impact of this process in PHC is still unclear.

Table 2. Organizational characteristics of PHC in Brazil and Portugal

	Brazil	Portugal
Objectives	Reorient the work process in PHC, articulated to the family and community context, to increase the resolution and impact on the health situation of the population.	Improve PHC accessibility, efficiency, quality and continuity of care and increase the satisfaction of professionals and citizens.
Responsibilities	The municipalities are responsible for the actions and activities of PHC and team management	The ACES are responsible for the actions and activities of PHC, under the administration of the ARS.
Family Health Teams		
Composition	At least one physician, preferably of the specialty of family medicine and community; one nurse, preferably specialist in family health; auxiliary and/or technician nurse and community health agents. Other professionals can be added to the team as needed.	Three to eight physicians, who must have a specialty in general and family medicine, and are responsible for 4 to 12 patient lists, with 1,500 people in each list; approximately the same number of nurses, and fewer number of administrative staff
Employment	Hired individually as civil servants or under temporary contracts.	Voluntary self-selecting teams, hired as civil servants.
Coverage	Each team should be responsible for a population of 2,000 to 3,500 people.	Each team should have 4,000 to 18,000 registered users.
Work process		
Definition of health actions	Teams define action plans. The Union, State and Municipality are part of the decision-making process of health actions.	Teams have autonomy to define action plan and internal organization. Teams contratualize actions and objectives with the ACES; which contratualize with the ARS.
Monitoring	Systematic monitoring, responsibility of the Union, states and municipalities.	The contratualization process includes the performance monitoring and assessment of activities by the ACESs and ARSs, according to a list of indicators.
Financing	Health financing is tripartite, involving resources from the Union, states and municipalities. Resources are composed of a fixed and a variable component. The variable component consists of specific conditional incentives based on adhesion and implementation of programs and performance.	The Ministry of Health and the ACSS allocates public funds to the ARS. The ARS finances services through contract-programs with the ACES, which finances the USF. Payment systems for staff varies according to development model of the USF, with team and individual incentives

Source: Elaborated by authors

Results associated to PHC reforms

Health outcomes

In Brazil, studies have found that the implementation and expansion of the ESF has been associated to positive health outcomes. Several studies have found an association between higher ESF coverage and lower post-neonatal and infant mortality (192–195). In particular, the ESF has been linked to reductions in mortality due to diarrhea and respiratory infections in children (193,195). For adults, the expansion of the ESF has been associated to reductions in mortality from heart and cerebrovascular diseases (196) and in hospitalizations for ambulatory care sensitive conditions (81,112,149). This effect was not necessarily seen in the whole population and for all conditions (192). This impact of the ESF on health outcomes has not been homogeneous across the country, with large and significant improvements in municipalities in the poorest regions of Brazil and with worse initial health conditions (194,195).

In Portugal, official reports indicated that the model B USF have presented better performance than model A USF and traditional PHC centers, according to indicators of health promotion and prevention indicators (183,197). It is unclear whether this is due to a positive effect of the organization model or self-selection of high-performing health care professionals to these models. (198). The proportion of controlled diabetics and hypertensive patients with controlled blood pressure are higher in model B USF (183). These units have also presented higher proportion of enrolled female users aged between 50 and 70 years with mammogram recorded between 2012 and 2014; enrolled adult users aged between 50 and 75 years with colon and rectal cancer screening performed and enrolled users with complete vaccination series (197).

Descriptive reports indicate that rates of hospitalizations for ambulatory care sensitive conditions have been declining since the beginning of the PHC reform and are among the lowest of the OECD countries, suggesting good quality of PHC in Portugal (39,183). In other study, a difference-in-difference analysis did not suggest statistical significant impact of USF on rates for of hospitalizations for ambulatory care sensitive conditions, indicating that these events are more related to the demographic and socioeconomic characteristics of the

population (198). A study found that, in three ACES of Portugal, in was expected that the contract process introduced by the PHC reform in the country contributed to the longitudinal increase in the proportion of specific health services usage and screening indicators (199). To the best of our knowledge, there are no studies of the impact of the health care reform on patient outcomes.

Economic impact

In Brazil, there is evidence suggesting that the ESF is a highly cost-effective approach to provide PHC and to promote health improvements, especially in poor areas (195). This analysis was done taking into consideration the cost per person covered by the ESF (estimated at around US$50), the mortality reductions associated to the ESF expansion and the available estimates in the literature for the value of a statistical life. The focus on poorer regions and on vulnerable population may have contributed to the increase of equity in health care utilization (200).

In Portugal, some studies provide indications of economic impact associated to PHC reform when comparing expenditure associated to medications and complementary diagnostics and therapeutics, both between the two USF models and traditional PHC centers (197,201) and in time intervals for selected ACES (199). The economic efficiency of USF has also been indicated throught data envelopment analysis (179) and stochastic discrete event simulation models (202) using total expenditure and remuneration of professionals, as well as costs of medication, diagnostic tests and other treatments. Other study compared performance of units that had the pay-for-performance scheme introduced, according to a set on indicators (203). Results indicate that there is a maximum performance that units reached from which no additional gains can be achieved. Authors recommend that indicators and targets should be regularly reviewed to avoid excessive focus on specific dimensions (203). Evidence is this subject is still lacking, as it has not been confirmed that these positive findings are results from the PHC reform, therefore further studies are necessary (198,204).

Access

The ESF in Brazil had a rapid expansion in the beginning of the 2000s, which has been facilitated by the increase of federal transfers to PHC, new norms establishing that the variable component of PHC financing would be based on population coverage, and the possibility of hiring professionals through contracts, instead as civil servants (171,172). The ESF has high levels of coverage, but its expansion has reached a plateau in the last years

(172). Data from the Primary Health Care Department *[Departamento de Atenção Básica-DAB]* indicated that, in September 2018, there were 42,960 ESF teams implemented in Brazil. The estimation of population covered used to be provided by DAB, and was calculated as one ESF team per 3,450 people. By this calculation, it was estimated that 71.90% of the Brazilian population was covered by ESF in September 2018. The highest coverage was in the Northeast region (95.11%) and the lowest was in the Southeast region (57.48%).

The USF were introduced in Portugal in 2006. The expansion of the USF was stimulated by the autonomy for professionals to voluntarily apply and by the introduction of new management model, institution of clinical management and reorganization of support services (190,205). By the end of 2007 there were 104 USF established in Portugal (206). The number of USF has been increasing steadily since their introduction (183). There were 505 active USF in July 2018, according to data from the SNS. Out of these, 270 were Model A and 235 were Model B (207). Nearly half of the USF were in the North region and another 31% of them were in the Lisbon and Tagus Valley region. There were also 380 UCSP providing PHC through the traditional approach. By 2016, more than half of the Portuguese population was covered by USF (190). The Portuguese Observatory of Health Systems (207) pointed that, if the number of USF increases at a pace of 25 new centers per year, only in 2030 that the estimated quantity needed of USF would be reached (around 820 units).

Satisfaction of population and professionals

In Brazil, the satisfaction of users with the PHC delivery system overall is high (208). This satisfaction is even higher among users of the ESF (171,209). There is evidence of a positive association between household enrolment in the ESF with having a usual source of care and this source being the PHC, and a negative association with reporting emergency and urgent care as the usual sources (210). Although there was found no national survey of satisfaction of ESF professionals, some local studies in Brazil found that the positive aspects of the ESF reported by professionals are related to team work and relationship with the users (211–214).

In Portugal, early studies found that professionals of the USF had good satisfaction levels overall (201,215,216), with the teamwork and work conditions at the units identified as improvements resulting from the implementation of USF (201,215,217). A report by the national association of USF lists sources of dissatisfaction among professionals, which

include inadequate clinical and informatics equipment, information systems and institutional incentives (218). There were high levels of satisfaction reported among USF users (201,205,219,220), which is aligned to one of the proposed objectives of the PHC reform.

Challenges faced by PHC

Unequal PHC access

Brazil and Portugal have unequal coverage distribution of USF and of human resources across the countries. In Portugal, the existing USF are concentrated along the coastal area and in the bigger cities, where there is higher population density (183,221). Because USF in Portugal are self-formed, some reasons found for the lower number of USF units in some regions are due to human resources (insufficient professionals, professionals near age of retirement), as well as economic contexts (221). Some of the regions that have faced low coverage of physicians before 2005; such as Alentejo and Algarve (222), continued with worst coverage after the PHC reform (39).

In Brazil, the highest percentage of families registered at ESF units is in the rural areas (223), and there are difficulties in promoting access and consolidation of a proactive model of PHC in large urban centers (224). The complex dynamics of urban regions can hinder the capacity of municipal managers in planning and executing the ESF policies effectively (225). The ESF implementation differentials between regions can be explained by the diversity in political, organizational and institutional contexts (223,226), as well as a broader choice of health providers by the population in bigger cities, including private health insurance (172).

In Brazil, improvements in access, health outcomes and economic impact were more significant for the poorer population, given the focus the PHC reform had for these groups and regions. It is possible to argue that, while seeking to improve health care for the less privileged segment of the Brazilian population, there were created social variations in access and use of PHC. In Portugal, the better understanding of how the health system works determines how well the user can navigate through it (227). This knowledge of the health systems can be derived from either the education or socioeconomic level of the population. Therefore, both countries face geographic and social inequities.

Brazil and Portugal have developed strategies and policies to address the insufficiency and unequal distribution of human resources. In Portugal, physicians with a specialty in general and family medicine compose most of the primary care workforce. In fact, Portugal has one of the highest shares of generalists among all doctors among OECD countries (183).

However, a high number of those professionals are approaching retirement. In addition, there are indications that the specialty in general and family medicine in Portugal was historically less attractive to recent graduates then other specialties (228). To address the lack of those professionals, the Portuguese government has increased the number of available places and established a minimal threshold of vacancies for the general and family medicine specialty (183,229). Between 2006 and 2015, the number of residency places almost doubled, reaching 1,569 in 2015 (229). Other measure taken was the recruitment of foreigner doctors through bilateral agreements, although there has been no assessment of the efficiency or effectiveness of such measure (229). Other measure was to provide incentives for geographic mobility of physicians to needed areas, although it was not enough to reach the needed PHC coverage (204). Besides the adoption of these strategies, no policy on human resources for health has been formulated yet (229).

Furthermore, Portugal has a low ratio of nurses to physicians when compared to other OECD countries. Although the country trains these professionals, a large number of them emigrate, which has been related to low wages and low recruitment of nurses in the Portuguese health system (183). Although USF are described as having multiprofessional teams, these are composed only by physicians, nurses and administrative staff. This situation could be better addressed if URAP were developed in integration with USF.

In Brazil, different wage structures, unstable contract arrangements and shortage of physicians have been associated to difficulties attracting and fixing professionals in teams of ESF, mostly in smaller cities (223,230). There has been an expansion in the formation of family physicians in the last years (231). However, unlike Portugal, currently there is no career plan for this category of physicians, which can render the specialty less attractive. Changes were introduced in the contracting of professionals to overcome such obstacles. Although the number of temporary labour contracts decreased, the situation remains (168,172).

Another measure taken was the adoption of the More Doctors program *[Programa Mais Médicos- PMM]* in 2013, in which physicians have been placed in areas with shortage of professionals. To date, the program distributed 19,000 physicians imported from other countries, especially Cuba, and almost 5,000 Brazilian physicians (232). Some studies point out that this program has been associated to better health outcomes due to PHC, especially in deprived areas (232–234). Despite the increase in number of physicians, there are still problems with poor governance on the municipality level and lack of infrastructure that

hinder the potential of the program (232,233). In addition, at the end of 2018, the government of Cuba withdrew from the Cooperation Agreement responsible for the PMM and called its professionals back. The Cuban Ministry of Public Health based its decision on statements by the Brazilian President-elect in 2018, who had made "direct, derogatory and threatening references to the presence of our physicians, stated and reiterated that it will modify the terms and conditions of the PMM" (235).

Organizational obstacles

Despite restructuring their health systems with PHC as a gatekeeper, both Brazil and Portugal have a traditional hospital-centricity on their health systems (88,172). Emergency departments and hospitals are commonly used by citizens due to perception of greater quality of care and timely response at hospitals (39,183). The misuse and excessive demand on emergency departments leads to high costs for the health system, as this level of care is more expensive than PHC. In Brazil, the PHC reform has helped to reduce the centricity of hospitals in the health system, although half of government spending is allocated to hospital services (171). Nevertheless, government spending has been reallocated towards PHC (171,172).

In 2016, the health expenditure as a share of GDP in Brazil was 6.2%, but the public share corresponded for less than half of this amount (37). Municipalities often have troubles with sustaining the ESF financially, due to municipal budget limitations (236). This situation is even more problematic for smaller and less developed municipalities, that depend greatly on the federative transferences which may not be enough (236,237). In Brazil, the strengthening of primary care services and its sustainability is compromised by the lack of financial resources. Overall, the Brazilian health system in general faces major financials challenges (165) that may be aggravated by fiscal adjustment measures implemented in the last two years. At the end of 2017, the Ministry of Health relaxed programmatic conditions which leads to the fragmentation of the public system and indirectly stimulates private arrangements (238). In addition, the former country's Government introduced one of the harshest set of austerity measures in modern history. The constitutional amendment passed in December 2016, called PEC-55, freezes the federal budget, including health spending, at its 2016 level for 20 years (239). Secondly, the Government plans to introduce commercial health plans *[Planos Populares]*, meant to replace functions previously performed, free of charge, by SUS. Commercial plans offer a narrower scope of services than the minimum offered by SUS and are subject to less regulatory scrutiny, which generally results in poor

service quality and high out-of-pocket costs (239). The constitutional amendment freezes the budget for 20 years; with severe projected consequences for the expansion and improvement of health services in the future (240,241).

In Portugal, the total health expenditure represented 8.9% of the country's GDP in 2016, which is similar to the mean of the OECD countries (37). Health spending peaked at 10.8% in 2010, but decreased the following years after the economic recession and the austerity measures required by the Economic and Financial Adjustment Programme in 2011 (39,242). The austerity measures required the reduction in public expenditure for health. In 2017, public expenditure corresponded to 66% of the total health expenditure, which was among the lowest in the European Union (39). On a positive reference, the Memorandum of Understanding for the economic crisis recommended the strengthening of primary care services through the increase in the number of USF with performance-related payments (243). This recommendation expected reduction in costs and more effective provision.

In Portugal, there is allocation of financial resources to support the pay-for-performance model institutionalized by the PHC reform. One study compared variable compensation mechanisms based on performance for PHC in Lisbon, Portugal and Curitiba and Rio de Janeiro, Brazil (244). While the variable compensation in Lisbon could reach 40% of the base wage, it the Brazilian cities it only reached 10%. There is evidence for the effectiveness of the pay-for-performance scheme in PHC in Portugal to improve quality of care and to reduce expenditures (245). These conclusions were based in the analysis of the evolution of performance indicators.

The use of specific performance indicators in the contractualization process in Portugal allows the monitoring of outcomes related to access, quality, coordination and efficiency of the PHC. However, the rigidity of the contractualization process can lead to a standardization of health activities and shift the focus of care to a biomedical perspective (246). The contractualization process based on specific indicators can prompt a lack on the people-centredness dimension and less flexibility, which are highly required in PHC. Some of these challenges were addressed by the introduction of a Global Performance Index [*Índice de Desempenho Global- IDG*] in 2014 and its modifications introduced in 2017 (188). There was an attempt to increase the sampling of dimensions considered to assess overall performance (198).

In Brazil, the introduction of health agents in the ESF seeks to guarantee a better understanding of the needs of users beyond the clinical aspects, bringing the health care

closer to the community. The managing of the ESF in Brazil is responsibility of the municipalities, but the management capabilities on this local level are often weak (168). The governance in the municipal level also leads to large variations in the capacity and quality of the ESF teams; including in physical and human resources and institutional support (165). In Portugal, on the other hand, the management and financing of health services are responsibility of the Ministry of Health and the ARS. Decentralization is a keyword of the Portuguese SNS framework, as in other European countries (39). But in practice, responsibilities for planning and financing have remained centralized. The ACES need adequate management autonomy and accountability. The decentralization is one of the main pillars of the PHC reform that is yet to be fully achieved (207). It is argued that decentralization is effective to improve health services delivery, to better allocate resources, to reduce health inequities and to involve the community (39).

Brazil and Portugal have co-existence of traditional PHC centers and Family Health Units, which indicates distinct levels of quality. In Portugal, distinct levels of quality are also results of different models of health care delivery, due to the voluntary aspect and autonomy promoted by the PHC reform. There is room to improve integration of USF with other PHC units, as well as vertical integration (39,205). The challenge for Portugal is how to develop such integration with different official and unofficial models of care. Some measures taken aiming at improved integration include the creation of Local Health Units [*Unidades Locais de Saúde- ULS*] in 1999 and the Integrated Continued Care National Network [*Rede Nacional de Cuidados Continuados Integrados- RNCCI*] in 2006. ULS are groups of care providers that integrate hospitals and PHC units to improve multi-disciplinary cooperation. The RNCCI connects hospitals, ACES, social security services, municipalities and other institutions to provide long-term care, social support and palliative care.

In Brazil, limitations in the information system and patient records have been one of the sources for the lack of integration between PHC and other levels or care (172). Integration of care still represents an important weakness of the SUS (172). Some measures have been taken to address such challenges. The Healthcare Network Policy was launched in 2010, to establish strong integrated health care networks in Brazil. The Ministry of Health has also implemented the e-SUS AB, which is the new Brazilian PHC information system. It has the purpose of reorganizing data of PHC and is integrated with e-SUS of ambulatory and hospital care.

Portugal has an extensive information infrastructure that allows the monitoring of the health system performance and public policies. The introduction of Identity Card of the Primary Health Care [*Bilhete de Identidade dos Cuidados de Saúde Primários – BI-CSP*] and the IDG allows for the monitoring and comparison of USF performance. However, there are obstacles to access relevant and articulated information, since not all data sources are effectively integrated (39). Few studies have analyzed the association of health care interventions with positive health outcomes; to establish evidence on this is still a challenge for health policy-makers (39). Most of the results collected on positive outcomes of the PHC reform come from official reports that can be biased. In addition, the policy evaluation process of health services in general in Portugal is not systematic, as there are usually no evaluation plans or ex-post assessments (39). Longitudinal studies from the periods before and after the reform are necessary to really understand the gains derived from the changes in PHC in the last years.

Final remarks

In Brazil and Portugal, the needs of the population and the positive results of innovative experimental projects on PHC delivery led to the reforms adopted in both countries. The main organization characteristic is the establishment of the Family Health Units, with multiprofessional teams providing community-oriented care in close contact with the population, integrated with other functional units and with payment schemes that rewards performance. Countries that structure their health systems around PHC have presented better results in different dimensions, and Brazil and Portugal have presented some advances in access, health outcomes, economic impact and satisfaction of the population with PHC.

Brazil and Portugal have a historic relationship that reflects on similarities in language and culture. Both countries also face similar challenges in PHC services delivery, namely inequities in access and quality, lack of integration in the health system and suboptimal organizational characteristics, to name a few. Brazil and Portugal have introduced public policies and strategies to overcome some challenges the PHC face. Improvements in health and well-being provided by PHC and health systems in Brazil and Portugal demand political commitment and the focus on bringing positive results to the population, and these should be in the future agenda for both countries to move forward.

Chapter 3. Objective and structure

To reduce ACSC hospitalizations is a major concern for health systems because it brings severe effects to individuals and to health systems. To understand the dynamics associated to avoidable hospitalizations can help designing interventions. Reducing the number of these events will contribute to both increased quality of care and reduced health care expenditures. Despite the advances in the ACSC hospitalizations field and its use for health care assessment, there are still some gaps in the knowledge that are worth exploring, especially concerning country-comparisons.

Countries might face similar health system challenges, and the comparative approach helps to explain the characteristics of health systems and reforms, as well as its potential to resolve difficult health care delivery problems (247,248). Comparisons between different settings have been used at the academic field of public policy analysis and in more applied policy studies (247). The comparison of these two countries brings some challenges, as Brazil and Portugal have disparate socioeconomic contexts.

The main objective of this thesis is to analyze the dynamics of hospitalizations for Ambulatory Care Sensitive Conditions in Brazil and Portugal. The two countries reformed their PHC with organizational similarities, with the establishment of the Family Health Units as the most visible feature of the reforms. They consist of multiprofessional teams providing community-oriented care, integrated with other functional units and with payment schemes that rewards performance.

This analysis can bring new insights on how to optimize PHC to reduce hospitalizations, with positive results for the health system and for the population.

This comparison does not seek to result in a ranking of which country has the better health system or has been more successful reducing avoidable hospitalizations, but to discuss their experiences regarding ACSC hospitalizations, given their convergent and divergent characteristics. The interaction of varied dimensions of the health system and how they produce outcomes in different settings is the basis for the analysis proposed in this thesis. The ability to produce desirable outcomes that lead to beneficial impact depends on the inputs available to the system. The inputs for health assessment are related to those of the health system structure, like the governance, the financing and the allocation of resources; and also related to the services: the way they are designed, organized, managed and the efforts to improve them. Such inputs lead to performance outcomes related to access,

quality, coordination and efficiency of health system delivery (21,249). These outcomes lead to impacts in health, which in the case of this study are the ACSC hospitalizations. Prevention and treatment of acute conditions and management of chronic diseases to prevent complications are core tasks of the PHC.

The analysis of health system delivery must take into consideration the specificities of the country analyzed. Therefore, to discuss performance across countries and to benefit from the opportunities of comparative studies, it is necessary to establish an adaptive approach that allows the analysis of each context (250).

This thesis has the following specific objectives:

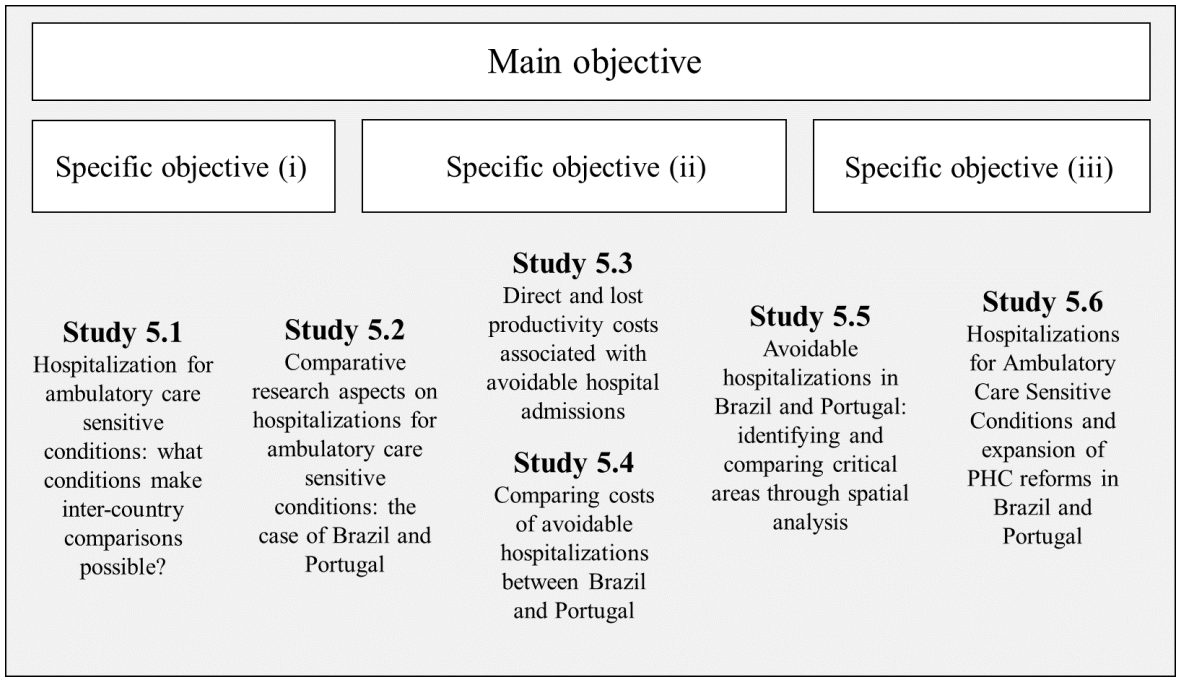
(i) Discuss conceptual and methodological aspects of comparative research on ACSC;

(ii) Compare ACSC hospitalizations in Brazil and Portugal in the dimensions of occurrence, rates, causes, sociodemographic characteristics, costs of hospitalizations and economic impact, geographic distribution and variations;

(iii) Analyze the evolution of ACSC hospitalizations in Brazil and Portugal and the possible associations with the PHC reforms

The objectives of this thesis were developed along different studies, as described in Figure 2. Henceforth, studies will be identified according to the chapter number they are presented in this thesis. Study 5.1 served as a starting point and background for the thesis, as it reviewed studies that performed inter-country comparisons of ACSC hospitalizations, identifying conceptual and methodological aspects to account for. Study 5.2 discussed methodological considerations for this comparison applied to Brazil and Portugal; it also compared ACSC hospitalizations in the dimensions of occurrence, rates, causes, age and sex distribution. Studies 5.3 and 5.4 analyzed the costs and economic impact of these hospitalizations; the former only for Portugal (as it introduces a novel methodology in cost estimation of ACSC hospitalizations) and the latter for both countries. In study 5.5 a spatial analysis of ACSC in Brazil and Portugal was performed and differences for regional PHC quantitative measures between cluster and non-cluster areas were analyzed. Finally, Study 5.6 analyzed trends of ACSC hospitalizations in Brazil and Portugal and possible associations to the expansion of their PHC reforms.

Figure 2. Structure of results of thesis



Chapter 4. Research Methods

The results chapter of this thesis consists of the six studies mentioned in the previous chapter. The studies have different perspectives, objectives, study designs and methodologies. More details of the research methods are provided in the methods section of each study.

4.1 Brief description of Brazil and Portugal

Brazil is the largest country in South America, with an area of 8.5 million km^2, and the sixth most populous in the world, with a population of 210 million people in 2019. It is a federal presidential republic, classified as an upper-middle income country by the World Bank. It is constituted of 27 federative states, which contains 5,570 municipalities. Distrito Federal, one of the federative units of Brazil (equivalent to states) was not included in the analysis and results of this thesis, as it is an autonomous territory and does not have municipalities; instead, it has administrative regions. Brazil's capital, Brasilia, is located in Distrito Federal and functions as both a municipality and a state.

Portugal is the westernmost country of mainland Europe, with an area of 92,000 km^2. Once recognized as one of the most important countries in the world in terms of economic, political and military power, today it is classified as a high income country by the World Bank. It is a unitary democracy with the executive power being exercised by the President and the Council of Ministers. Administratively, Portugal is divided into 18 Districts in the mainland and 2 autonomous regions consisting of archipelagos in the Atlantic Ocean. Portugal has a total population of 10 million people as in 2019, with most living in the mainland, which is composed of 278 municipalities. All analysis and results in this thesis refer to mainland Portugal; the archipelagos of Açores and Madeira were not included as they have autonomous health systems, independent from the SNS.

Brazil and Portugal have been presenting an increase in the number of people over 65 years and of life expectancy, however Portugal is more advanced in the demographic transition. In 2016, 21% of the population in Portugal was over 65 years, while this proportion in Brazil was 8% (251). Brazil and Portugal are also in different levels of economic development, as Brazil is considered an upper-middle income economy, while Portugal is a high income economy. Age distribution and socioeconomic differences reflect on the burden of diseases of each country. In Portugal the global burden of disease is mostly composed by

noncommunicable diseases, while a significant share of the global burden of disease in Brazil comes from infectious diseases and external causes (252).

4.2 Methodologies

4.2.1 Study design

The methodology for study 5.1 consisted of literature review and analysis. The review was conducted through searches in the electronic databases BioMed Central, PubMed and Web of Science. Google Scholar was also consulted to identify thesis and grey literature. The scoping review aimed at identifying conceptual, methodological, contextual and policy aspects that need to be accounted for when comparing ACSC hospitalizations across countries. The methods for studies 5.2 to 5.5 consisted of cross-sectional quantitative data analysis. Study 5.2 consisted of descriptive statistics to compare ACSC hospitalizations in Brazil and Portugal. Studies 5.3 and 5.4 consisted of cost of illness analysis to estimate costs of ACSC hospitalizations. Outputs were expressed in monetary terms and represent the burden of ACSC hospitalizations to society. Study 5.5 was an ecological cross-sectional study on spatial of ACSC hospitalizations and association to socioeconomic and PHC characteristics. Study 5.6 was an ecological longitudinal study that employed correlation analysis, linear regression models and non-parametric tests to analyze possible impact of PHC reforms in ACSC hospitalization rates differences.

4.2.2 Data sources

The main data used for studies 5.2 to 5.6 were about hospital admissions in Brazil and Portugal. In Brazil, this data is collected by the SUS and compiled at the Hospital Information System database [*Sistema de Informações Hospitalares do SUS* (SIH-SUS)], which is administered by the Brazilian Health System´s Information Technology Department [*Departamento de Informática do Sistema Único de Saúde* (DATASUS)]. The SIH-SUS gathers information about all inpatient cases on Brazilian public hospitals; the data is available for the public and can be downloaded at the DATASUS website (253).

In Portugal, the patient's discharges database is collected by the ACSS. This database gathers information about all hospitalization cases on Portuguese public hospitals. The data is not publicly available. The approval to access and use the data for the studies was obtained both from the ACSS and the Escola Nacional de Saúde Pública- Universidade NOVA de Lisboa.

The databases used for the cross-sectional studies 5.2 to 5.5 were for the year 2015, as it was the latest year for which hospitalization data were available for both countries during the data analysis phase of this thesis. For study 5.6, a longitudinal analysis was carried out using data from years 2007 to 2016 for Portugal and Brazil.

Databases in both countries are produced to reimburse hospitals, therefore only cover public hospitals. In both countries, health professionals evaluate the patients and determine the principal and secondary diagnosis code according to the International Classification of Diseases (ICD): in Brazil the 10th revision has been used for all the years analyzed; in Portugal the 9th revision was used until 2016, while most of the hospitals used the 10th revision in 2017. In addition to the evaluation of the physician, external auditors frequently check the hospital databases, to ensure quality and identify potential errors.

4.2.3 Variables

The information used from these databases included: a) demographic information of the patient: age, sex, municipality of residence; and b) information of the hospitalization: hospital, date of admission, length of stay, discharge disposition, principal and secondary diagnosis, principal and secondary procedures. For the studies of cost analysis (studies 5.3 and 5.4), the price of hospitalizations in Brazil were included in the database; for Portugal the price was obtained according to the code of Diagnosis Related Groups (DRG).

The data is anonymized; in both databases the patients were attributed a number for linking purposes, but that does not allow his/her identification. Therefore, none of the studies presented in chapter 5 or in this thesis as a whole required ethics approval or consent to participate.

For studies 5.2 to 5.6 other variables besides hospitalization were included in the analysis. Resident population were used to calculate hospitalization rates; these information were obtained from the Brazilian Institute of Geography and Statistics [*Instituto Brasileiro de Geografia e Estatística- IBGE*] for Brazil and Statistics Portugal (SP) for Portugal. Data on socioeconomic characteristics (proportion of elderly, population density, rurality, economic level, education level) and labour information (unemployment, mean wage and labour force participation) were also obtained from IBGE and SP. Data on primary health care quantitative characteristics were obtained from DATASUS for Brazil, and from the periodic publication on number of patients registered on PHC services for Portugal (254).

For studies 5.2 to 5.6, data curation and statistical analysis were carried out using IBM SPSS 21.0. For study 5.5, the spatial scan analysis was performed using SatScan 9.4. Maps for studies 5.5 and 5.6 were generated using QGis 2.18.

4.2.4 Summary of methodologies

Table 3 summarizes the methods used in each study that comprises this thesis. The table provides a description of the study types, aims, years of analysis, variables and data sources and methods employed, study perspective, aims, data source, setting, outcome measures, and statistical analysis. A more detailed version of the research methods is provided in the methods sections of each study in chapter 5.

This thesis complies to all research regulations regarding human rights and data protection. The work of other authors is properly acknowledged and there are no conflicts of interest to declare.

Table 3. Summary of research methods

Study	Aim	Type of study	Year of Analysis	Variables and Data Sources	Methods
5.1 Hospitalization for ambulatory care sensitive conditions: what conditions make inter-country comparisons possible?	Identify the conceptual, methodological, contextual and policy dimensions and factors that need to be accounted for when comparing ACSC hospitalizations across countries	Scoping Review		• Electronic databases BioMed Central, PubMed, Web of Science and Google Scholar	• Literature review and analysis • Elaboration of conceptual framework
5.2 Comparative research aspects on hospitalizations for ambulatory care sensitive conditions: the case of Brazil and Portugal	Compare hospitalizations for ACSC in Brazil and Portugal, discussing conceptual and methodological aspects to be taken into consideration on doing so.	Descriptive cross-sectional	2015	• Hospital admission databases- DATASUS (Brazil) and ACSS (Portugal) • Adult Population- IBGE (Brazil) and SP (Portugal)	• Descriptive statistics • Calculation of variations to baseline scenario
5.3 Direct and lost productivity costs associated with avoidable hospital admissions	Estimate the direct and lost productivity costs of ACSC hospitalizations in Portugal.	Economic estimation	2015	• Hospital admission databases- ACSS (Portugal) • Adult Population- SP (Portugal) • Monthly wage, unemployment and labour force participation- SP (Portugal)	• Estimation of direct costs using prices as proxy • Estimation of lost productivity costs using the human capital approach • Sensitivity analysis of costs
5.4 Comparing costs of avoidable hospitalizations between Brazil and Portugal	Estimate and compare direct costs and lost productivity of ACSC hospitalizations in Brazil and Portugal	Economic estimation	2015	• Hospital admission databases- DATASUS (Brazil) and ACSS (Portugal) • Adult Population- IBGE (Brazil) and SP (Portugal) • Monthly wage, unemployment and labour force participation- IBGE (Brazil) and SP (Portugal)	• Direct costs estimated using prices as proxy • Lost productivity costs estimated using the human capital approach • Sensitivity analysis of costs

Study	Aim	Type of study	Year of Analysis	Variables and Data Sources	Methods
5.5 Avoidable hospitalizations in Brazil and Portugal: identifying and comparing critical areas through spatial analysis	Identify and compare critical areas of ACSC hospitalizations in Brazil and Portugal,	Ecological cross-sectional	2015	• Hospital admission databases- DATASUS (Brazil) and ACSS (Portugal) • Adult Population- IBGE (Brazil) and SP (Portugal) • Proportion of physicians in FHU and PHC per 1,000 population- DATASUS (Brazil) and ACSS (Portugal) • FHU coverage- DATASUS (Brazil) and ACSS (Portugal) • Population density, rurality, economic level, education level- IBGE (Brazil) and SP (Portugal)	• Analysis of geographic variations using descriptive statistics, percentiles, coefficient of variation, and ratio of variation • Identification of clusters using Spatial Scan Statistics • Comparisons between clusters and non-clusters areas using non-parametric Mann-Whitney tests
5.6 Hospitalizations for Ambulatory Care Sensitive Conditions and expansion of PHC reforms in Brazil and Portugal	Analyze the evolution of these hospitalizations in Brazil and Portugal and discuss possible indications of the impact of the reforms in the rates differences.	Ecological longitudinal	2007 to 2016	• Hospital admission databases- DATASUS (Brazil) and ACSS (Portugal) • Adult Population- IBGE (Brazil) and SP (Portugal) • FHU coverage- DATASUS (Brazil) and ACSS (Portugal) • LHU coverage- ACSS (Portugal) • Hospital beds- SP (Portugal) • Purchase Power- SP (Portugal)	• Descriptive statistics • Association between FHU coverage and ACS hospitalization rates using Spearman's correlation • Comparison of differences in ACSC hospitalization rates using non-parametric Kruskal-Wallis tests • Analysis of geographic variations using linear regression models for Portugal

4.3 Defining ACSC

For studies 5.2 to 5.6, it was necessary to select a single methodology to define ACSC, to ensure comparability between countries and studies. As a baseline, the definition of which hospitalizations were for avoidable was determined according to the AHRQ methodology. This methodology identifies PQI, indicated in Table 4. Details on disease codes used and methods of calculation can be found in the AHRQ guidelines (60).

Table 4. Ambulatory Care Sensitive Conditions (PQI) selected

PQI 01 Diabetes short-term complications
PQI 03 Diabetes long-term complications
PQI 05 COPD or Asthma in older adults
PQI 07 Hypertension
PQI 08 Congestive heart failure
PQI 10 Dehydration
PQI 11 Bacterial pneumonia
PQI 12 Urinary tract infection
PQI 14 Uncontrolled diabetes
PQI 15 Asthma in younger adults
PQI 16 Rate of lower-extremity amputation among diabetics

Source: Agency for Healthcare Research and Quality (60)

This list has a strong theoretical basis for its composition and a well-defined methodology for inclusion of cases and exclusion for some comorbidities and can be applied for both ICD-9 and ICD-10. Version 6.0 was applied for ICD-9 (reviewed October 2016), and Version 7.0 for ICD-10 (reviewed September 2017). Despite differences in codification between ICD-9 and ICD-10, the names of the conditions were consistent between versions. This methodology was applied for all admitted patient aged 18 years and older.

Obstetric admissions and transfers from other health care facilities were excluded. All cases with missing values for the variables age, sex, diagnosis, and municipality of residency were also excluded. More details on the use of the AHRQ methodology are found in the methods section of each study. In 2015, there were no hospitalizations with missing values for the variables age, sex, diagnosis, and municipality of residency in Brazil. In the same year for Portugal, there were excluded five observations for missing sex and 484 for invalid municipality of residence.

Chapter 5. Research Findings

5.1 Hospitalization for ambulatory care sensitive conditions: what conditions make inter-country comparisons possible?

Material in this section has been published as:

Rocha JVM, Santana R, Tello, JE. Hospitalization for ambulatory care sensitive conditions: what conditions make inter-country comparisons possible? Health Policy Open, 2021.

https://doi.org/10.1016/j.hpopen.2021.100030

Abstract

Hospitalizations for ambulatory care sensitive conditions have been extensively used in health services research to assess access, quality and performance of primary health care. Inter-country comparisons can assist policy-makers in pursuing better health outcomes by contrasting policy design, implementation and evaluation. The objective of this study is to identify the conceptual, methodological, contextual and policy dimensions and factors that need to be accounted for when comparing these types of hospitalizations across countries. A conceptual framework for inter-country comparisons was drawn based on a review of 18 studies with inter-country comparison of ambulatory care sensitive conditions hospitalizations. The dimensions include methodological choices; population's demographic, epidemiologic and socio-economic profiles and features of the health services and system. Main factors include access and quality of primary health care, availability of health workforce and health facilities, health interventions and inequalities. The proposed framework can assist in designing studies and interpreting findings of inter-country comparisons of ambulatory care sensitive conditions hospitalizations, accelerating learning and progress towards universal health coverage.

Keywords

Ambulatory care sensitive conditions; Avoidable hospitalizations; Inter-country comparison; scoping study

Introduction

It is commonly accepted that, for some health conditions, timely and adequate management, treatment and interventions delivered in the outpatient setting could potentially avoid the need for hospitalization. These conditions are known as *ambulatory care sensitive conditions* (ACSC) and they have been widely used as an indicator of access, quality and performance of primary health care and overall health services (47,60,82,90). The concept of analysing potentially avoidable hospitalizations started in the United States in the 1990s to evaluate access to health services (47). It later expanded to other countries. Since then, there is a wide and growing body of literature on ACSC and, due to its usefulness, it has been endorsed by national stewards and international organizations as an indicator of performance (21,32,37,60,82).

There is evidence that features related to access, quality, integration and efficiency of services are positively associated with ambulatory care sensitive conditions hospitalizations (ACSC hospitalizations) (21). Availability of health professionals and facilities, financial incentives, continuity of care, gatekeeping role of primary health care, monitoring of high-risk patients, among others are associated with ACSC hospitalizations (58,61,93,105,130,255). However, the severity of the disease and the patient underlying clinical conditions may influence the hospitalizations rates (122,123,125,126). ACSC hospitalizations are also positively associated with deprivation, unemployment, scarce education attainments, low level of income and rurality (58,95,109,130).

ACSC hospitalizations may be unsafe and harmful for patients and their families, generate an additional burden for health professionals, create difficulties for health managers and policy-makers responsible for planning health services delivery and negatively impact the health system funding. Governments and international organizations are increasingly encouraging the development of primary health care and overall outpatient services as an alternative model to expensive hospital care. Comparative studies on ACSC hospitalizations across countries can indicate vantage points and achievable goals to improve services delivery, design interventions and reduce ACSC hospitalizations.

Comparisons across countries can accelerate health service and system improvements by providing valuable opportunities for contrasting experiences, stimulating inter-country learning and increasing policy options to act upon. The use of comparable indicators on the quality of health services can help countries assessing their situation and improving performance (247,256). Studies have shown that ACSC hospitalizations account for around

20% of total hospital admissions in England (257), Colombia, Argentina and Paraguay (80), around 13% in France (258) and 8% in Italy (84). In Germany and Kazakhstan over 75% of hospitalizations for hypertension could have been avoided (83,85); in Portugal and Germany around 60% of hospitalizations for heart failure could have also been avoided (83,88). For diabetes, the percentage for avoidable hospitalizations has been found to range from 40% to 80% in Germany, Latvia and Moldova (83,86,259). The use of ACSC hospitalizations to compare performance across countries may result in joint policy developments. One notable example is the Health Care Quality Indicators Project initiated in 2001. The Project measures and compares the quality of health care of different countries through a set of agreed indicators (145).

Despite these advantages, up to date, only few studies compare ACSC hospitalizations across countries and those available have different objectives and use different methodologies.

This study seeks to identify the conceptual, methodological, contextual and policy aspects that need to be accounted for when comparing ACSC hospitalizations across countries.

Methods

The starting point for this study was to review the published literature, research articles and grey literature, on ACSC hospitalizations inter-country comparisons. The review was conducted through searches in the electronic databases BioMed Central, PubMed and Web of Science using the terms “ambulatory care sensitive conditions”, “hospitalizations for ambulatory care sensitive conditions”, “avoidable hospitalizations”, “potentially avoidable hospitalizations” and “avoidable hospital conditions”. The search aimed to identify studies published in English from January 2000 to April 2019.

Those studies that compared numbers or rates of ACSC hospitalizations between two or across more countries were included regardless if the comparison was the main aim or part of a broader objective of the study. All studies were considered whether they analyzed ACSC hospitalizations by single condition or aggregately. The references of the included studies were also reviewed to identify additional research. Abstracts without full articles and studies not published in English were excluded (one study in German and one in Portuguese). In total 390 studies were found. Out of this, 18 met the inclusion criteria and were reviewed.

The data analysis consisted of three steps. In a first step, the conceptual and methodological considerations of the included studies were examined. In a second step, the findings of the

studies were clustered to identify common dimensions associated to ACSC hospitalizations. A third step consisted on analysing the policy implications of these studies and match them to their purposes and the countries involved. A conceptual framework for ACSC hospitalizations inter-country comparisons was derived.

This cross-sectional, scoping study aimed at outlining the factors that weigh inter-country comparisons. The study identifies limitations, and measures to overcome them, regarding the conceptualization, methodological aspects and contextual factors associated to ACSC hospitalizations.

Findings

Eighteen studies were identified and analyzed. Table 5 shows the full-text articles and reports selected. Eight studies used only descriptive statistics to compare ACSC hospitalizations between countries (37,80,257,258,260–263). In four of these studies, comparison of ACSC hospitalizations was part of a broader objective of discussing health services performance (37,257,260,263). Nine studies employed additional statistical methods to explore possible associations with different variables (84,108,111,135,264–268). Most of studies included only high-income countries (84,108,265,267,268,111,135,257,260–264). Three studies targeted specific cities (135,264,266). Three studies analyzed only one specific health condition (diabetes) (108,265,266) and for two studies the conditions selected for analysis for each country were different (21,258).

Table 5. Overview of studies included in the review

Study	Cities/ Countries	Objective	Methods	Conditions
Chau et al. (2013) (264)	HKG, London, New York	Compare and analyze ACSC hospitalizations as proxy for assessing access to primary care	Multiple logistic regression models to examine the possible association between ACSC hospitalizations and individual and neighbourhood-level variables	*
Degos and Rodwin (2011) (260)	FRA, USA	Highlight differences between care-centred and system-centred approaches	Review and discussion of evidence	*
Guanais, Gómez-Suárez and Pinzón (2012) (80)	ARG, COL, CRI, ECU, MEX, PRY	Compare and analyze ACSC hospitalizations and their economic effect	Descriptive statistics of ACSC hospitalizations and estimation of costs	**
Gusmano et al. (2007) (261)	England, FRA	Compare and analyze ACSC hospitalizations as proxy for assessing access to primary care	Comparison of age-standardized rates	*
Gusmano, Rodwin and Weisz (2006) (135)	Manhattan, Paris	Compare and analyze ACSC hospitalizations as proxy for assessing access to primary care	Multiple logistic regression models to examine the possible association between ACSC hospitalizations and individual and neighbourhood-level variables	*
Gusmano, Rodwin and Weisz (2014) (262)	England, DEU, FRA, USA	Compare and analyze ACSC hospitalizations as proxy for assessing access to primary care	Comparison of age-standardized rates	*
Kim and Cheng (2018) (265)	KOR, TWN	Compare and analyze hospitalizations for diabetes (an ACSC) as proxy for assessing quality of primary care	Multivariate, multi-level longitudinal models to examine the possible association between ACSC hospitalizations and individual and system-level variables	Diabetes
Kossarova, Blunt and Bardsley (2015) (257)	AUS, BEL, CAN, DEU, ESP, FRA, GBR, GRC, IRL, ITA, NLD, NZL, PRT, SWE, USA	Compare and analyze health care in the United Kingdom relative to other countries	Comparison of age-standardized rates	Asthma, COPD, diabetes

Study	Cities/ Countries	Objective	Methods	Conditions
Kringos et al. (2013) (111)	AUS, BEL, CHE, CZE, DEU, DNK, England, ESP, FIN, GBR, ISL, IRL, ITA, LVA, MLT, NLD, NOR, POL, PRT, SVN, SWE	Compare and analyze ACSC hospitalizations as a proxy for assessing overall strength of primary care	Pearson correlation to examine the possible association between ACSC hospitalizations and variables on the strength of primary care	Asthma, COPD, diabetes
Loenen et al. (2016) (108)	AUS, AUT, BEL, CAN, CHE, CZE, DEU, DNK, England, ESP, FIN, HUN, ISL, IRL, ITA, LVA, NLD, NZL, NOR, POL, PRT, SVN, SWE	Compare and analyze hospitalizations for diabetes as proxy for comparing differences in the organization of primary care	Negative binomial analysis to examine the possible association between ACSC hospitalizations and variables on organizational characteristics of primary care	Diabetes
OECD (2017) (37)	AUS, AUT, BEL, CAN, CHE, CHL, COL, CRI, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, HUN, ISL, IRL, ISR, ITA, JPN, KOR, LVA, LTU, LUX, MEX, NLD, NZL, NOR, POL, PRT, SVK, SVN, SWE, TUR, USA	Compare and analyze health outcomes and performance of health systems	Comparison of age and sex-standardized rates	Asthma COPD, diabetes, heart failure
Quan et al. (2017) (266)	HKG, JPN, Rural and peri-urban Beijing, SGP	Compare and analyze hospitalizations for diabetes (an ACSC) and their economic effect	Pearson correlation to examine the possible association between ACSC hospitalizations and variables on PHC use. Estimation of costs	Diabetes
Rosano et al. (2013) (84)	DEU, ITA	Compare and analyze ACSC hospitalizations as proxy for comparing differences in the health systems	Poisson regression models to examine the possible association between ACSC hospitalizations and contextual factors	***
Schiøtz et al. (2015) (267)	DNK, USA*	Compare and analyze ACSC hospitalizations as proxy for comparing differences in the organization of primary care	Logistic model to calculate the odds of rehospitalisation within 30 days after discharge for persons hospitalised with an ACSC	Angina, COPD, diabetes, heart failure, hypertension
Schneider et al. (2017) (263)	AUS, CAN, CHE, DEU, FRA, GBR, NLD, NZL, NOR, SWE, USA	Compare and analyze health care in the United States relative to other countries	Comparison of health system performance score	Asthma, Congestive heart failure, diabetes

Study	Cities/ Countries	Objective	Methods	Conditions
Thygesen et al. (2015) (268)	DNK, England, ESP, PRT, SVN	Compare and analyze ACSC hospitalizations and variations	Exploratory multivariate regression models to examine the possible association between ACSC hospitalizations and contextual factors	Angina, asthma, COPD, dehydration, diabetes, heart failure
Weeks, Ventelou and Paraponaris (2016) (258)	AUS, BRA, CAN, CHE, DEU, DNK, ESP, FRA, GBR, IRL, ITA, PRT, SGP, SVN, USA	Compare and analyze ACSC hospitalizations in France with other countries	Comparison of age-standardized rates with results from previous studies	Varied
WHO (2016) (21)	DEU, KAZ, LVA, MDA, PRT	Review findings and the proposed conceptual framework for measuring ACSC hospitalizations	Stakeholder consultation. Estimation of rates of avoidability. Review and discussion of evidence	Varied

Abbreviations: ARG Argentina, AUS Australia, AUT Austria, BEL Belgium, BRA Brazil, CAN Canada, CHE Switzerland, CHL Chile, COL Colombia, CRI Costa Rica, CZE Czech Republic, DEU Germany, DNK Denmark, ECU Ecuador, ESP Spain, EST Estonia, FIN Finland, FRA France, GBR United Kingdom of Great Britain and Northern Ireland, GRC Greece, HKG Hong Kong, HUN Hungary, IRL Ireland, ISL Iceland, ISR Israel, ITA Italy, JPN Japan, KAZ Kazakhstan, KOR Republic of Korea, LTU Lithuania, LUX Luxembourg, LVA Latvia, MDA Republic of Moldova, MEX Mexico, MLT Malta, NLD Netherlands, NOR Norway, NZL New Zealand, POL Poland, PRT Portugal, PRY Paraguay, SGP Singapore, SVK Slovakia, SVN Slovenia, SWE Sweden, TUR Turkey, TWN Taiwan, USA United States of America

*Asthma, bacterial pneumonia, cellulitis, congestive heart failure, diabetes, gangrene, hypokalaemia, immunisable conditions, malignant hypertension, perforated or bleeding ulcer, pyelonephritis, ruptured appendix (64).

**Anaemia, angina, asthma, cellulitis, congestive heart failure, COPD, dehydration, diabetes, ear, nose and throat infections, epilepsy, gastroenteritis, hypertension, immunisable conditions, nutritional deficiencies, pelvic inflammation, perforated or bleeding ulcer, pneumonia, pregnancy and birth related conditions, tuberculosis, urinary tract infection (57).

***Angina, appendicitis with complications, asthma, congestive heart failure, diabetes, disorders of hydro-electrolyte metabolism, hypertension, nutritional deficiency, pelvic inflammation, perforated or bleeding ulcer, pneumonia, urinary tract infections, (269).

Notes: Degos and Rodwin (2011) study is based on data analysis by Gusmano using data from 2004, which are also present in the study Gusmano, Rodwin and Weisz (2014). Schiøtz et al. (2015) study compared the Danish Health System with Kaiser Permanente, a not-for-profit managed care organization in the United States. Weeks, Ventelou and Paraponaris (2016) mimicked definitions of ACSC used in previous studies. WHO (2016) asked health providers and other relevant stakeholders to select priority ACSC

Three studies apply ACSC hospitalizations to evaluate access to care (135,261,264). These studies discuss how social, economic and health system barriers are associated to ACSC hospitalizations in countries with different health systems. Other eleven studies apply ACSC hospitalizations to evaluate performance of services, with access being one of its components (21,37,268,84,108,111,262,263,265–267). These studies investigate how health services, particularly primary health care, improve health outcomes in terms of performance, quality, organization or effectiveness.

The definition of what is expected from primary health care and its gatekeeping role varies across studies. The research methodology and the conditions selected for analysis depend on the objective of the analysis, the scope of primary health care and the organization of the health services (33,130,160). The effective gatekeeping role of primary health care in combination with higher or lower accessibility to inpatient care, lead to lower or higher rates of ACSC hospitalizations. Authors of five studies argue that the availability of hospitals lead to induced-demand for hospitalizations and emergency services (21,80,84,108,262). Therefore, although ACSC hospitalizations are commonly associated with performance of primary health care, their analysis encompasses the whole health service delivery system (21,84,262,264).

Findings emerging from the inter-country studies: conceptual and methodological

A first challenge inherent to the analysis of ACSC hospitalizations is to reach consensus on the concept of what is sensitive to ambulatory care, i.e., what conditions could have been avoided by timely and effective ambulatory care. Different lists of conditions have been developed (see seven of the reviewed studies (80,84,135,260–262,264)). The process to define the ACSC usually starts with a literature review followed by discussions and validation with clinicians and health managers in each country. Such process takes into account the organization of care, the disease prevalence, the socioeconomic and cultural characteristics of the population and the patient pathway in the context of each health system (33,160). Given that these factors vary among and within countries, there is no consensus on a definitive list of ACSC. For two studies, the conditions analyzed for each country varied (21,258).

The first list of ACSC hospitalizations was developed in the 1990s for analysing of hospital utilization in the United States of America (47). In 2004, an adapted ACSC hospitalizations list was developed in Spain (90). In 2009, Purdy *et al*. (33) combined the ACSC hospitalizations and obtained a common set of 36 diagnosis. The NHS England used a

subset of 19 conditions, corresponding to 35% of all ACSC hospitalizations identified by Purdy *et al.* (33). In 2013, Bardsley *et al*. (91) combined previous sets of conditions to develop a unique non-country specific ACSC hospitalizations list. Despite these attempts for moving towards a common agreed list of ACSC hospitalizations, countries have developed or adapted the lists to their national context.

Regarding the methodological aspects, important considerations arise for how hospital admissions information is obtained. The most common data source for studies on ACSC hospitalizations is administrative databases; all 18 studies analyzed used official hospital discharge databases. The extraction of information was done directly from databases (84,258,264,265,267,268) or retrieving it from other datasets (108,111,257). These databases are available in most countries; thus, facilitating data collection. However, data are usually collected for reimbursing providers and, in some cases, refer only to publicly funded activities (264,268). The data collection process can be more difficult in countries with health systems based on private insurance (258). Despite verifications (21), these administrative databases are susceptible to errors which lead to lower reliability and quality (258,264,265). The inter-country comparisons of ACSC hospitalizations may also be undermined by differences in data availability.

Discrepancies in coding practices and disease classification systems may also affect the inter-country comparability. Some ACSC hospitalizations studies only take the primary diagnosis into analysis (57,64,269). For instance, the principal diagnosis recorded can be dehydration, a complication of diabetes, that may or may not be considered an avoidable condition, instead of the diabetes itself (37,268). How lower extremity amputation procedures are recorded can influence rate variations for diabetes across countries.

Different versions of the International Classification of Diseases (ICD) are used to record hospitalization data (264,267,268). There are some inconsistencies between the structures of different versions of the ICD applied (270). Six of the studies compare ACSC hospitalizations using codes from different ICD versions (21,108,264–266,268). In addition, data on the category level; i.e., the first three numeric or alphanumeric digits in the 9th and 10th version of the ICD, may not accurately describe the health condition of the patient (21). Eight studies describe the ICD codes used to identify the ACSC hospitalizations using the first numeric or alphanumeric digits (21,80,108,258,262,265,266,268). However, subcategory digits, useful to provide specific information of the disease or condition, are not always available or require manual extraction (21). This approach does not account for

comorbidities, e.g., mental health conditions, immunosuppressed status or low physical mobility. In order to overcome some of these challenges, an approach to estimate the proportion of avoidable ACSC hospitalizations by national practitioners has been developed (21).

Some initiatives have been taken to mitigate these challenges. Many countries have been working on improving the quality and comparability of hospitalizations data, focusing on coding practices, dataset structure and data specification, many times linked to payment and reimbursement mechanisms (60,271). The Organisation for Economic Co-operation and Development (OECD), for example, supports the use of linked data using a unique patient identifier, as they are more robust and comparable across countries (271). However, indicators based on linked data are often more complex to calculate. To deal with problems of misclassification in diagnosis coding or the use of different ICD versions, some studies have enlisted experts to review and validate codes (267,268).

Six studies adopt rigorous exclusion criteria to allow for comparability. Out of these six, four studies exclude cases of inter-hospital transfer (37,264,266,267), two studies exclude episodes in which patients died during the admission (37,265), and three studies exclude cases of admissions with any diagnosis code or major diagnostic category (MCD) for pregnancy, childbirth and the puerperium (ICD-9: codes 630-677; ICD-10: codes O00-O99; MCD:14) (266–268). However, not all countries have coding practices that would allow to apply similar exclusion criteria, for example, one study acknowledges that the exclusion of inter-hospital transfer could not be fully complied with by some countries (37). Ten studies analyze specific age groups, mostly adults (37,84,257,260–262,264,265,267,268). Two studies use data of more than one year to avoid the effect of seasonal variations (135,264), seven others to allow for longitudinal analysis (80,84,258,265–268). The use of data from different years requires appropriate interpretation and comparison of trends to account for changes in the coding practices and other disrupting factors.

Most studies calculate age and gender-standardized rates using different standardization methods and different reference populations to account for differences in population structure. Other variables controlled for and included in statistical models were ethnicity and comorbidities (135,264–266), however, these were only available at the individual-level. At the population level, studies also accounted for income, education level and rurality (135,264,265) as well as health services resources, such as density of physicians, primary health care centres and hospital beds (84,264).

In order to account for positive association between the availability of hospital beds and the hospitalization rates three studies include hospitalizations for all causes (264), or for conditions which admissions were non-preventable, non-elective or referral-sensitive e.g., appendicitis, gastrointestinal obstruction, hip fractures, lower-extremity joint replacements and organ transplants (135,267). Three studies account for the prevalence of a disease to explain variations across countries (108,111,266). All these adjustments, although beneficial for comparative analysis, are subject to the availability of data.

Findings emerging from the inter-country studies: contexts, systems and services

The concept of ACSC was introduced in the United States to analyze access and use of health services. All the reviewed studies find higher rates of ACSC hospitalizations in the United States of America compared to other countries (258,260–264) or to the OECD mean (37). Researchers associate these findings with barriers to accessing primary health care (135,263). Differences in ACSC hospitalizations odds are attributed to differences in ethnicity, benefits of being covered by health insurance and ecological factors measured through neighbourhoods by income level (135,264).

ACSC hospitalization rates were used to assess performance of primary health care in six studies which argue that a responsive primary health care is associated with lower rates of ACSC hospitalizations (21,84,111,265–267). In these studies, the quality of health services delivery was assessed through different dimensions such as access, coordination, continuity of care and efficiency.

The availability of general practitioners or primary health care facilities is not always positively associated with lower ACSC hospitalizations. The number of general practitioners in Italy and Germany, for instance, was not found to be statistically significant in its association with the ACSC hospitalizations (84). In London and New York, the density of primary health care physicians did not influence ACSC hospitalizations (264). On the contrary, the absence of general practitioners, in interaction with other variables, contributed to higher ACSC hospitalizations in some European countries (21). Despite the supply of health professionals is commonly used as a proxy for access to primary health care (92,255), the studies reviewed provide inconclusive information on how the supply of health workforce and health facilities could be acted upon to reduce ACSC hospitalizations.

There are no unidirectional results regarding whether ACSC hospitalizations are induced by the availability of hospital beds. For four studies, higher ACSC hospitalizations are closely related to greater hospital bed supply (21,80,108,262). One study on diabetes find that

hospital bed supply had a stronger effect on ACSC hospitalizations than continuity and coordination of care have (108). For others four studies, the density of hospital beds is not related to ACSC hospitalizations (135,264,267,268). Three out of these four studies included hospitalizations for all causes, for marker conditions or referral-sensitive conditions as controls (135,264,267). Marker conditions are those for which the probability of hospitalization is not influenced by ambulatory care, e.g. hospitalizations for appendicitis, gastrointestinal obstruction and hip fractures (135). These three studies found great differences between ACSC hospitalizations and hospitalizations for other conditions across countries (135,264,267).

The analysis of the reviewed studies illustrate how countries can respond differently to similar health interventions. Since the '90s, Italy implemented policies to reduce the number of hospital beds discouraging inappropriate hospitalizations. More recently, Germany applied a similar initiative to reduce the costs of the hospital sector but did not led to significant results (84). A more comprehensive and systematic approach to early detection of diseases, prevention programmes and self-management support explains differences between ACSC hospitalizations rates of Kaiser Permanente and Denmark (267). Following an aggressive chronic care policy promoting coordination of care and health education introduced in 2001, the rates for hospitalizations for diabetes have decreased consistently between 2002 and 2013 in Taiwan. A similar policy in Korea was introduced in 2003 but implemented at slower pace; with limited administrative support and scarce financial resources from local governments, has started to show results only after 2011 (265).

The populations epidemiologic profiles explain some of the variations for ACSC hospitalizations. For example, across 35 countries, Mexico presented some of the lowest age and sex-standardized rates of hospital admissions for asthma, chronic obstructive pulmonary disease and congestive heart failure (37). However, it presented more than twice the mean rate of OECD countries of hospitalization for diabetes. Diabetes is the leading cause of death and disability in Mexico (272). In fact, Mexico was the only Latin American country for which diabetes represented the highest proportion of ACSC hospitalizations (80).

The selection of conditions influences the outcomes of the inter-country comparison study. For example, Mexico, Korea, Turkey and Ireland report the lowest or higher ACSC hospitalization rates according to the condition chosen (37). Age and sex-standardized rates for diabetes varied 7-fold among OECD countries, 12-fold for congestive heart failure and 25-fold for chronic obstructive pulmonary disease (37). One study finds differences in trends

depending on the conditions studied. Trends in ACSC hospitalizations rates differ between acute and chronic conditions in Italy while in Germany, the increase is more drastic for chronic conditions (84). Aggregating the hospitalization rates for different conditions into one single index can level-out the differences. However, inter-country comparisons by single conditions allow a deeper understanding of the factors associated with deviations.

Two studies argue that the prevalence of diseases and health status do not explain differences in ACSC hospitalization rates. Older people in Hong Kong had better health indicators than their peers in London, but London showed lower ACSC hospitalizations for this age group (264). Differences in the prevalence of asthma and ischemic coronary conditions were only slightly higher in Denmark than in Portugal. However, the age and sex-standardized rates of ACSC hospitalizations in Denmark were nearly 3 times higher than in Portugal. Given that differences in the burden of diseases did not significantly affect rates, the authors believe that country specific factors influence health services delivery and explain the variations across countries (268).

There is a strong association between inequality and health status. Four of the reviewed inter-country studies found that people living in economically disadvantaged areas have higher probabilities of being hospitalized for ACSC (84,135,264,265). These findings, though, did not apply to four out of the five European countries analyzed in another study (268). Divergences in results regarding socioeconomic status can result from data availability and collection, conditions selected and method of analysis. Socioeconomic status as a proxy of people needs was mostly analyzed at regional level.

Table 6 provides an overview of the key information analyzed in the 18 studies and discussed in the sections above.

Table 6. Overview of the objectives, methods and findings of the 18 studies analyzed

Topic	Number of studies	Studies
Objective of Study		
Assess access to health care	3	(135,261,264)
Assess performance of health care	11	(21,37,268,84,108,111,262,263,265–267)
Compare ACSC hospitalizations	4	(80,257,258,260)
Setting		
Cities	3	(135,264,266)
Two countries	5	(84,260,261,265,267)
Three or more countries	10	(21,37,80,108,111,258,260,262,263,268)
Methods		
ACSC hospitalizations analysis		
Descriptive comparison of rates	8	(37,80,257,258,260–263)

Topic	Number of studies	Studies
Statistical models	9	(84,108,111,135,264–268)
Study design		
Cross-sectional	11	(21,37,264,108,111,135,257,260–263)
Longitudinal	7	(80,84,258,265–268)
Data source		
Administrative database	18	(21,37,261–268,80,84,108,111,135,257,258,260)
Conditions included		
Existing lists	7	(80,84,135,260–262,264)
One condition (diabetes)	3	(108,265,266)
Set of conditions	6	(37,111,257,263,267,268)
Different conditions for each country	2	(21,258)
Diagnosis codes		
ICD-9	7	(21,84,108,264–266,268)
ICD-10	11	(21,80,268,108,258,260,262,264–267)
Unclear ICD version	6	(37,111,135,257,261,263)
Diagnosis analyzed		
Principal only	11	(21,37,266,80,84,108,135,260,262,264,265)
Principal and secondary	3	(258,267,268)
Unclear	4	(111,257,261,263)
Exclusion criteria		
Inter-hospital transfer	4	(37,264,266,267)
Diagnosis codes or major diagnostic category for pregnancy, childbirth and the puerperium	3	(266–268)
Inpatient death	2	(37,265)
Specific age groups	10	(37,84,257,260–262,264,265,267,268)
Unclear / no exclusion criteria	4	(21,111,258,263)
Findings		
Responsive primary health care associated to lower rates of ACSC hospitalizations		
Yes	6	(21,84,111,265–267)
Inconclusive	1	(108)
Availability of hospital beds associated to ACSC hospitalizations		
Yes	4	(21,80,108,262)
No	4	(135,264,267,268)
Association between Availability of GP and ACSC hospitalizations		
Inverse	2	(21,135)
Mixed results	2	(264,266)
Non-significant results	2	(84,265)
Association between socioeconomic factors and ACSC hospitalizations		
Yes	4	(84,135,264,265)
Mixed results	1	(268)

Source: Elaborated by the authors

Findings emerging from the inter-country studies: policy implications and knowledge translation

The comparison of health system performance across countries has been increasingly stimulated by the growing availability of data. Some of the reviewed studies analyze clinical practice variations among ACSC hospitalizations rates (37,80,257,258,261–263) while others explore possible associations with contextual factors, mostly through statistical methods (84,108,111,135,264–268). The OECD Healthcare Quality Initiative uses admissions of ACSC to share and compare information on the performance of the health services across member countries (147).

The reviewed studies find high variability of ACSC hospitalizations across and within countries (37,84,268). The analysis of rates, trends and inter-country variations allow to identify possible improvements in the quality of care in addition to efficiency gains. In a context of limited resources and increasing health expenditure, the possibility of decreasing spending by avoiding unnecessary or inappropriate hospitalizations is relevant to the national health agendas worldwide. One of the studies, for example, estimates avoidable hospitalizations and associated costs for countries without available data by using trends of other countries (80). It could be argued that additional investment or more efficient allocation of existing resources towards strengthening primary health care would reduce ACSC hospitalizations and, consequently, decrease expenditure on the hospital care, which has notably higher individual costs (26,28) and increased patient safety risks (273).

One of the analyzed studies estimates that the 1.6 million ACSC hospitalizations in France had a total cost of 5 billion euros in 2010 (258). Another study estimates that ACSC hospitalizations accounted for 2.4% of the public health expenditure of 26 countries in the region of Latin America and the Caribbean in 2009 (80). Costs were estimated using unitary costs of the Brazilian public health system and adjusted by purchasing power parity in US dollars. Although the use of purchase power parity can be useful for inter-country comparisons (274,275), spending associated to ACSC hospitalizations across countries remains challenging. Notably, in addition to the above-described methodological challenges, prices represent the values reimbursed to hospitals rather than real costs; differences in clinical practice weight in the procedures reimbursed. Other two studies acknowledge that reduced ACSC hospitalizations can lead to reduced hospital care expenditures; these studies however, did not estimate nor compare ACSC hospitalizations costs between countries (111,266).

The factors associated to variations in performance have implications for health policies across countries. The relative success of specific health policies in Italy (84) and Taiwan (265), Kaiser Permanente (267), France and England (135,264) cannot be adopted by policy-makers without taking into account the contextual factors of each health system (79). There are many factors associated with ACSC hospitalizations which vary across countries and are sources of uncertainty. The transferability of policies and organizational characteristics is not, therefore, a straightforward process. For example, the reviewed studies are inconclusive regarding how the supply of general practitioners or of hospital beds affects ACSC hospitalizations (21,84,108,111,135,265,267).

Some studies compare countries with similar features. One study analysis Latin American countries at similar stages in the demographic and epidemiologic transition (80). Another study compares South Korea and Taiwan, both countries have health systems based on social health insurance schemes and similar cultural heritages (265). A study compares Italy and Germany, both European high-income countries (84). The inter-country comparisons can also derive from aspects of divergence: Italy and Germany adopted different health systems, South Korea and Taiwan have differences in the organization and financing of primary health care as well as in how health policies were implemented. The inter-country comparison of ACSC hospitalizations can focus on performance of the health systems: three studies discuss financial barriers to access health care the United States of America in comparison to other countries (135,262,264). Comparisons across health systems are useful since many challenges are common across countries: demographic and epidemiological changes, resource constraints and rising costs (79).

Discussion

Based on the above findings, three dimensions need to be accounted for in inter-country comparison of ACSC hospitalizations: methodological choices; population demographic and epidemiologic profiles and features of health services and systems. Table 7 provides an overview of the conceptual framework for inter-country comparisons of ACSC hospitalizations.

Table 7. Conceptual model for ACSC hospitalizations inter-country comparison

Methods				Population	System
Ambulatory care sensitive conditions	**Data**	**Analysis**	**Study design**		
Selection of condition including diagnostic codes	Representativeness	Unit of observation	Longitudinal vs cross-sectional analysis	Demographic structure	Gatekeeping role
Inclusion/exclusion criteria	Reliability	Unit of analysis	Retrospective vs prospective	Epidemiological profile	Payment of providers
Single vs multi conditions	Co-morbidities and severity	Metrics		Socioeconomic status	Availability of general practitioners
Multiple hospitalizations	Coding practice			Geographic distribution	Availability of inpatient beds
					Public-private mix

Selecting the ACSC

The selection of the ACSC depends on the demographic and epidemiologic profile and the scope of primary health care services of a given country. There is significant variation of rates of ACSC hospitalizations across countries depending on which conditions are selected (33,258,276,277). For this reason, there is need to define consistent inclusion and exclusion criteria of cases e.g. make explicit if inter-hospital transfers, multiple hospitalizations (readmissions) or death of patients during the admission or which diagnosis codes will be included for a certain condition. Inter-hospital transfers and inpatient deaths may indicate that the hospitalization was ultimately not avoidable (37). Some patients have multiple ACSC hospitalizations within a specific time frame. An option would be to count only one admission per patient if these are episode-based analysis. In any case, the methodological choice on how to account for these multiple hospitalizations related to a single patient would affect hospitalization-based rates (271). The inter-country comparison of one single condition can be useful for deciding on a specific policy while the analysis of several conditions illustrates features in the assessment of the performance of health services.

Accounting for data configurations- data

The representativeness of data needs to be accounted for in ACSC hospitalizations inter-country comparisons. Data may be limited to public funded activities or be only available for

a non-representative sample of the population. In some cases, hospitalizations compensate for inequities in access rather than clinical conditions e.g. social hospitalizations (161). Not all ACSC hospitalizations are avoidable, in many cases due to comorbidities or the complexity and severity of cases. Variations in coding practices across countries and the use of different versions of the ICD may be also considered.

Choosing between one or more snapshot- analysis

Another methodological choice that affects inter-country comparison is the type of analysis. The choice between longitudinal and cross-sectional analysis will depend on the research questions. For instance: longitudinal comparisons can be useful to analyze the impact of health policies or changes in clinical practices while cross-sectional comparisons can be useful to analyze performance or to estimate efficiency gains. Inter-country comparisons can also be used for estimating ACSC hospitalization rates. The analysis of descriptive statistics can be suitable when comparing a wide variety of countries; more advances statistical models allows for more accurate inferences regarding the countries analyzed. The methods of analysis will depend on the objectives and objects of comparison. Although no inter-country study that performed prospective analysis was found, it should be noted that adopting this type of analysis for inter-country comparison of ACSC hospitalizations needs to consider the complexity on data collection, limitation on external validity and necessary ethical considerations.

Observing units and analysing data- study design

Different units of observation and of analysis were found in the inter-country comparison of ACSC hospitalizations: by episode, patient, geographic area and provider. Different metrics are also used for analysis: ACSC hospitalizations can be measured in absolute number, rate, proportion of all hospitalizations or economic value.

Profiling the population

The profile of the population has significant impact in the analysis and need to be included in the inter-country comparison. These factors include the demographic structure of the population, its epidemiologic profile, socio-economic status and geographic distribution. The reviewed studies find high variability of ACSC hospitalizations across and within countries. The demographic and epidemiologic profiles of populations may explain some of these variations. Similarly, variations can be explained by the socioeconomic status of the population, since economically disadvantaged areas show higher rates of ACSC

hospitalizations. To include individual information on socioeconomic characteristics of patients in inter-country comparisons is challenging since most administrative data is essentially used for reimbursement purposes. However, linkages among different databases may be possible.

Featuring services and system- health system

Features of health services and system to account for include the gatekeeping role, remuneration schemes, workforce distribution, public/private mix, coordination across providers and settings as well as the financing and availability of the hospital care; as found in the studies analyzed. To account for features of health services and systems, including others outside the literature analyzed, can be challenging, mostly due to difficulties in defining measurements and the unavailability of data.

Mitigating inter-country comparison limitations

There are possible steps that can mitigate limitations and improve comparability. The selection of avoidable hospitalizations can include codes for certain comorbidities, e.g. the methodology developed by the Agency for Healthcare Research and Quality (60). Some countries use diagnosis-related groups to record hospitalizations and the level of severity can be accounted for. Experts can be consulted to estimate rates of avoidability (21,59). The use of single patient identifier on data can handle the existence of multiple counts of cases due to readmission. Comparing different populations may be possible by standardizing for age and sex and the controlling for prevalence rates and for socioeconomic status. The inclusion of hospitalizations for marker conditions in the analysis can help to account for the differences in overall hospitalization rates and practices among countries.

Limitations

The findings of this study have limitations. The inclusion criteria were narrowed to include full-text studies published in English. This resulted in the exclusion of two studies. One study, in German language, compares ACSC hospitalizations in Austria against other countries using OECD data but it did not discussed the method or interpret findings (278). The second study, in Portuguese language, presents ACSC hospitalizations of two Brazilian cities and Spain to illustrate differences in the context (279). These two excluded studies do not provide additional information to this study. The search-terms used might not have been comprehensive enough to retrieve all relevant studies. The scientific quality of the articles was not assessed. Despite these limitations, the approach adopted in this study allowed to

examine methodological choices and to identify mitigating measures for the inter-country comparison of ACSC hospitalizations. The study findings align with our hypothesis and expectations.

Conclusions

Inter-country comparisons can assist policy-makers pursuing better health outcomes. The use of ACSC hospitalizations has the potential to signal suboptimal performance of services delivery. Inter-country comparison can help explain variations and explore policy options to improve practice based on evidence. This study proposes a framework to illustrate relevant dimensions and factors that need to be accounted for in inter-country comparisons of ACSC hospitalizations. The dimensions include methodological choices regarding selection, quality, treatment and analysis of information; population´s demographic, epidemiologic and socio-economic profiles and features of the health services and system. Factors to account for include access and quality of primary health care, availability of health workforce and health facilities, health policy interventions, and inequalities.

Despite this study advances methodological aspects and contextual policy implications, ACSC hospitalizations inter-country comparisons require caution. Most studies concur that the opportunities to reduce ACSC hospitalizations are mostly related to strengthening primary health care and promoting access, especially among more vulnerable populations but there is no agreement on how to target the root-cause of ACSC hospitalizations.

5.2 Comparative research aspects on hospitalizations for ambulatory care sensitive conditions: the case of Brazil and Portugal

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Abstract

Hospitalizations for ambulatory care sensitive conditions have been used to measure access, quality and performance of the primary health care delivery system, as timely and adequate care could potentially avoid the need of hospitalization. Comparative research provides the opportunity for cross-country learning process. Brazil and Portugal have reformed their primary health care services in the last years, with similar organizational characteristics. We used hospitalization data of Brazil and Portugal for the year 2015 to compare hospitalizations for ambulatory care sensitive conditions between the two countries, and discussed conceptual and methodological aspects to be taken into consideration in the comparative approach. Brazil and Portugal presented similarities in causes and standardized rates of hospitalizations for ambulatory care sensitive conditions. There was great sensitivity on rates according to the methodology employed to define conditions. Hospitalizations for ambulatory care sensitive conditions are important sources of pressure for both Brazil and Portugal, and there are conceptual and methodological aspects there are critical to render the country-comparison approach useful.

Keywords

Ambulatory care sensitive conditions, avoidable hospitalization, comparative methodology.

Introduction

Some hospitalizations could be potentially avoided by adequate and timely management, treatment and interventions delivered in the ambulatory care setting. This group of conditions is commonly referred to as Ambulatory Care Sensitive Conditions (ACSC). These can include conditions preventable through vaccination; acute episodic illness sensible to early diagnosis and treatment; and chronic conditions that can be managed through medication, self-management or lifestyle interventions, thus preventing flare-ups (56,90,113).

The concept of ACSC was introduced in the United States in the 1990s (47), and since then, further research on this theme has been developed in other countries. The premise of ACSC is based on the potential preventability of hospitalizations these conditions present. Subsequently, hospitalizations for ACSC have been extensively used in health care research and health policy to measure access, quality and performance of the Primary Health Care (PHC) delivery system within the broader health system (21,37,84).

Comparative health system delivery research provides a valuable opportunity for countries to contrast their experience with others. Different countries might face similar health challenges, and the comparative approach can help explain the characteristics of health systems and health policies and their potential to solve difficult health care delivery problems (247). In the case of potentially avoidable hospitalizations, these challenges can include inequities in access and quality, lack of integration and traditional hospital-centricity of health systems. Brazil and Portugal have a historic relationship that reflects on similarities in language and culture, but have different socioeconomic levels, population composition and global burden of diseases distribution (252,280). Both countries have gone through recent reforms and expansion of PHC as a health policy. The objective of this study is to compare hospitalizations for ACSC in Brazil and Portugal, discussing conceptual and methodological aspects to be taken into consideration on doing so.

Background

About Ambulatory Care Sensitive Conditions

The analysis of potentially avoidable hospitalizations as an indirect indicator of PHC started in the United States (47) and subsequently expanded to other countries. One important aspect of the ACSC concept is that the definition of which hospitalizations are potentially avoidable varies according to what is expected of ambulatory care, according to the context

(33,130,160). The capacity of primary health care to prevent hospitalizations depends on many different factors, such as the way the health system is organized, practice patterns, supply of physicians, hospital bed availability, diseases' incidence, prevalence and severity and socioeconomic factors of the population (58,130,255,281). Different actors, such as researchers, health managers, policy makers and professionals, may also have a different concept of ACSC between them; according to the objective of the analysis (33). For these reasons, the definitions of which conditions are avoidable vary between settings.

Different definitions on what is deemed avoidable by the provision of adequate PHC lead to variations in methodologies to identify hospitalizations for ACSC. The utilization of different ACSC selection methodologies has significant effects on the comparison within and between countries and on its use as an indicator of PHC quality (33,277,282). The process of defining ACSC lists usually comprises systematic literature reviews and consensus opinions of experts. Currently different ACSC lists have been developed in countries, such as Australia (56), Brazil (57), Canada (32), Germany (59), Spain (54), United Kingdom (33) and United States (60). While the variation in methodologies hinders the possibility of international comparisons, it allows for an increased specificity to each countries' health system.

Table 8 shows conditions usually identified as sensitive to ambulatory care and their presence in some different lists, to illustrate how the definition of an avoidable hospitalization varies between methodologies. It is worth mentioning that this table contains broader identification of diagnostics, but specific disease coding and inclusion/exclusion criteria may vary between lists.

Table 8. Comparison between conditions present on different ACSC identification methodologies

Diagnosis	**Australia**	**Brazil**	**Canada**	**Germany**	**Spain**	**United Kingdom**	**United States**
Vaccine-preventable conditions	X	X			X	X	
Pneumonia	X	X		X	X	X	X
Tuberculosis		X			X		
Ear, nose and throat infections	X	X		X	X	X	
Urinary tract infection	X	X		X	X	X	X

Diagnosis	Australia	Brazil	Canada	Germany	Spain	United Kingdom	United States
Gastroenteritis or other intestinal infectious diseases	X	X		X	X	X	
Cellulitis and other skin conditions	X	X		X	X	X	
Nutritional deficiencies	X	X		X	X	X	
Dehydration	X	X			X	X	X
Dental conditions	X			X	X	X	
Pelvic inflammation	X	X			X	X	
Perforated/bleeding ulcer	X	X			X	X	
Congestive heart failure	X	X	X	X	X	X	X
Hypertension	X	X	X	X	X	X	X
Diabetes	X	X	X	X	X	X	X
Asthma	X	X	X		X	X	X
Chronic obstructive pulmonary disease (COPD) and bronchitis	X	X	X	X	X	X	X
Anaemia	X	X		X	X	X	
Angina	X	X	X			X	
Epilepsy	X	X	X		X	X	
Pregnancy and birth related conditions		X					
Mental and behavioural disorders due to use of alcohol or opioids				X			

These lists are comprised of conditions for which there is wide expert consensus that knowledge and technology exist to avoid the need for hospitalization, although it is not possible to avoid all hospitalizations. It is also important to distinguish between avoidable and adequate hospitalizations. Both concepts may apply simultaneously, once at the time of certain diagnosis the hospitalization in necessary, but it still could have been prevented in case of earlier and/or more effective ambulatory intervention. There is variation between lists of ACSC according to the versions of the ICD used, or even different codes for the same conditions in the same ICD version. In addition, there are differences between the structures of different versions of the ICD (270).

These lists may have different inclusion and exclusion of cases according to different criteria. For example, the Canadian methodology does not include people over 75 years. In addition, it only considers chronic conditions and also excludes hospitalizations that resulted in intra-hospital death of the patient, under the reasoning that the hospitalization was ultimately not

avoidable (32). The methodology in the United States only applies to people over 18 years old (60). It also excludes transfers from other health facilities, which can be relevant as local referral protocols might lead to the patient being hospitalized (160). In addition, some lists only consider the primary diagnosis; therefore not accounting for comorbidities. The AHRQ methodology accounts for some comorbidities. For example, it does not consider cases of COPD with any-listed ICD-9-CM diagnosis codes for cystic fibrosis and anomalies of the respiratory system as avoidable.

Some studies have questioned the use of ACSC as a performance indicator in the individual perspective, as they have found low agreement between what is considered avoidable by the lists and by case reviews performed by specialists (158). It has been suggest that the association between ACSC and PHC is not as clear as previously described, which may hinder its use as a performance indicator (157,158,283). In the macro perspective for comparative studies, the variation of crude ACSC rates between regions can be influenced by different age structures of the populations analyzed. The age and sex adjustment process, although allows better comparative analysis, does not alleviate completely the influence of different disease prevalence across populations. Despite its limitations, ACSC are extensively used in health research and by health managers, and have been promoted by national and international organizations (21,57,60,82,284).

Making the case for Brazil and Portugal

Brazil and Portugal have reformed their Primary Health Care as a public health policy, aiming to improve access, efficiency and quality, providing continuous care and increasing the satisfaction of patients and professionals. In both countries, the PHC is intended to be the first point of contact of users with the health system, providing health promotion, disease prevention and health management (39,165). The creation and implementation of Family Health Units (FHUs) was one of the major features of the reform in both countries. The FHUs have multidisciplinary teams providing community-based care, with a pay-for-performance system (165,183).

The National Health Service of Brazil and Portugal provide universal health care and services are financed primarily through tax payments. The decentralization is also a key feature of both health systems, defining that the management should be at the regional level. This organization seeks to improve service delivery and resource allocation, involving the community and reducing inequities (39,168).

In the context of health policy reforms and similarities on PHC between Brazil and Portugal, the comparison of hospitalizations for ACSC between both countries is an important and valuable opportunity for contrasting experiences and prompting cross-country learning. In general, there are few studies that compare avoidable hospitalizations between countries (84,135,258,267,268). These studies primarily compared developed countries and used, when possible, the same definitions of ACSC to compare age and sex-standardized rates between them.

The implications of using different methodologies to identify ACSC in different contexts can be further explored. The discussion of methodological aspects to be taken into consideration when performing comparative studies on ACSC can deepen the understanding of this indicator. This paper tries a different approach by comparing characteristics and rates of hospitalizations for ACSC in two countries and afterwards analysis how methodological options may influence the comparison between countries, which has not been done in past studies.

Methods

This descriptive study used hospitalization data of the year 2015. For Brazil the data source was the hospital admissions information system *[Sistema de Informações Hospitalares do SUS (SIH-SUS)],* and for Portugal it was the national hospitalization database from the ACSS *[Administração Central dos Serviços de Saúde]*. Initially, the methodology used to define ACSC hospitalizations was the Agency for Healthcare Research and Quality (AHRQ) of the United States, which identifies Prevention Quality Indicators (PQIs) (60). This list has a solid theoretical basis, clear and periodically revised methodology for inclusion and exclusion of cases, has adjustment for comorbidities and can be applied for both the 9th and 10th revision of the ICD (as data on hospitalization for Brazil and Portugal use different versions of the ICD). This methodology is widely used in the United States, has been adopted and adapted by different countries in Europe and is a common instrument on ACSC studies (285–287).

Secondly, descriptive statistics were used to present and compare age, sex and cause distribution of hospitalizations for ACSC in Brazil and Portugal. Age and sex-standardized hospitalization rates were calculated using the direct method, taking as a reference the world population prospect for 2015 of the United Nations Population Division (288). Crude and standardized rates were presented as number of hospitalizations per 100,000 people aged 18 or older.

Finally, some variations from the baseline scenario (the one obtained using the AHRQ methodology) were performed. These variations presented the effect on crude and standardized rates of hospitalizations per 100,000 adults in Brazil and Portugal. This was done according to the addition of conditions included in other lists to define ACSC, as well as the use of additional exclusion criteria. Table 9 shows the conditions present at the baseline scenario and the conditions added in the analysis, and their ICD codes, selected according to the other lists previously presented in Table 8.

Table 9. ICD coding of baseline scenario and additional diagnosis considered ACSC in others lists

Diagnosis	ICD 9-CM	ICD 10
Baseline scenario[1]		
Acute conditions		
Dehydration	276.5	E86
Bacterial pneumonia	481, 482.2, 482.4, 482.3, 482.9, 483, 485, 486	J13, J14, J15.2-J15.4, J15.7, J15.9, J16, J18.0, J18.1, J18.8, J18.9
Urinary tract infection	590.1-590.3, 590.8, 590.9, 595.0, 595.9, 599.0	N10, N11.9, N12, N15.1, N15.9, N16, N28.8, N30.0, N30.9, N39.0
Chronic conditions		
Hypertension	401.0, 401.9. 402-404	I10, I11.9, I12.9, I13.1, I16
Congestive heart failure	398.9, 402, 404, 428	I09.8, I11.0, I13.0, I13.2, I50.1-I50.4, I50.9
COPD or asthma in older adults	491- 494, 496	J41-J45, J47
Asthma in younger adults	493	J45
Diabetes short-term complications	250.1-250.3	E10.1, E11.0
Diabetes long-term complications	250.4-250.9	E10.2-E10.5, E10.8, E11.2-E11.5
Uncontrolled diabetes	250.0	E10.6, E11.6
Lower-extremity amputation among diabetics	250	E10.1-E11.9, E13
Additional conditions		
Vaccine-preventable conditions	032, 033, 037, 045, 055, 056, 072, 320.0	A27, A35, A36, A80, B05, B06, B26, G00.0
Tuberculosis	011-018	A150-A179
Ear, nose and throat infections	382, 461, 462, 463, 465, 472.1	H66, J01, J02, J03, J06, J31
Gastroenteritis or other intestinal infectious diseases	558.9	K52.8, K52.9
Cellulitis and other skin conditions	681, 682, 683, 686	L03, L04, L08

Diagnosis	ICD 9-CM	ICD 10
Nutritional deficiencies	260, 261, 262, 268.0, 268.1	E40, E41, E42, E43, E55.0, E64.3
Pelvic inflammation	614	N70, N73, N74
Perforated/bleeding ulcer	531.0-531.4, 531.6, 532.0, 532.2, 532.4, 532.6, 533.0, 533.2, 533.4, 533.6	K25, K26, K27
Anaemia	280	D50.1, D50.8, D50.9
Angina	411.1, 411.8, 413	I20, I24.0, I24.8, I24.9
Epilepsy	345	G40, G41

1. More details on the ICD coding for the baseline scenario can be found at the AHRQ website (60).

Results

An overview of hospitalizations for ACSC in Brazil and Portugal is shown in Table 10. In Brazil, 11,638,853 hospitalizations were registered in 2015; according to the AHRQ methodology, 836,873 (7.19%) of these hospitalizations were potentially preventable. Of the 1,000,186 hospitalizations registered in Portugal, almost 100,000 of them were considered sensitive to ambulatory care (9.94%). The crude rate of hospitalizations for ACSC for Portugal was more than double the rate for Brazil; however, the difference in age and sex-standardized rates is small (415 and 426 per 100,000 population for Brazil and Portugal, respectively).

Table 10. Overview of hospitalizations for ACSC, by country, 2015

	Brazil	**Portugal**
Adult Population (over 18 years old)	139,901,201	7,928,764
Total of hospitalizations	11,522,004	1,000,670
Total hospitalization rate (per 100,000 adults)	8,235.81	12,620.76
Number of hospitalizations for ACSC (% of total of hospitalizations)	836,837 (7.26%)	99,417 (9.93%)
Crude rate of hospitalizations for ACSC (per 100,000 population over 18 years old)	598.16	1,253.88
Age and sex-standardized rate of hospitalizations for ACSC (per 100,000 population over 18 years old)	415.86	426.61
Mean age of patients hospitalized for ACSC (standard deviation)	61.85 (19.93)	75.84 (14.54)
Mean length of stay in days for hospitalizations for ACSC (standard deviation)	5.69 (7.47)	10.08 (11.22)
Hospitalizations for ACSC resulting in intra-hospital death	71,930 (8.59%)	13,453 (13.53%)

Figures 3 and 4 present age and sex distribution and crude rates of hospitalization for ACSC. For both countries, potentially avoidable hospitalizations were concentrated among older age groups; however, this distribution was more intense for Portugal: more than 80% of all hospitalizations for ACSC were for patients older than 65 years. In Brazil, these were more equally distributed among age groups: 432,415 (51.68%) of all hospitalizations attributable to ACSC occurred in people over 65. Hospitalizations for ACSC in patients with less than 45 years represented 21% and 5% of all hospitalizations for Brazil and Portugal, respectively. Rates of hospitalization by age group are very similar between both countries for people aged 79 years or less, but it is much higher for Portugal among people aged 80 years or older.

According to gender of the patient, females represent around 53% of all hospitalizations for ACSC in both countries. Differences in distribution of hospitalizations between genders were more expressive in Brazil than in Portugal. Male rates of hospitalization are higher than female rates for people aged 55 years of older for both countries, reaching nearly 10,000 ACSC hospitalizations per 100,000 adults for men aged 80 years or older in Portugal.

Figure 3. Age and sex distribution and rates of patients admitted for ACSC, Brazil 2015

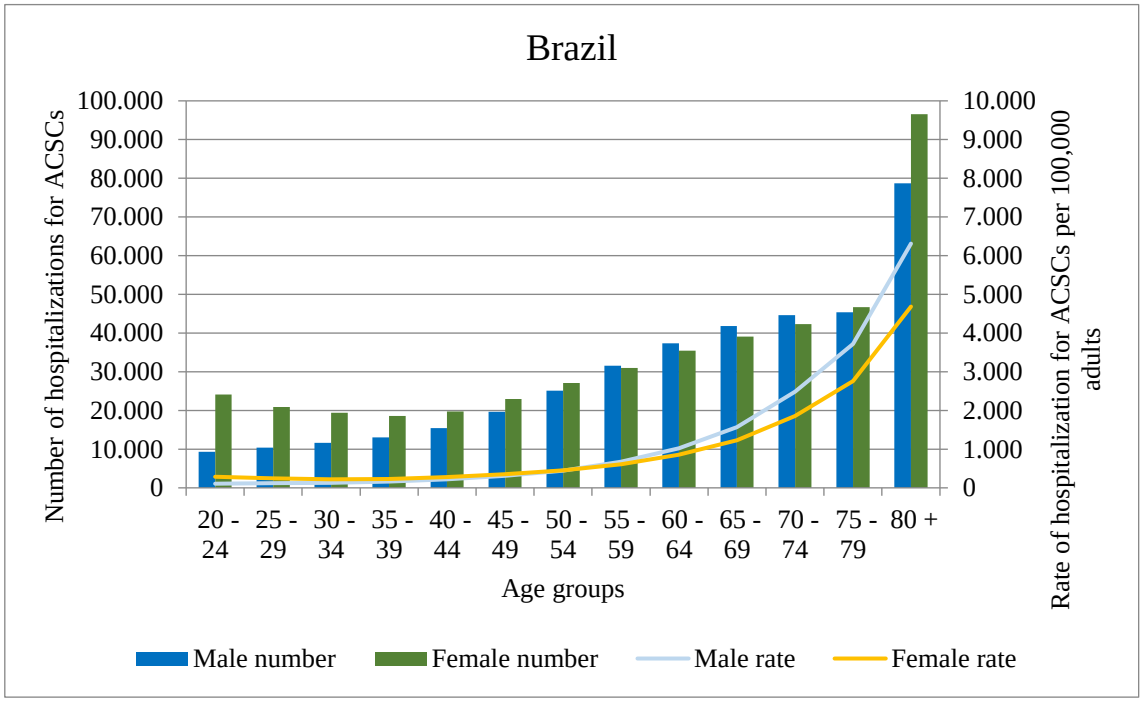

Figure 4. Age and sex distribution and rates of patients admitted for ACSC, Portugal 2015

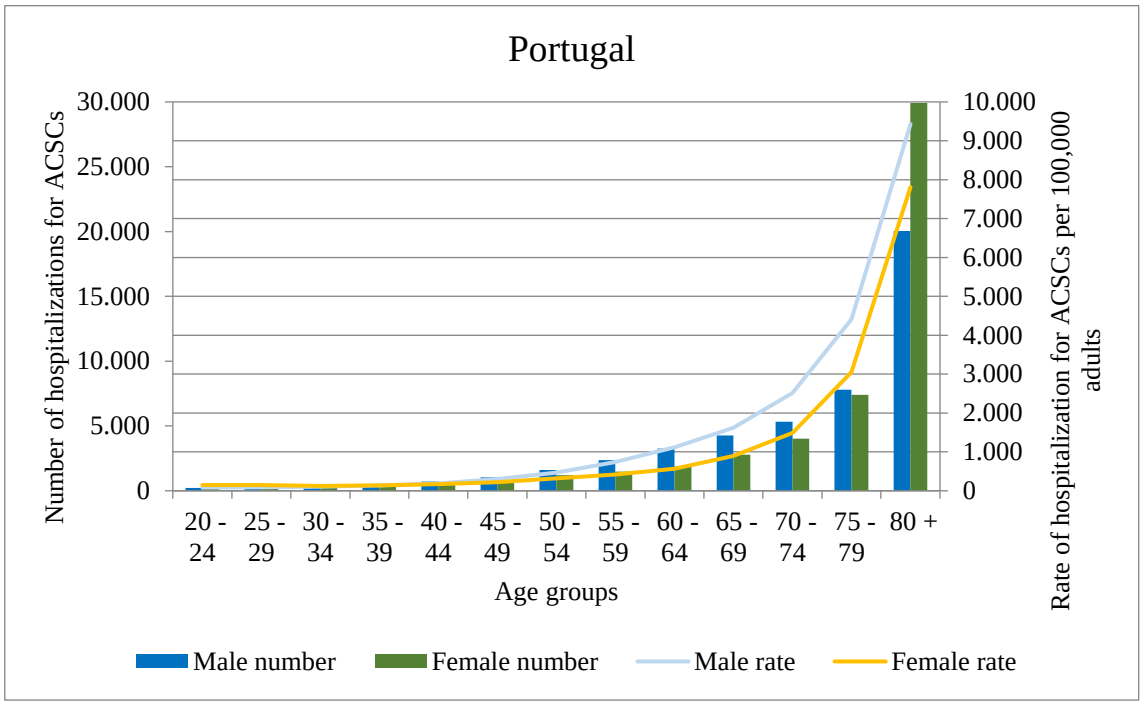

Figure 5 presents rates of ACSC hospitalizations according to causes. Pneumonia presented the higher rates among ACSC for both countries (223 and 450 hospitalizations per 100,000 adults for Brazil and Portugal, respectively). In Brazil, it was followed by urinary tract infection and COPD or asthma in older adults. In Portugal, it was followed by congestive heart failure and urinary tract infection. Avoidable hospitalizations related to diabetes presented low crude rates per 100,000 adults for both countries, when compared to the other conditions.

Figure 5. Crude rates of hospitalizations for ACSC by cause and country, 2015

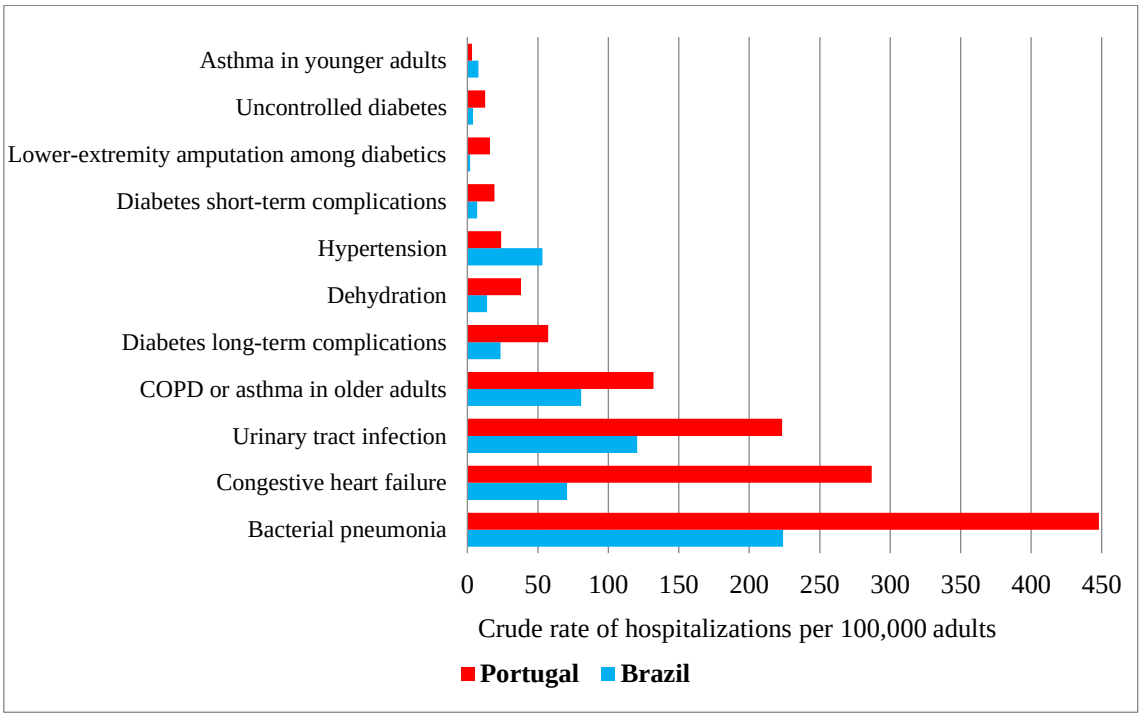

Table 11 presents variations on crude and standardized rates of the baseline scenario, according to inclusion of other conditions and differences on assumptions that are usually made in different methodologies for exclusion criteria on ACSC. In Brazil, if all considered conditions were included, the crude rate of hospitalizations for ACSC would increase 34%, reaching 802 hospitalizations per 100,000 adults. The single inclusion of angina would represent an increase of 16% on crude and standardized rates. The addition of all conditions for Portugal would result in a smaller increase, reaching 1,479 hospitalizations for ACSC per 100,000 adults (18% increase).

For the exclusion criteria presented, if only chronic conditions were considered as ACSC, the rates of crude and standardized hospitalizations would decrease almost 60% for both countries. As it was already presented, older people accounted for a significant share of hospitalizations for ACSC in Portugal. For this reason, rates of hospitalizations between both countries were very similar when people aged 75 years or older were excluded. If all exclusion criteria were applied simultaneously for both countries, the standardized rate of hospitalizations attributable to ACSC per 100,000 adults would decrease to 108.91 (-74%) and 105.66 (-75%) in Brazil and Portugal, respectively.

Table 11. Variations (in %) in rates of hospitalizations for ACSC according to different included conditions and exclusion criteria

	Brazil		Portugal	
	Crude Rate	Standardized Rate	Crude Rate	Standardized Rate
Baseline scenario	598.16	415.68	1,253.88	426.61
Inclusion of conditions				
Vaccine-preventable conditions	599.90 (+0.29%)	416.84 (+0.28%)	1,254.39 (+0.04%)	426.89 (+0.07%)
Tuberculosis	610.03 (+1.98%)	423.59 (+1.90%)	1,266.15 (+0.98%)	434.55 (+1.86%)
Ear, nose and throat infections	607.86 (+1.62%)	422.13 (+1.55%)	1,272.30 (+1.47%)	439.85 (+3.10%)
Gastroenteritis or other intestinal infectious diseases	602.10 (+0.66%)	418.34 (+0.64%)	1,272.99 (+1.52%)	435.70 (+2.13%)
Cellulitis and other skin conditions	624.51 (+4.41%)	433.50 (+4.29%)	1,300.24 (+3.70%)	451.08 (+5.74%)
Nutritional deficiencies	601.76 (+0.60%)	418.20 (+0.61%)	1,254.03 (+0.01%)	426.68 (+0.02%)
Pelvic inflamation	612.61 (+2.42%)	424.83 (+2.20%)	1,263.95 (+0.80%)	434.88 (+1.94%)
Perforated/bleeding ulcer	606.08 (+1.32%)	421.12 (+1.31%)	1,279.75 (+2.06%)	437.48 (+2.55%)
Anaemia	603.58 (+0.91%)	419.41 (+0.90%)	1,272.49 (+1.48%)	433.82 (+1.69%)
Angina	694.55 (+16.11%)	483.14 (+16.23%)	1,287.67 (+2.69%)	440.84 (+3.34%)
Epilepsy	620.69 (+3.77%)	430.82 (+3.64%)	1,293.57 (+3.17%)	450.49 (+5.60%)
All conditions added	802.05 (+34.09%)	555.12 (+33.55%)	1,478.76 (+17.93%)	546.15 (+28.02%)
Exclusion criteria				
Acute conditions (1)	241.49 (-59.63%)	167.83 (-59.62%)	544.52 (-56.57%)	190.42 (-55.36%)
People over 75 years (2)	422.08 (-29.44%)	276.17 (-33.56%)	433.04 (-65.46%)	225.92 (-47.04%)
Hospitalizations that resulted in death (3)	546.78 (-8.59%)	378.87 (-8.86%)	1084.22 (-13.53%)	380.34 (-10.85%)
(1;2)	168.13 (-71.89%)	114.15 (-72.54%)	215.81 (-82.79%)	109.32 (-74.37%)
(1;3)	226.47 (-62.14%)	157.18 (-62.19%)	493.75 (-60.62%)	176.52 (-58.62%)
(2;3)	388.32 (-35.08%)	260.32 (-37.37%)	407.13 (-67.53%)	214.20 (-47.79%)
(1;2;3)	160.53 (-73.16%)	108.91 (-73.80%)	207.49 (-83.45%)	105.66 (-75.23%)

Discussion

One important finding in this study was the great difference between Brazil and Portugal in crude rates, but very similar values for standardized rates. There was a significant disparity on the age distribution of people hospitalized for ACSC in Brazil and Portugal, which was behind these dynamics of rates. There are different levels of avoidability according to patient and disease characteristics (21). Age is a factor commonly associated to hospitalizations for ACSC (103,120,122), as there is increased prevalence of chronic conditions, severity and comorbidity in older population. To not consider hospitalizations among older people as avoidable would lead to more than half of hospitalizations identified as ACSC in Portugal to be deemed not avoidable. In fact, the new crude rate of hospitalizations for ACSC in Portugal would almost the same as for Brazil (464 and 422 per 100,000 population, respectively).

Demographic characteristics of populations are also reflected in the analysis of ACSC by genders, as women represented more than half of all avoidable admissions for older age groups in both countries. These results can carry health policy implications on important demographic risk groups to focus on. In Portugal, for example, 30% of all hospitalizations for ACSC occurred in women aged 80 or older. Another similarity found between Brazil and Portugal was in the distribution of main causes of hospitalizations. Pneumonia, urinary tract infection, heart failure and COPD or asthma in older adults were the most significant causes of avoidable hospitalizations in both countries; this creates the opportunity of shared learning between Brazil and Portugal for specific disease interventions in the ambulatory care setting.

Portugal presented higher crude rate of hospitalizations for ACSC than Brazil, and also presented higher rates for all hospitalizations. Commonly, most developed countries have higher hospital discharge rates than less developed countries (37). In general, there is also a difference in hospital beds supply between these countries; in 2015, nearly all OECD countries (expect Chile and Mexico) had more hospital beds per 1,000 population than less developed countries, namely Brazil, Colombia, India, Indonesia and South Africa (37). Portugal and other OECD countries have decreased the number of hospital beds following advances in medical technology and an increase in the number of day surgery. This reduction has also been driven by the need to reduce public spending on health and the heavy reliance of the health care system on hospital care (183). Brazil has significant inequalities in socioeconomic development and levels of health services supply (289), as well as an increasing number of hospitalizations in the private sector (171), making it hard to assess the adequateness of hospital care for the country as a whole.

Hospitalization rates are influenced by the provision of hospital bed, health care model, as well as epidemiology of diseases, socioeconomic status of the population and other factors (84). The adjustment for all factors when analyzing hospitalizations for ACSC may not be feasible, therefore this has to be taken into consideration when comparing rates of hospitalizations between settings. Table 12 presents characteristics of the public health services delivery in Brazil and Portugal that may influence differences in rates of hospitalizations (total and for ACSC). Portugal presented higher physician supply and higher number of consultations per 100,000 habitants than Brazil, both for PHC and for hospital care. As already commented, Portugal presented higher supply of hospital beds than Brazil.

Table 12. Characteristics of public health services delivery, by country, 2015

	Brazil	Portugal
Number of physicians in PHC per 100,000 hab.	26.05	72.08
Number of PHC consultations per 100,000 hab.	191.50	260.33
Number of physicians in hospitals per 100,000 hab.	79.49	194.17
Number of hospital consultations per 100,000 hab.	102.13	122.08
Number of hospital beds per 100,000 hab.	153.62	223.65

Sources: DATASUS/Ministry of Health website for Brazil (http://www2.datasus.gov.br/DATASUS/index.php?area=02). Statistics Portugal and PORDATA for Portugal (https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_base_dados and https://www.pordata.pt/Tema/Portugal/Sa%C3%BAde-12).
Note: The last year of available data for number of physicians in PHC and hospitals for Portugal was 2012.

The conditions that compose different ACSC lists are selected based on what can be considered avoidable according to the setting. One might argue that potential preventability varies across different demographic groups, age strata, among others. But ultimately, there are some conditions for which there is wide expert consensus that, at least in some situations, potential preventability of admissions is present.

Different methodologies of ACSC can reflect what are the objectives of PHC and the health care services and their priorities. Brazil and Portugal face different challenges regarding the health of the population. In Portugal the global burden of disease is mostly composed by noncommunicable diseases, while a significant share of the global burden of disease in Brazil comes from infectious diseases and external causes (252). This contrast can reflect on the comparison of ACSC between countries: most of the conditions included in the AHRQ methodology are noncommunicable diseases, and Portugal presented higher rates of hospitalizations for ACSC than Brazil. These aspects of health system organization and epidemiology lead to the question of which lists should be used according to the context.

It is important to notice that a list of ACSC for the Brazilian context was developed in 2009 (57). The list has an emphasis on conditions that can be managed in primary care (and not any ambulatory care service) it includes several infectious diseases not included in lists developed in higher income countries (112). Currently there is no country-specific ACSC list in Portugal, but the National Health System includes hospitalizations for ACSC as an indicator of health gains in the commissioning process with PHC (290). The conditions included are asthma, COPD, pneumonia, congestive heart failure, angina, hypertension and diabetes. Reports by the OECD commonly use asthma, COPD, congestive heart failure and diabetes to compare avoidable hospitalizations between countries, as an indicator of quality and outcomes of care (37).

The results in this study showed that there was significant variation on rates of ACSC according to the methodological choices made. Standardized rates of hospitalizations for ACSC would be around 30% higher in both countries if all conditions considered in other lists were added to the baseline scenario. In fact, standardized rates in Brazil would be slightly higher than rates in Portugal. The variations according to the addition of each condition are a reflection of each country's context. For example, the inclusion of vaccine-preventable diseases and nutritional deficiencies would represent a minimal increase in rates for Portugal, when compared to Brazil. These conditions are relevant in the public health agenda in Brazil, and are included in the country-specific list (57).

If hospitalizations for ACSC which resulted in death were excluded from the analysis, the standardize rate per 100,000 adults would decrease 9 and 11% in Brazil and Portugal, respectively. The interpretation of this criterion for exclusion is paradoxical. On the one hand, the death could indicate that not only was ambulatory not effective enough to prevent the occurrence of such admissions, but hospital care might also have been inadequate, as mortality has been used as an indicator of hospital performance assessment (291). On the other hand, it might indicate a more complex or severe situation, therefore with a lower level of avoidability, hindering the usefulness of ACSC as a PHC quality indicator.

Previous studies in Brazil and Portugal have used different methodologies to define ACSC and to analyze the association with quantitative measures of PHC. Longitudinal studies in Brazil have found that, for most of the country, rates of ACSC hospitalizations have been declining, despite contextual increases in some specific regions and for certain conditions (112,292,293). This reduction has been associated to the expansion of FHUs, even when controlled for socioeconomic factors (112,149). In Portugal, there are mixed findings about

the association between aspects of the health system and hospitalizations for ACSC; in the north of the country, the higher development of FHU is positively associated with higher rates of admissions for ACSC, which is contrary to what is expected (294). Conversely, higher primary care physicians supply was associated to lower ACSC hospitalization rates in mainland Portugal (285).

Conclusion

Hospitalizations for ACSC are important sources of pressure for the health system and society in general for both Brazil and Portugal, with similarities in causes and standardized rates. Socioeconomic and health services factors have to be taken into consideration when comparing hospitalizations for ACSC between countries. How to define hospitalizations that could be avoided is critical, as it influences the assessment of PHC and can affect the comparative approach, making the valuable cross-country learning process more difficult. Further research should be developed to understand more intricately the interactions between the several determinants of ACSC hospitalizations, informing interventions to reduce avoidable hospitalizations, thus bringing positive effects for individuals and the population.

5.3 Direct and lost productivity costs associated with avoidable hospital admissions

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Abstract

Background

Hospitalizations for ambulatory care sensitive conditions are commonly used to evaluate primary health care performance, as the hospital admission could be avoided if care was timely and adequate. Previous evidence indicates that avoidable hospitalizations carry a substantial direct financial burden in some countries. However, no attention has been given to the economic burden on society they represent. The aim of this study is to estimate the direct and lost productivity costs of avoidable hospital admissions in Portugal.

Methods

Hospitalizations occurring in Portugal in 2015 were analyzed. Avoidable hospitalizations were defined and their associated costs and years of potential life lost were calculated. Direct costs were obtained using official hospitalization prices. For lost productivity, there were estimated costs for absenteeism and premature death. Costs were analyzed by components, by conditions and by variations on estimation parameters.

Results

The total estimated cost associated with avoidable hospital admissions was €250 million (€2,515 per hospitalization), corresponding to 6% of the total budget of public hospitals in Portugal. These hospitalizations led to 109,641 years of potential life lost. Bacterial pneumonia, congestive heart failure and urinary tract infection accounted for 77% of the overall costs. Nearly 82% of avoidable hospitalizations were in patients aged 65 years or older, therefore did not account for the lost productivity costs. Nearly 84% of the total cost comes from the direct cost of the hospitalization. Lost productivity costs are estimated to be around €40 million.

Conclusion

The age distribution of avoidable hospitalizations had a significant effect on costs components. Not only did hospital admissions have a substantial direct economic impact, they also imposed a considerable economic burden on society. Substantial financial resources could potentially be saved if the country reduced avoidable hospitalizations.

Keywords

Hospital admissions; Avoidable admissions, Ambulatory care sensitive conditions; Cost analysis

Background

Ambulatory care sensitive conditions (ACSC) are health conditions for which hospital admission could be prevented by timely and adequate ambulatory care (47,90). Hospitalizations for ACSC have been extensively used in health care research and health policies to assess accessibility, quality and performance of the primary health care, as timely and effective primary care could potentially avoid hospitalization (21,36). Previous studies in the field have mostly analyzed rates and trends of hospitalizations for ACSC and the association with different contextual factors; less attention has been given to the economic and social impact these hospitalizations produce.

Direct costs of admissions for ACSC were estimated in previous studies in Ireland (295), the United Kingdom (33,82), France (258) and Brazil (43,112), using the official prices of hospitalizations in each country's respective national health system. Two studies in Portugal used different ACSC definition methodologies to estimate costs associated with avoidable hospital admissions (296,297); the first (in 2007) used the methodology of Agency for Healthcare Research and Quality (AHRQ) (36), while the second (in 2014) used the ACSC list developed by Caminal (54). These studies found that the direct costs of avoidable hospital admissions amounted to approximately €200 million and €250 million, respectively. Both studies found that around 10% of all hospitalizations in Portugal were potentially avoidable (296,297), indicating that there is room for improvement in the country regarding ACSC.

Of the limited number of studies that estimated the costs of avoidable hospitalizations, none of them included estimations of costs for lost productivity, lost wages and premature death. Although the findings of existing studies already indicate that avoidable hospitalizations create a substantial direct financial burden on health expenditures, considering lost productivity costs can further illustrate how much economic pressure such hospitalizations present.

Analysis of the economic burden on society associated with avoidable hospitalizations provides valuable information for planning of health services and allocation of resources. Moreover, as such hospitalizations could have potentially been avoided in the ambulatory care setting; this analysis indicates the potential of saving costs by reducing hospitalizations for ACSC. The aim of this study was to estimate direct and lost productivity costs of hospitalizations for ACSC in Portugal. This country provides universal health care, with

services financed primarily through tax payments. The primary health care is intended to be the first point of contact of users with the health system.

Methods

Data source and sample definition

This study used the hospitalization data base provided by the Portuguese Central Administration of the Health System for the year 2015. A total of 1,000,670 hospitalizations were registered in continental Portugal in 2015. For each hospital admission, the inpatient data used in this study were age, sex, principal and secondary diagnosis (according to ICD-9-CM code), diagnosis-related groups (DRGs), length of stay and reason for end of the hospitalization.

The definition of which hospitalizations were for ACSC was determined according to the AHRQ methodology, which uses the codes of principal and secondary diagnosis, for different versions of the ICD (36). This list has a strong theoretical basis for its composition and a well-defined methodology for inclusion of cases and exclusion of some comorbidities (36). The AHRQ guidelines provide more details in disease coding and inclusion/exclusion criteria (36).

Cost estimation

The costs associated with hospitalizations for ACSC were both direct and from a socioeconomic perspective, incurred by lost productivity. The identification of direct costs was done in the total of hospitalizations. The valuation was done according to the number of hospital admissions classified as avoidable. For the monetization of direct costs, official hospital inpatient admission prices were used as proxy for costs. Prices are defined by DRGs and severity of the condition, according to values published by the Ministry of Health (298). The prices correspond only to the hospital admission and, therefore did not include other pre- and post-hospitalization expenses.

Lost productivity costs were identified for absenteeism and premature death. The valuation was based on to the length of stay and years of potentially productive life lost for avoidable hospitalizations. In order to monetize productivity losses, the human capital approach was applied. In this methodology, the value to society of potentially lost production (either due to absenteeism or premature death) is estimated by market wages (299,300). The human capital approach has been used in the literature to estimate lost productivity costs of

morbidity and/or mortality for cancer (300–302), asthma (303), *E. coli* infections (304), visual impairment (305) and road traffic accidents (306), to name a few.

For all hospitalizations for ACSC, the estimated absenteeism cost was estimated as the value of days of productivity lost, calculated as the length of stay multiplied by the daily wage (the monthly mean wage of the region divided by 30 days, as done by previous studies (307–309), taking into account whether the person was of working age (between 18 and 64 years of age), the probability of the patient being part of the labour force (based on labour force participation) and being employed (based on the unemployment rate).

For avoidable hospitalizations in which the patient died in the hospital, premature deaths are understood as potentially preventable hospitalization-related deaths that occur at working age have a cost of lost productivity that extends to retirement age. The estimated cost of the lost productivity for such premature death was also calculated. In this case, the years of potentially productive life lost were calculated as the difference between the age of the patient and the retirement age (considered 65 years old), and multiplied by the annual mean local wage. Monthly wage, unemployment and labour force participation were specific according to the gender of the patient for both absenteeism and premature death, to reflect the gender differentials in the labour market. These data were obtained at the municipal level from Statistics Portugal (SP).

The methodology used for lost productivity costs only accounts for the working-age population. While it has to be acknowledged that retired people contribute to the production of the country, this was not monetized in this study. For equity, the impact of avoidable hospitalizations in the whole population was taken into consideration. Therefore, this impact was considered illness burdens instead of lost productivity costs. Years of potential life lost (YPLL) were calculated to quantify the burden imposed on society by avoidable hospital admissions. YPLL were calculated to represent the non-financial impact these hospitalizations present. For hospitalizations that ended in intra-hospital death, YPLL were calculated as the difference between the age of the patient and the patient's life expectancy based on their age and gender. The data source was SP.

Statistical analysis

Both crude and standardized hospitalization rates were calculated. Age and sex-standardized hospitalization rates were calculated using the direct method, taking as a reference the 2015 European population prospect from the United Nations Population

Division (310). Descriptive statistics were used to present the distribution of hospitalizations for ACSC by condition, age group, mean length of stay and the share of intra-hospital deaths.

For direct, lost productivity and total costs, cost per person and per hospitalization were calculated. For the direct and total costs per person, the population aged 18 or over of each country was the denominator. For the cost of lost productivity per person, the denominator was people aged 18 to 64 years, as people aged 65 years or older were considered not part of the workforce and therefore did not have associated lost productivity costs.

Sensitivity analysis

Sensitivity analysis was done according to variations in the variables retirement age and age limit, presented as percent variation from base-case values. The retirement age used as the base-case was 65 years, for consistency and to facilitate comparison. Variations were made according to the respective official retirement ages for basic and minimum pensions in Portugal in 2015, which was 66 years.

Some other methodologies that identify hospitalizations for ACSC limit the inclusion of older age groups (32,311), as clinical complexity and increasing prevalence of comorbidities makes classifying hospitalizations as avoidable problematic for this population. Therefore, another variation in parameters for the sensitive analysis was to limit the definition of hospitalizations for ACSC to those below 75 years. Both one-way (varying one parameter at a time) and multi-way (varying different parameters simultaneously) sensitivity analysis were performed. Costs per capita according to the variation on each parameter were also presented.

Results

Overview of hospitalizations for ACSC

Table 13 shows an overview of hospitalizations in Portugal. A total of 99,417 hospitalizations were attributable to ACSC, representing 10% of the total hospital admissions registered in 2015. Portugal presented crude and standardized rates of 1,254 and 851 hospitalizations for ACSC per 100,000 adults, respectively.

Hospitalizations for ACSC were disproportionally concentrated in older-age groups (>65 years), accounting for more than 80% of them. The mean age of patients hospitalized for ACSC was 76 years (SD=14.5) and the mean length of stay was 10 days (SD=11.2). Women

accounted for 52% of avoidable hospital admissions. Around 13.5% of the hospitalizations attributable to ACSC ended with intra-hospital death. The most frequent cause of hospital admission was pneumonia (35.5%), followed by congestive heart failure (22.8%) and urinary tract infections (17.1%). Avoidable hospitalizations led to 109,641 YPLL.

Table 13. Overview of population age distribution, overall hospitalizations and hospitalizations for ACSC, Portugal, 2015

	Portugal
Total number of hospitalizations	1,000,670
Number of hospitalizations for ACSC	99,417
Hospitalizations per ACSC[a]	
Bacterial pneumonia	35,523 (35.54%)
Congestive heart failure	22,753 (22.76%)
Hypertension	1,896 (1.90%)
Chronic obstructive pulmonary disease (COPD) or asthma in older adults	10,470 (10.48%)
Asthma in younger adults	265 (0.27%)
Urinary tract infection	17,704 (17.71%)
Diabetes long-term complications	4,541 (4.54%)
Diabetes short-term complications	1,521 (1.52%)
Uncontrolled diabetes	993 (0.99%)
Lower-extremity amputation among diabetics	1,266 (1.27%)
Dehydration	3,019 (3.02%)
Hospitalizations for ACSC per total of hospitalizations	9.93%
Rate of hospitalizations for ACSC (per 100.000 population over 18 years old)	1,253.88
Age and sex-standardized rate of hospitalizations for ACSC (per 100.000 population over 18 years old)	850.60
Hospitalizations for ACSC per sex	
Male	47,548 (47.83%)
Female	51,869 (52.17%)
Hospitalizations for ACSC per age group	
18-44 years	4,455 (4.49%)
45-64 years	13,573 (13.66%)
65+ years	81,389 (81.87%)
Mean age of patients hospitalized for ACSC (standard deviation)	75.84 (14.54)
Mean length of stay in days for hospitalizations for ACSC (standard deviation)	10.08 (11.22)
Hospitalizations for ACSC with death outcome (% of all hospitalizations for ACSC)	13,453 (13.53%)
Per sex and age group	

Male	6,732 (50.04%)
18-44 years	43 (0.32%)
45-64 years	492 (3.66%)
65+ years	6,197 (46.06%)
Female	6,721 (49.96%)
18-44 years	30 (0.22%)
45-64 years	194 (1.44%)
65+ years	6,497 (48.29%)
Years of potential life lost	109,641

[a] Some discharges due to lower extremity amputation also accounted for other diabetes-related ACSC

Costs related to hospitalizations

Table 14 presents the estimation of costs related to hospitalizations for ACSC in Portugal. The total estimated cost associated with admissions for ACSC was €250 million. Nearly 84% of this total cost comes from the direct cost of the hospitalization itself. Lost productivity costs are estimated to be around €40 million. Most of this value was due to premature death (€37.4 million). Absenteeism corresponded to 1% of the total estimated costs (€2.6 million). The total cost related to ACSC corresponded to €31.53 per capita. This value represented the financial burden that was imposed on each adult inhabitant that could potentially have been avoided if ambulatory care was more effective.

Table 14. Estimated costs associated to hospitalizations for ACSC, in €, 2015

	Total	Direct costs	Lost productivity	
Cost in €	250,064,177	210,026,755	40,037,422	
			Absenteeism	*Premature mortality*
			2,631,311	*37,406,111*
% of total cost		83.99%	16.01%	
Cost per person*	31.53	26.49	6.83	
Cost per hospitalization for ACSC*	2,515.31	2,112.58	2,220.85	

* For total and direct costs, the denominator was population over 18 years old. For lost productivity, the denominator was population between 18 and 64 years old.

Table 15 details the cost of hospitalizations for each ACSC and by gender, and YPLL. Bacterial pneumonia accounted for a significant share of overall costs (€106 million; 41.9%), corresponding to a higher percentage than this condition represented in number of hospitalizations for ACSC (Table 13). Bacterial pneumonia had a value of 63,905 YPLL,

which is more than half of the YPLL for all ACSC combined. Congestive heart failure and urinary tract infection were also important sources of costs associated with avoidable hospital admissions. The order in which these conditions account for total number of hospitalizations (Table 13) is the same as the order of cost distribution. Dehydration and bacterial pneumonia had the highest percentage of lost productivity representing total costs. These conditions presented the highest mortality rates among all ACSC.

Table 15. Cost distribution and composition by ACSC and sex, in €, 2015

ACSC	Total Costs (% all ACSC costs)	Direct costs (% from total costs)	Lost productivity (% from total costs)	Mean total costs (95% CI)	Death rate	YPLL	Total costs Males (% all ACSC costs)	Total costs Females (% all ACSC costs)
Bacterial pneumonia	106,306,862 (41.90%)	80,546,077 (75.77%)	25,760,785 (24.23%)	2,992 (2,896; 3,089)	21.20%	60,570	62,181,998 (24.51%)	44,124,864 (17.39%)
Congestive heart failure	59,334,934 (23.38%)	54,247,983 (91.43%)	5,086,951 (8.57%)	2,608 (2,545; 2,670)	12.12%	21,539	27,690,862 (10.92%)	31,644,073 (12.47%)
Hypertension	3,109,537 (1.23%)	2,953,911 (95.00%)	155,626 (5.00%)	1,640 (1,507; 1,773)	5.54%	726	1,571,535 (0.62%)	1,538,003 (0.61%)
COPD or asthma in older adults	22,618,306 (8.92%)	19,984,570 (88.36%)	2,633,735 (11.64%)	2,160 (2,067; 2,254)	6.87%	6,913	14,215,817 (5.6%)	8,402,488 (3.31%)
Asthma in younger adults	444,844 (0.18%)	422,311 (94.92%)	22,573 (5.08%)	1,681 (1,205; 2,157)	0%	0	189,805 (0.07%)	255,667 (0.10%)
Urinary tract infection	29,616,268 (11.67%)	26,741,082 (90.29%)	2,875,186 (9.71%)	1,673 (1,623; 1,722)	8.32%	11,785	11,887,808 (4.69%)	17,728,460 (6.99%)
Diabetes long-term complications	12,815,990 (5.05%)	11,598,869 (90.50%)	1,217,121 (9.50%)	2,822 (2,670; 2,975)	4.54%	2,241	7,941,403 (3.13%)	4,874,587 (1.92%)
Diabetes short-term complications	3,146,821 (1.24%)	2,700,532 (85.82%)	446,290 (14.18%)	2,069 (1,828; 2,310)	7.76%	1,212	1,405,176 (0.55%)	1,741,645 (0.69%)
Uncontrolled diabetes	1,352,185 (0.53%)	1,304,232 (96.45%)	47,954 (3.55%)	1,362 (1,304; 1,419)	2.52%	218	590,309 (0.23%)	761,876 (0.30%)
Lower-extremity amputation among diabetics	9,031,819 (3.56%)	8,329,937 (92.23%)	701,883 (7.77%)	7,134 (6,734; 7,535)	12.16%	1,707	5,643,650 (2.22%)	3,388,170 (1.34%)
Dehydration	5,913,323 (2.33%)	4,565,029 (77.20%)	1,348,294 (22.80%)	1,959 (1,722; 2,196)	14.08%	3,345	2,959,256 (1.17%)	2,954,067 (1.16%)
Acute ACSC	141,836,453 (56.72%)	111,852,188 (78.86%)	29,984,265 (21.14%)	2,521 (2,457; 2,586)	16.76%	75,880	77,029,061 (30.80%)	64.807.392 (25.92%)
Chronic ACSC	108,227,724 (43.28%)	98,174,566 (90.71%)	10,053,157 (9.29%)	2,509 (2,464; 2,554)	9.32%	33,761	56.941.238 (22.77%)	51,286,486 (20.51%)

Sensitivity Analysis

Table 16 presents the results of the sensitivity analysis. Extending the retirement age from 65 to 66 years led to an increase of 12% on costs associated with lost productivity in Portugal. The exclusion of people aged 75 years or older had a high impact on the estimation of direct costs, which reduced by 68%. The simultaneous variation in both parameters led to a 55% decrease in estimated total costs associated with hospitalizations for ACSC. In this case, 39.6% of total costs were due to lost productivity.

Table 16. Sensitivity analysis results. Changes from Base-case, in %, according to different parameters on retirement age and age exclusions

	Direct cost	Lost productivity	Total
Base-case (in €)	**210,026,755**	**40,037,422**	**250,064,177**
Retirement age	0.00	+11.81	+1.89
Age limit			
Exclusion ≥ 75 years	-67.50	0.00	-56.69
Multi-way (retirement age and age limit)	-67.50	+11.81	-54.80
Total costs per population aged 18 years or older (in €)			
Base-case			31.53
Retirement age variation			32.13
Age limit variation			13.66
Multi-way variation			14.25

Discussion

Key findings

Hospitalizations for ACSC involve high costs to both the health system and to individuals, and this situation is cause for concern, since these episodes are potentially avoidable. The cost of each avoidable hospitalization was estimated at €2,515 for Portugal, indicating that substantial health resources could be saved by reducing the number of avoidable hospitalizations. In 2015, the total budget of public hospitals in Portugal was €4,299 million (312). Avoidable hospital admissions represented 6% of this value, indicating that they can be considered a major source of pressure on health system resources.

This study is the first to provide estimates of lost productivity costs associated with avoidable hospitalizations. Therefore**,** it is unfeasible to contrast the overall findings of this study with the existing literature. It is possible, however, to compare the direct costs estimated on previous studies with the ones found here. The previous study in Portugal that also used the AHRQ methodology found that, between 2000 and 2007, the mean yearly direct costs

amounted to €200 million (296), which is similar to the €210 million estimated in this study. The previous studies in France and Ireland used DGRs. In France, they amounted to €5,066 million in 2010 (258) (€3,098 per hospitalization/ €80 per capita). In Ireland, costs were €352 million in 2008 (295) (€5,055 per hospitalization/ €78 per capita).

It is important to emphasize that the choice of methodology used to select ACSC codes leads to differences in the estimation of costs. The two studies in France and Ireland used different ACSC identification methodologies that included several conditions not considered in this study, such as vaccine-preventable conditions, angina, nutritional deficiencies and cellulitis, among others (258,295). The impact of differing definitions of ACSC on quantitative results has been pointed out by Purdy et al. (33), in which total costs estimated in 2005 and 2006 in England could be between £1.183 and £1.714 billion, depending on the conditions considered. Furthermore, there are possible differences in the prevalence of diseases and the organization of the health care systems in Portugal, France and Ireland. In addition, there are substantial differences between DRGs systems in European countries (313).

The human capital approach employed in this study attributes higher values of lost productivity to younger people, due to the higher number of potentially productive years lost. Patients over the age of 65 accounted for 81% of the 99,000 hospitalizations for ACSC. Nonetheless, lost productivity due to absenteeism and premature death represented 16% of the total estimated cost. Studies produced in other countries analyzed lost productivity costs for some conditions (avoidable or not), including diabetes (314), asthma (315), heart failure (316) and COPD (317). The proportion that lost productivity accounted for total costs in these studies ranged between 15% and 47% of total costs. The results show the importance of including lost productivity in cost estimation, to represent the economic impact more comprehensively.

When comparing frequencies and costs between genders, results show that although 52% of the avoidable hospitalizations occurred among women, they represented 46% of total costs. As each gender represented nearly half of all intra-hospital deaths, the difference can be seen both in the higher death rates among younger age groups for men, and their higher mean salaries and labour force participation, when compared to women. Therefore, lost productivity was the driver for men accounting for a higher share of total costs. Previous studies on costs for lost productivity for different conditions that analyzed gender differences also found higher costs for men (300–302).

The exclusion of people aged 75 years or older in the sensitivity analysis showed the relevance of age distributions to the cost composition. As direct costs account for a high share of total costs in Portugal, the estimation of total costs in this case became less than half of what was estimated on the base-case (from €250 million to €68 million). Concerning the variations in the retirement age, it is important to note that the average effective age of retirement in different countries varies from what is defined as official retirement age. In Portugal, there is the possibility of retiring early or continuing to work after retirement age. In fact, data from 2014 shows that, among the population between 65 and 69 years in Portugal, around 20% were still working (318).

Concerning cost distribution by condition, acute conditions were responsible for more than half of all avoidable hospital admissions and associated costs. Previous studies showed that distribution between avoidable conditions varied substantially between countries, with different conditions accounting for the largest proportion of total costs (33,82,258,295).

Strengths and limitations

To our knowledge, this is the first study to estimate both direct and lost productivity costs associated with avoidable hospital admissions. Its strengths include the use of population data and a transparent and reproducible methodology. However, there are limitations in this study according to the method applied to estimate costs. The direct costs were estimated according to prices defined with the purpose of reimbursing hospitals (and therefore only cover public hospitals). These values do not reflect actual costs of an inpatient admission. Official prices are good proxy for real costs, are useful for health managers as they represent values reimbursed, allow the use of the same values for patients treated in different hospitals but with the same disease and have been used in other studies of cost estimation of avoidable hospitalizations (33,285,295).

When estimating lost productivity costs, the human capital measures potential lost productivity, instead of actual losses. The costs associated with premature death are not limited to the year of 2015, but also include the future lost potential such events represent. This methodology does not take into consideration the time it would require to replace a worker, how long it takes for the patient to return to work after discharge and the possibility of the patient not returning to the labour market due to being declared permanently incapable of work. There was no available information to calculate individually the patients experience after the discharge, as well as no indication if this population behaves the same as the average of hospitalized individuals for all causes. Costs were estimated using a

standardized 30-day month; different approaches of estimation for daily wages provides different results; to consider only the working days in a month would require detailed information about the work of the patient, which were not available. Furthermore, the estimation for premature death does not take into consideration whether the death of the patient occurred after leaving the hospital, as it could still be associated with an ACSC. Therefore, the criteria selected might lead to underestimation of productivity loss.

There are other methods to estimate productivity loss costs, such as the friction cost method. The costs estimated by this method are expected to be lower, as it depends on the time organizations need to restore the initial production level in the absence of a worker (319). Estimating this time span requires lots of information on labour market conditions that was not available (320). The results may also change for a single country over time, depending on the macroeconomic context (320). The human capital approach to the estimation is grounded in economic theory and is commonly used in the literature of cost estimation (299,300,320), enhancing comparability of results.

Conclusions

The age distribution of avoidable hospitalizations had a significant impact on cost components in Portugal. One of the main findings of this study was that, although these hospital admissions had a substantial direct economic impact, they also imposed a considerable economic burden on society. Despite the methodological limitations on the estimation of costs, results indicate that substantial financial resources and YPLL could potentially be saved if the country reduced hospitalizations for ACSC. Effective primary health care in the dimensions of accessibility, prevention and promotion are important to achieve such reduction. Reducing the number of avoidable hospitalizations can contribute to reduced hospital care use and alleviate health care-related financial pressures both on the state and on society, with positive results for the population.

5.4 Comparing costs of avoidable hospitalizations between Brazil and Portugal

Background

In the context of strengthening health care systems based on PHC, the increasing demand and limited health care resources, the analysis of the economic burden on society associated to avoidable hospitalizations in Brazil and Portugal provide valuable information for planning of health services and allocation of resources. Moreover, as such hospitalizations could have potentially been avoided in the ambulatory care setting, this analysis indicates the potential of saving costs by reducing hospitalizations for ACSC. The objective of this study was to estimate and compare direct costs and lost productivity of avoidable hospitalizations in Brazil and Portugal.

Methods

All hospitalizations registered for Brazil and Portugal in 2015 were analyzed and avoidable hospitalizations were identified, using the AHRQ methodology (as used in chapters 5.2 and 5.3). The methods for estimation of costs of Brazil was the same as used in chapter 5.3, as presented by the equations below.

$$\text{Direct cost} = PH$$

$$\text{Absenteeism cost} = (MMI/30) * (1-UNE) * LFP * LOS$$

$$\text{Premature mortality cost} = (YPPLL * 12 * MMI) * (1-UNE) * LFP \text{ (If the hospitalization ended in the death of the patient at the hospital}$$

PH: Price of the hospitalization

MMI: Mean monthly wage (per gender and municipal (Portugal)/ state level (Brazil))

UNE: Unemployment (per gender and municipal (Portugal)/ state level (Brazil))

LFP: Labour force participation (per gender and municipal (Portugal)/ state level (Brazil))

LOS: Length of stay (in days)

YPPLL: Years of potentially productive life lost (Retirement age – age at time of hospitalization)

Hospitalization costs were retrieved from DATASUS database, while information on labour variables was retrieved from IBGE. Costs were presented in US$, according to the purchasing power parity (PPP) method. This method equalizes the purchasing power of different currencies by eliminating the differences in price levels between countries and

allowing for more accurate comparisons (321). The values converted by PPP are measured in terms of national currency per US dollars. The conversion rates used for 2015 were US$ 1 = R$ 1.866 for Brazil and US$ 1 = € 0.588 for Portugal (321).

Sensitivity analysis was performed for costs of both Brazil and Portugal, in the same parameters as performed in chapter 5.3.

Years of potential life lost (YPLL) were calculated to quantify the burden of ACSC hospitalizations in both countries, to represent the non-financial impact these hospitalizations account for. For hospitalizations that ended with the death of the patient in the hospital, YPLL were calculated as the difference between the age of the patient and the patient's life expectancy based on their age and gender. Data sources were SP and IGBE.

Results

Table 17 presents the estimation of total costs related to hospitalization for ACSC for Brazil and Portugal in 2015. The cost of admissions for ACSC in Brazil was estimated at US$ PPP 1.60 billion in 2015. Nearly 77% of this cost is related to lost productivity, and more specifically due to premature death (75%). Absenteeism in Brazil represented 2% of total costs. The direct cost of hospitalizations for ACSC was US$ PPP 370 million. These results show that costs components have a different distribution between countries, with Brazil showing a higher proportion of costs related to premature mortality and Portugal showing a higher proportion of costs related to direct hospitalizations costs. Additionally, in Brazil, the total cost related to ACSC corresponded to US$ PPP 11.48 per person aged 18 years or older, while in Portugal it corresponded to US$ PPP 53.63 per person aged 18 years or older. ACSC hospitalizations led to 929,224 and 109,641 YPLL in Brazil and Portugal, respectively.

Table 17. Estimated costs associated to hospitalizations for ACSC, in US$ PPP, 2015

	Brazil	**Portugal**
Total	**1,605,989,050**	**425,279,213**
Cost per person (population over 18 years old)	**11.48**	**53.63**
Cost per hospitalization for ACSC	**1,919.12**	**4,277.73**
Direct costs	370,179,239 (23.05%)	357,188,359 (83.99%)
Cost per person (population over 18 years old)	2.65	45.05
Cost per hospitalization for ACSC	442.36	3,592.83

	Brazil	Portugal
Productivity loss costs	1,235,809,757 (76.95%)	68,090,854 (16.01%)
Cost per person (population 18-64 years old)	9.99	11.62
Cost per hospitalization for ACSC (population 18-64 years old)	3,055.74	3,776.95
Absenteeism	*31,129,456 (1.94%)*	*4,475,019 (1.05%)*
Premature mortality	*1,204,680,301 (75.01%)*	*63,615,835 (14.96%)*
Years of potentially life lost	929,224	109,641

Purchase power parity values: (US$ PPP 1 = R$ 1.866 and € 0.588)

The relevance of age distributions in the difference of cost composition between countries was also evident with the exclusion of people aged 75 years or older in the sensitivity analysis (Table 18). While direct costs in Brazil reduced 33%, the percent reduction in Portugal was two times higher (67%). In the sensitivity analysis, the definition of an age limit affects only the direct costs, while the variation in retirement age affects only costs associated to lost productivity. As direct costs account for a high share of total costs in Portugal, the percent variation difference from base-case in the multi-way sensitivity showed that the variation in Portugal is nearly 4 times higher than in Brazil (54 and 15%, respectively).

Table 18. Sensitivity analysis results. Changes from Base-case, in %, according to different parameters on retirement age and age exclusions

	Brazil			Portugal		
	Direct cost	**Lost productivity**	**Total**	**Direct cost**	**Lost productivity**	**Total**
Base-case (in US$ PPP)	**370,179,293**	**1,235,809,757**	**1,605,989,050**	**357,188,359**	**68,090,854**	**425,279,213**
Retirement age	0.00	-9.38	-7.22	0.00	+11.81	+1.89
Age limit						
Exclusion ≥ 75 years	-33.70	0.00	-7.70	-67.50	0.00	-56.69
Multi-way (retirement age and age limit)	-33.70	-9.38	-14.99	-67.50	+11.81	-54.80

Discussion and conclusion

Substantial health resources could be saved if more efforts were employed to reduce the number of avoidable hospitalizations in both countries. The difference in age distribution of avoidable hospital admissions between Brazil and Portugal had a substantial impact on cost components. Out of the 836 thousand avoidable hospitalizations in Brazil in 2015, 22% occurred for patient below 45 years. In Portugal, patients with more than 65 years accounted for 81% of the 99 thousand hospitalizations for ACSC. The human capital approach employed in this study attributes higher values for younger people, due to higher amount of years of potentially productive years lost. The differences in age distribution of hospitalizations for ACSC between countries reflected on the estimation of costs for lost productivity. In Brazil, 77% of the total ACSC associated cost is related to lost productivity due to premature death. In Portugal, only 16% of the total estimated cost comes from lost productivity.

The cost of each avoidable hospitalization was estimated at US$ PPP 1,919 and US$ 4,277 for Brazil and Portugal, respectively. This difference in age distribution impacted significantly on the estimated costs for lost productivity, with the difference in costs components between Brazil and Portugal being one of the main findings of this study. This study shows that beyond the economic impact, avoidable hospitalizations represent a considerable societal burden for both countries, as indicated by the years of potential life lost associated to these events.

5.5 Avoidable hospitalizations in Brazil and Portugal: identifying and comparing critical areas through spatial analysis

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Abstract

Background

Hospitalizations for ambulatory care sensitive conditions have been used to assess the performance of primary health care. Few studies have compared geographic variation in rates of avoidable hospitalizations and characteristics of high-risk areas within and between countries. The aim of this study was to identify and compare critical areas of avoidable hospitalizations in Brazil and Portugal, because these countries have reformed their primary health care systems in recent years and have similar organizational characteristics.

Methods

An ecological study on hospitalizations for ambulatory care sensitive conditions produced in Brazil and Portugal in 2015 was used. Geographic variation of rates were analyzed and compared at the municipal level. A spatial scan statistic was employed to identify clusters with higher risk of hospitalizations for acute and chronic conditions in each country separately. Socioeconomic and primary health care characteristics of critical areas were compared to non-critical areas.

Results

There were high variations in rates of avoidable hospitalizations within and between Brazil and Portugal, with higher variations found in Brazil. A more evident pattern of rates was found in Portugal. Rates and cluster distribution of acute and chronic conditions had significant agreement for both countries. The differences in primary health care and socioeconomic characteristics between areas identified as high risk clusters and non-clusters varied between category of conditions and between countries.

Conclusion

Brazil and Portugal presented expressive regional differences with respect to rates of avoidable hospitalizations, indicating that there is room to improve by reducing such events in both countries. Different areas presented distinct interactions between primary health care, socioeconomic characteristics, and avoidable hospitalizations. Results indicate that the primary health care reforms, with similar organizational characteristics in different contexts, did not produce similar results either between or within countries. Possible actions to reduce these events should be defined at a local level.

Introduction

Ambulatory care sensitive conditions (ACSC) are conditions for which timely and effective care in the ambulatory setting could potentially avoid the need for hospitalization. For this reason, hospitalizations due to ACSC have been extensively analyzed in health care research, and their usefulness has been endorsed by national and international organizations. This indicator can also be used by health managers to assess performance of the primary health care (PHC) delivery system within the broader health system (21,31,60,82,322).

The interaction of different dimensions of the health system and how they produce outcomes is the basis for the analysis of ACSC. The inputs for health assessment are related to the design, organization and management of health systems. Such inputs lead to performance outcomes related to access, quality, coordination and efficiency of health system delivery (21,249). These outcomes lead to impacts in health, namely the avoidable morbidity represented by hospitalizations for ACSC. When measuring the performance of health services delivery through avoidable hospital admissions, it is important to note the way elements of the social, economic, political and geographic dimensions interact with individual biological factors and behaviors, shaping health status.

Detection of geographical areas which present higher rates of hospitalization for ACSC can identify critical areas which should be focused on—e.g., health managers should conduct deeper epidemiological investigations and health policy interventions (323,324)—because it is expected that there are inequities in distribution and access to health care and a low capacity of PHC for preventing, diagnosing, treating, and managing these conditions (21,82,325).

Wide geographic variations in rates of hospitalizations for ACSC were found in Italy (325), London (326), Madrid (327) and Switzerland (95), despite the existence of universal health care systems. In France, Germany and Italy, different geographic patterns between acute and chronic ACSC were also found (84,258,325). Acute and chronic conditions have distinct levels of prevention, management and treatment (21,157); while acute conditions could be avoided by early diagnosis and treatment, the management of chronic conditions can depend on referral to a specialist and an appropriate follow-up (84,130). Chronic conditions can be the result of long periods of some specific health behaviors or a gradual deterioration of the patient's condition, indicating that there are different degrees of preventability among commonly considered ACSC.

Previous evidence indicates that geographic variation in avoidable hospitalization rates is associated with both lower physician supply and PHC center availability in areas with higher risk (84,95,324). In addition, socioeconomic and health characteristics of the population (such as rurality, education, and economic level) also play an important role in geographic variations in the rates of these hospitalizations (95,324,326,328). Comparing characteristics of critical areas can help us understand variables associated with a higher risk of avoidable hospitalization (160).

Only a few studies have analyzed variations in rates of hospitalizations for ACSC and associated factors between countries, taking into consideration their health care systems; these have mostly focuses on developed countries. A study of five European countries (Denmark, England, Portugal, Slovenia and Spain) found substantial variation between and within countries. The findings indicated that there was a significant association between the proportion of people with low levels of education and higher rates of avoidable hospital admissions for Denmark, Portugal, Slovenia and Spain (268). Another comparative study analyzed hospitalizations for ACSC in Italy and Germany, because these countries have sociodemographic and economic similarities, but have different models of organization of their health care systems (84). The study found clear patterns of higher rates of hospitalization for chronic ACSC in specific regions of both countries; those regions have a lower GDP per person and lower levels of health care facility resources. Less clear patterns and not statistically significant correlations were found for acute ACSC.

Different countries have carried out reforms of their health care systems, in the interests of improving the quality and efficiency of care. Brazil and Portugal have reformed their PHC in recent years to improve accessibility, efficiency, and quality of health care, both using a similar approach based on family health units (FHUs), in which multidisciplinary teams provide community-based care, with a payment system that rewards performance (165,183).

These reforms were adopted following the positive results of innovative experimental projects on PHC services adopted in Brazil and Portugal, given the health needs of the population. These experiences were mostly based on the autonomy of FHU teams, the close contact with the community and pay for performance schemes. Brazil and Portugal also have coverage differential across the countries: in Portugal the existing FHUs are concentrated along the coastal area, which is more densely populated (183,221); in Brazil there are difficulties in promoting access to and consolidating a proactive model care of

primary health care in large urban centers (224). There are also difficulties related to insufficiency and unequal distribution of human resources, which can be partially explained by inequities in socioeconomic contexts (such as the knowledge of health management and of the organization of the health system), choice of health providers and human resources distribution (172,221).

In both countries, the FHUs coexist with traditional PHC units, mainly characterized in Brazil by services provided in response to spontaneous demand based on physician-centred care and, in Portugal, by the lack of incentive mechanisms and autonomy for health teams (167,197). Both countries have universal health systems with decentralized organization, indicating that management of the PHCs happens at the regional level (39,168). On the other hand, both countries have considerable differences in their level of development, population compositions according to age group (329), life expectancies, causes of years-of-life-lost (185,330), economic inequality, poverty rates (280,329) and educational levels (284). Table 19 presents selected primary health care and socioeconomic characteristics of Brazil and Portugal.

Table 19. Sample characteristics

	Brazil	**Portugal**
Primary Health Care		
Objective of PHC reform	Reorient the work process in primary health care, articulated to the family and community context, to increase the resolution and impact on the health situation of the population.	Improve primary health care accessibility, efficiency, quality and continuity of care and increase the satisfaction of professionals and citizens.
Coverage of FHU [1,2]	Family health teams: 39,675 Population covered: 124,126,038 (60.7%) (2015)	Family health units: 459 Population covered: 5,361,959 (54.5%) (2016)
Physician supply [1,3] *Primary care physicians per 1,000 people*	0.36 (2015)	0.66 (2015)
Socioeconomic characteristics		
Proportion of elderly [4] *Proportion of people aged 65 years or older*	8.0% (2015)	21.1% (2015)
Life expectancy at birth [4]	75 years (2015)	81 years (2015)
Rurality [5,6] *Proportion of population living in rural areas*	19.5% (2015)	12.7% (2015)

	Brazil	Portugal
GDP per capita [4] *In US$ Purchase Power Parity (PPP)*	US$ PPP 15,656 (2015)	US$ PPP 29,523 (2015)
Gini índex [4]	51.3 (2015)	35.5 (2015)
Level of education [7] *Proportion of population aged 25-64 years with primary education or below*	37% (2015)	32% (2016)

Sources:

1. Brazilian Health System Informatics Department (DATASUS) for Brazil
2. (190) for Portugal
3. (254) for Portugal
4. The World Bank open data
5. Brazilian Institute of Geography and Statistics (IBGE) for Brazil
6. Statistics Portugal database (SP)
7. (284)

Both countries have sufficient similarities in objectives, organization and coverage of primary health care services, and differences in socioeconomic characteristics means within and between countries, to make the comparison of geographic dynamics of hospitalizations for ACSC suitable, opportune, and relevant. Other countries might face similar health system challenges and the comparative approach can provide information on the potential to resolve difficult health care delivery problems. To identify and characterize critical areas of avoidable hospitalizations is a first step to later target those and reduce the overall burden of ACSC. As the two countries have similar PHC organization, this analysis can provide hints on what dimensions in PHC supply and socioeconomic characteristics should be the focus of subsequent targeted actions. The objective of this study was to identify critical areas of avoidable hospitalizations in Brazil and Portugal in 2015, considering both acute and chronic ACSC. A secondary goal was to characterize and compare these areas with non-critical areas, considering socioeconomic and health services characteristics.

Materials and methods

Study design and data sources

This is an ecological cross-sectional study on hospitalizations for ACSC occurring in adult populations in Brazil and Portugal in 2015. The unit of analysis in this study is the municipality: 5,570 for Brazil and 278 for mainland Portugal. The average size of the municipal units in Brazil is 1,526 km^2, and the average population was 36,706 (minimum: 813; maximum: 11,967,824; SD: 215,590). The average size of the municipal units in

Portugal is 320 km^2, and the average population was 35,393 (minimum: 1,717; maximum: 504,471; SD: 56,807).

This study used the hospitalization databases provided by the Brazilian Hospital Admissions Information System and the Portuguese Central Administration of the Health System for the year 2015. A total of 11,522,004 and 1,000,670 hospitalizations were registered for Brazil and continental Portugal in 2015, respectively. Both databases are produced to reimburse hospitals and, therefore only cover public hospitals. In both countries, the physicians evaluate the patients and determine the principal and secondary diagnosis code, according to the International Classification of Diseases (ICD) (the 9th revision for Portugal and the 10th revision for Brazil). In addition, external auditors frequently check the hospital data bases, to ensure quality and identify potential errors. The data is anonymized and was analyzed according to the municipality of residence of the patient.

Data on PHC supply and the socioeconomic characteristics of municipalities were selected according to the literature and data availability, and the sources were the Brazilian Institute of Geography and Statistics (IBGE), the Brazilian Health System Informatics Department (DATASUS), the Statistics Portugal database (SP), and the Portuguese Central Administration of the Health System (ACSS). Table 20 details the variables used and data sources. The ecological variables were: proportion of people aged 65 years or older in the population, population density, proportion of people living in rural areas, economic level (mean of household income in Brazilian reais for Brazil; relative purchase power with the national purchase power used as reference (=100) for Portugal), proportion of people with low education, physician supply in FHUs and in PHC centers in general, and population coverage of FHUs (for Brazil, this was the number of family health teams * 3,450/population and, for Portugal, this was the number of users registered at FHUs/population).

Table 20. Variables information

Variable	Description	Brazil		Portugal	
		Source	Year	Source	Year
Primary health care reform quantitative characteristics					
Physician supply in FHU	Proportion of physicians in FHU per 1,000 population	DATASUS	2015	ACSS[1]	2015
Physician supply in PHC	Proportion of physicians in PHC per 1,000 population	DATASUS	2015	ACSS[1]	2015
FHU coverage	(Number of Family Health Teams X 3,450)/Population (%) (for Brazil) Number of users registered on FHU/Population (%) (for Portugal)	DATASUS	2015	ACSS[1]	2015

Variable	Description	Brazil		Portugal	
		Source	Year	Source	Year
Socioeconomic characteristics					
Proportion of elderly	Proportion of people aged 65 years or older (%)	IBGE	2015	SP	2015
Population density	Number of habitants per km²	IBGE	2015	SP	2015
Rurality	Proportion of people living in rural areas (%)	IBGE	2010	SP	2011
Economic level	Mean of household income (for Brazil) Relative Purchase power, with the national used as reference (=100) (for Portugal)	IBGE	2010	SP	2015
Education level	Proportion of people with no education or incomplete 1st grade level (%) (for Brazil) Proportion of people with no education (%) (for Portugal)	IBGE	2010	SP	2011

1. Primary Health Care data for Portugal was retrieved from the periodic publication on number of patients registered on PHC services (254)

Definition of hospitalizations for ACSC

The definition of which hospitalizations were avoidable was determined according to the methodology of the US Agency for Healthcare Research and Quality (AHRQ), which identifies prevention quality indicators (PQIs) according to the codes of the principal and secondary diagnoses (AHRQ). This methodology was applied for all admissions of patients aged 18 years and older; it excluded obstetric admissions and transfers from other health care facilities. Cases with missing values for the variables age, sex, diagnosis, and municipality of residency were also excluded. This list has a solid theoretical basis, is periodically revised for inclusion and exclusion of cases, and can be applied for both ICD-9 and ICD-10. The use of a single list allows for comparison between both countries.

Analysis was performed separately for the composite indicators PQI 91 (acute conditions) and PQI 92 (chronic conditions). The acute conditions analyzed by this methodology were bacterial pneumonia, urinary tract infection, and dehydration. The chronic conditions were hypertension, congestive heart failure, chronic obstructive pulmonary disease (COPD) or asthma in older adults, asthma in younger adults, short-term and long-term complications of diabetes, uncontrolled diabetes, and lower-extremity amputation among diabetics. Details on disease codes used and methods of calculation can be found in the AHRQ guidelines (60).

Spatial statistical analysis

Rates of hospitalizations for ACSC were presented as number of hospital admissions per 100,000 people over 18 years, as defined by the AHRQ methodology. Descriptive statistics, percentiles, coefficient of variation, and ratio of variation were used to visualize rates and geographic variation of ACSC rates across Brazil and Portugal for each category of ACSC. Spearman's correlation was used to assess the relationship between rates of acute and chronic ACSC in both countries.

A spatial scan statistic was employed to identify clusters with higher risk of hospitalizations for acute and chronic ACSC in each country separately. The spatial scan statistic employed is a methodology proposed by Kulldorff (331) to test if the number of cases were randomly distributed across different circular windows or if significant spatial clusters exists, according to the corresponding relative risk (RR). The Poisson model was employed as it deals with a discrete variable (number of hospitalizations). The spatial scan statistic is based on a maximum likelihood ratio for each potential cluster, to test the hypothesis of clustering against the hypothesis of uniformity. One important assumption was the scan through circular window shapes, as there is no evidence of the presence of other specific shapes (default). The maximum spatial cluster size was defined as 20% of the population at risk; this parameter identifies clusters in useful sizes for the development of local strategies. The likelihood p-value for the hypothesis test was estimated using Monte Carlo simulations (999 simulations), as the exact distribution of the test statistic cannot be defined. Kulldorff (331) provides more details on the statistical procedure.

A chi-square test was used to analyze if there was a relationship between clusters of acute and chronic ACSC in each country.

The non-parametric Mann-Whitney U-test was performed to compare if significant differences for the socioeconomic variables and regional PHC quantitative measures existed between areas identified as clusters with high-risk of hospitalization for ACSC and non-cluster areas, for each category of ACSC. The spatial scan analysis was performed using SatScan 9.4 and statistical analysis was carried out using IBM SPSS 21.0.

Results

An overview of hospitalization for ACSC in Brazil and Portugal is presented in Table 21. A total of 836,837 and 99,417 million avoidable hospital admissions were registered in Brazil and Portugal, respectively. The distribution of those hospitalizations according to the category of condition was similar in both countries (59.9% and 56.6% of the hospitalizations

for ACSC were due to acute conditions in Brazil and Portugal, respectively). Although Portugal presented higher rates of hospitalizations of ACSC, Brazil presented higher coefficients and ratios of variation for both categories of conditions, indicating more heterogeneity in the distribution of rates among municipalities in that country. In Brazil, the highest variation was for chronic conditions, while in Portugal it was for acute. The Spearman correlation between rates of acute and chronic ACSC across municipalities showed a positive association for both countries, indicating agreement between rates for both categories of ACSC.

Table 21. Rates and variation of hospitalizations for ACSC, by category and country, 2015

		Brazil		Portugal	
		Acute	Chronic	Acute	Chronic
N	Adult Population	139,901,201		7,928,764	
	Total hospitalization cases	11,522,004		1,000,670	
	Total hospitalization rate (per 100,000 adults)	8,235.81		12,620.76	
	Hospitalizations for ACSC	836,837		99,417	
	(% of all hospitalizations)	(7.26%)		(9.94%)	
	Per category	501,377	335,460	56,245	43,172
	(% of all hospitalizations for ACSC)	(59.9%)	(40.1%)	(56.6%)	(43.4%)
Rates	Rate per 100,000 adults	358.38	239.78	709.38	544.50
	Minimum	0. 00	0.00	212.77	221.02
	Percentile 5	58.33	36.95	351.19	335.38
	Percentile 25	189.46	120.77	596.13	452.32
	Percentile 50	371.89	243.74	792.43	566.70
	Percentile 75	688.66	495.31	1,082.36	724.35
	Percentile 95	1,530.01	1,330.85	1,639.41	1,032.15
	Maximum	7,662.79	6,589.39	3,573.84	1,742.46
Variation	Coefficient of Variation	0.98	1.23	0.47	0.39
	Ratio Max/Min			16.80	7.89
	Ratio P95/P5	26.24	36.03	4.67	3.08
	Ratio P75/P25	3.64	4.11	1.82	1.61
Correlation	Spearman's coefficient (ρ)	0.562 ($p < 0.001$)		0.536 ($p < 0.001$)	

Figure 6 presents the geographical distribution of ACSC hospitalization rates in quintiles for Brazil and Portugal, respectively. In Brazil, municipalities in the northeast region had lower rates of acute ACSC hospitalizations. There was a concentration of municipalities with higher rates of acute ACSC hospitalizations in the center of the south half of the country, as well as in the middle of the northern region. Conversely, municipalities in the northern region

had lower rates of chronic admissions. The coastal municipalities of Brazil had lower rates of avoidable hospitalizations for both acute and chronic ACSC.

In Portugal, municipalities close to Lisbon had lower rates of hospitalizations for both acute and chronic ACSC; however, the city of Lisbon itself was an exception, with higher rates for both categories. For hospital admissions due to acute conditions, the north half of the country comprised most of the municipalities with higher rates, especially in the center region. For chronic ACSC, the north–south pattern was not as evident, because municipalities in the southern region presented higher rates. Municipalities in the northern half of the country presented higher rates of both categories of conditions, especially in municipalities close to the border with Spain.

Figure 6. Distribution of ACSC hospitalizations rates by quintiles in Brazil and Portugal, 2015

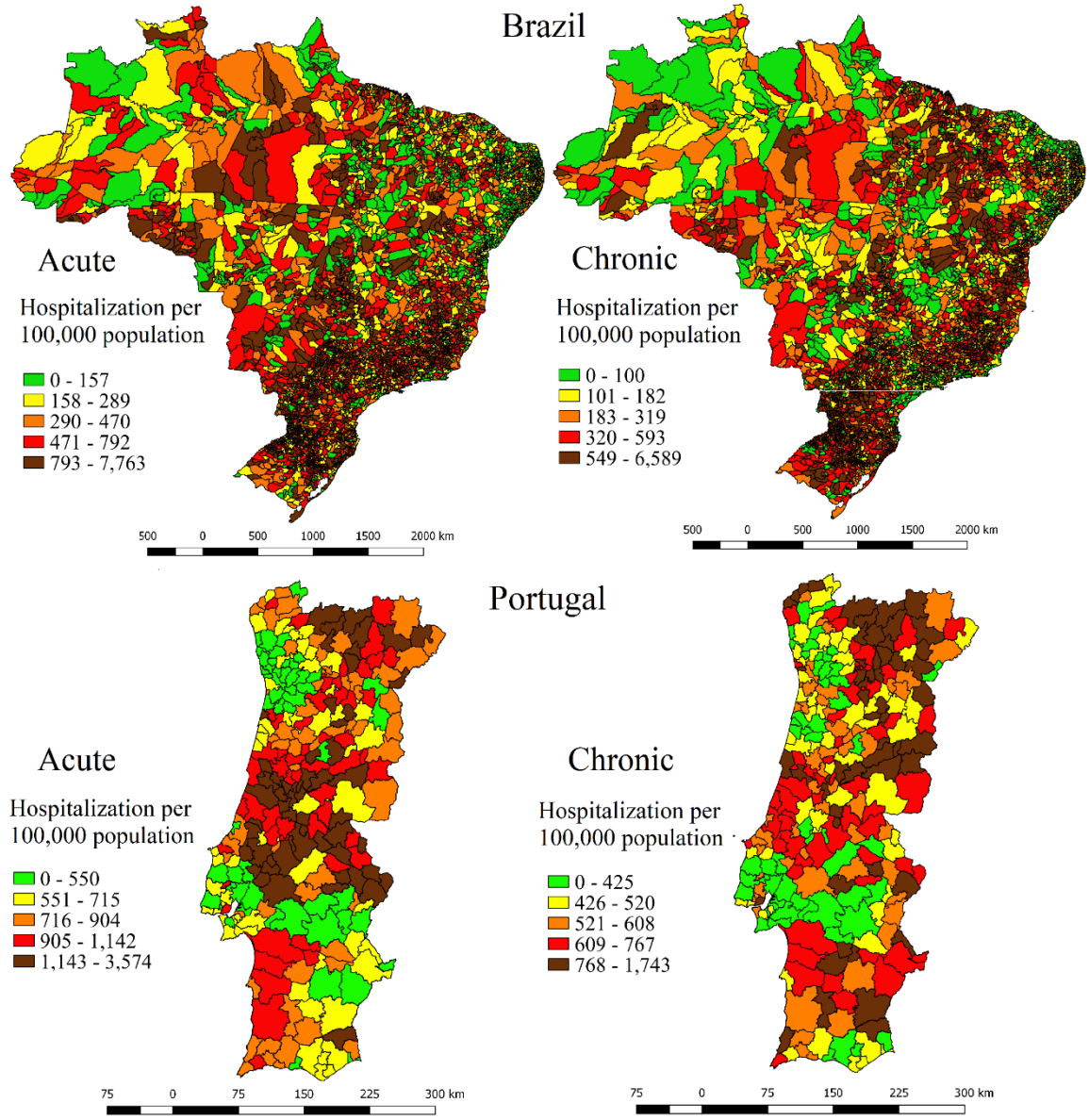

Figure 7 indicates where clusters of high risk of avoidable hospitalizations were located in Brazil and Portugal. The chi-square test indicated that there was an agreement between municipalities constituting clusters of acute and chronic ACSC for Brazil (χ^2 = 39.801, p<0.001) and Portugal (χ^2 = 18.436, p<0.001).

In Brazil, seven clusters were identified as having high risk of hospitalization for acute ACSC. The biggest cluster comprised 1,413 municipalities, covering the center region of the country (RR= 1.83). Four other clusters were located in the interior of the southeast and northeast regions. Nine clusters with high risk for chronic ACSC where identified; the biggest one had

669 municipalities and was located in the interior of the northeast region (RR= 2.67). The other clusters were located in the interior of the southern half. There were 1,021 municipalities that were part of both acute and chronic clusters.

In Portugal, three clusters of high risk of hospitalization for acute ACSC were identified; the biggest one was in the center of the country (RR = 1.76) and the second biggest one comprised 15 municipalities of the northern region (RR = 1.82); these municipalities also composed the biggest cluster for chronic ACSC (RR= 2.04). Of the nine clusters identified for chronic ACSC, most of these were located in the central and northern regions. The spatial scan test identified Lisbon as a cluster with high risk for both categories of ACSC. There were 35 municipalities that were part of both acute and chronic clusters.

Figure 7. Distribution of clusters of high risk of ACSC hospitalizations in Brazil and Portugal, 2015

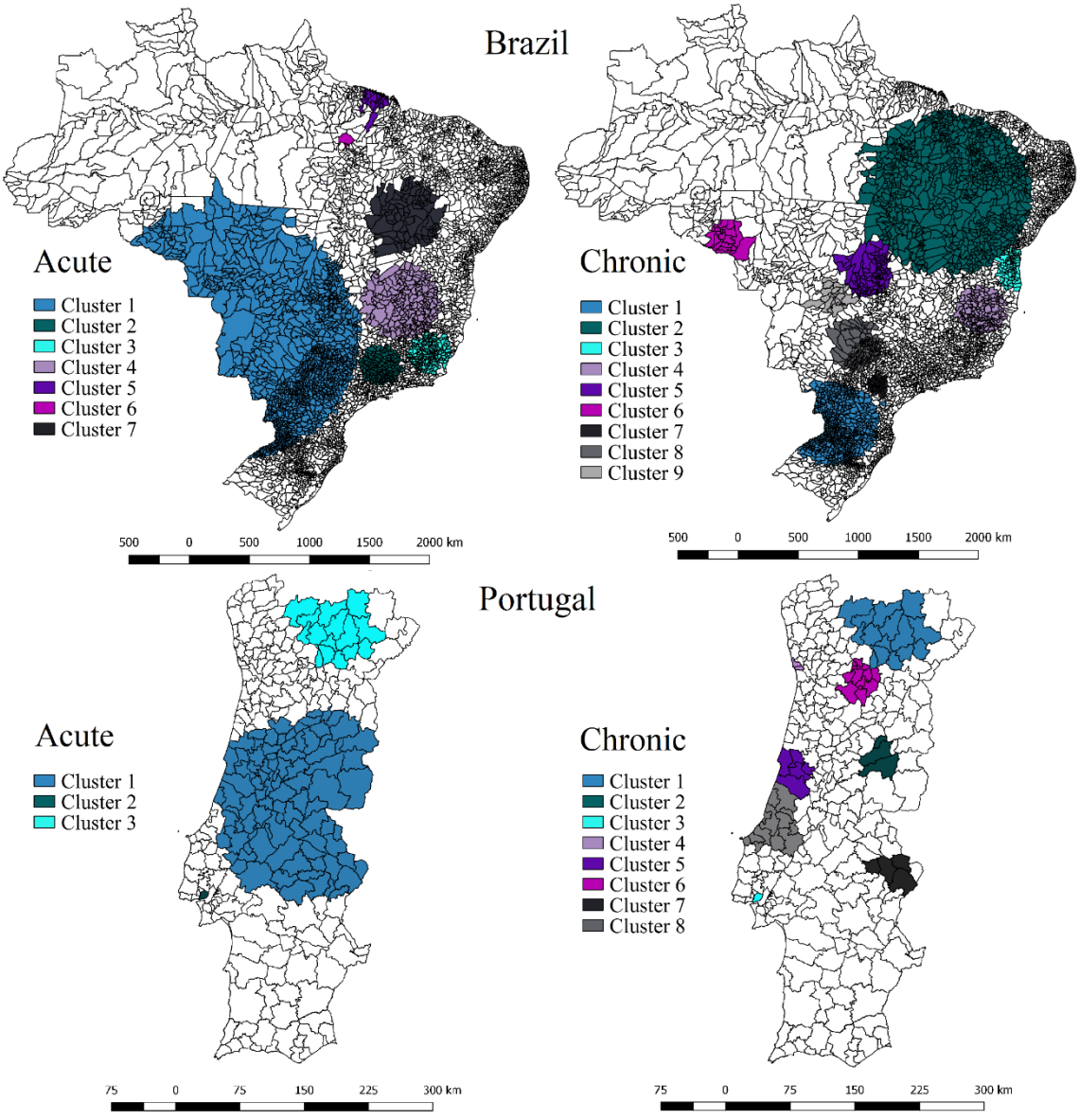

Table 22 presents the means and standard deviation for measures of socioeconomic and PHC supply characteristics of municipalities; the Mann-Whitney U-test was used to indicate if the difference in the quantitative values of the ecological variables between cluster and non-cluster was significant.

Table 22. Comparison of ecologic variables means between high risk clusters and no clusters using the Mann-Whitney U-test, by country and category, 2015

	Brazil				Portugal			
Ecologic variables	Acute ACSC		Chronic ACSC		Acute ACSC		Chronic ACSC	
Mean (standard deviation)	High Risk Cluster N=2,239	Non-cluster N=3,331	High Risk Cluster N=2,258	Non-cluster N=3,312	High Risk Cluster N=109	Non-cluster N=169	High Risk Cluster N=54	Non-cluster N=224
Physician supply in FHU	**0.28 (0.23)**	**0.32 * (0.22)**	**0.32 (0.24)**	**0.29 * (0.21)**	**0.16 (0.27)**	**0.27 * (0.29)**	0.19 (0.27)	0.24 (0.29)
Physician supply in PHC	0.51 (0.43)	0.47 (0.37)	0.48 (0.37)	0.5 (0.41)	0.74 (0.19)	0.68 (0.19)	0.72 (0.16)	0.7 (0.19)
FHU coverage	87.13 (22.72)	86.77 (23.9)	**92.04 (17.8)**	**83.42 * (26.03)**	**21.6 (36.05)**	**36.65 * (38.27)**	25.4 (36.72)	32.04 (38.35)
Proportion of elderly	**13.94 (3.4)**	**12.72 * (3.66)**	**14.02 (3.58)**	**12.66 * (3.53)**	**27.91 (5.16)**	**22.55 * (5.57)**	25.7 (4.5)	24.4 (6.3)
Population density	**39.95 (94.69)**	**167.11 * (777.53)**	**27.27 (41.32)**	**176.48 * (781.3)**	**117.84 (499.86)**	**423.08 * (974.49)**	317.3 (1019.2)	300.05 (785.6)
Rurality	**52.42 (35.67)**	**54.60 * (32.49)**	**61.70 (33.02)**	**48.29 * (33.28)**	**41.51 (20.71)**	**25.64 * (24.09)**	38.83 (23.16)	30.18 (24.03)
Economic level	**556.43 (182.48)**	**434.28 * (258.96)**	**465.81 (234.18)**	**495.41 * (241.33)**	77.84 (18.28)	82.78 (18.86)	80.01 (26.28)	81.04 (16.52)
Education level	**35.44 (8.98)**	**39.93 * (12.59)**	**40.06 (10.93)**	**36.81 * (11.67)**	**16.83 (4.73)**	**13.72 * (5.06)**	15.97 (4.76)	14.69 (5.23)

* Significant difference by Mann-Whitney U-test between means of non-cluster when compared to high-risk cluster ($p<0.001$)

In Brazil, the mean proportion of elderly was greater for municipalities belonging to clusters with high risk of hospitalization for acute and chronic ACSC than for non-cluster municipalities. For the variables rurality, economic level, and education level, the differences between cluster and non-cluster municipalities were the opposite for acute and chronic ACSC. The Mann-Whitney test indicates that there were no differences in physician supply in PHC in general between cluster and non-cluster municipalities, but the difference in physician supply in FHUs was significant and opposite between both categories of ACSC.

For Portugal, the results indicate that there were no differences between chronic ACSC clusters and non-cluster municipalities for any of the parameters. For acute ACSC, municipalities belonging to a high-risk cluster had a greater mean proportion of elderly, people living in rural areas, and people with low education level. The mean proportion of physician supply in FHUs and coverage of FHUs was lower for high risk municipalities than in non-cluster municipalities. For both Brazil and Portugal, the population density was significantly lower for high risk cluster municipalities for both categories.

Discussion

Key findings

The results of this study show that: (i) there are high variations in rates of hospitalizations for ACSC within and between Brazil and Portugal, with higher variations found in Brazil; (ii) there is a more evident pattern of rates in Portugal (with the northern half of the country presenting higher rates); there is no clear pattern in Brazil, only that the northern region had fewer municipalities identified as high risk clusters; (iii) the differences in PHC supply and socioeconomic characteristics between areas identified as high risk clusters and the rest of each country varied between category of ACSC and between Brazil and Portugal; and (iv) rates and cluster distribution of acute and chronic ACSC had a significant agreement between them for both countries. The results presented here agree with previous studies that indicate that hospitalizations for ACSC vary across geographic units and have different associated factors (84,95,258,268,324).

Regional variations in distribution of hospitalizations for ACSC, both within and between Brazil and Portugal, indicate a possible difference in the underlying factors associated with avoidable hospitalizations and, consequently, which interventions could be more successful for reducing such admissions. Given the use of hospitalizations for ACSC as a performance indicator, it is expected that the variations between and within countries indicate differences

in the accessibility and quality of PHC service delivery. Despite a similar approach to providing PHC and similar ACSC hospitalization composition, Brazil and Portugal have very distinct dynamics with regard to mean values of PHC supply and coverage between critical and non-critical areas. In both countries, areas identified as clusters at high risk of acute ACSC had a lower supply of physicians in FHUs, but for chronic conditions these areas had a higher supply in Brazil and no difference for Portugal.

Some studies in Brazil have found an association between the expansion of FHUs and lower ACSC hospitalization rates (even when controlled for socioeconomic factors) (112,149,332). Conflicting results on the association of the impact of FHUs on ACSC were found for different regions of Brazil (192), corroborating the idea of variability of ACSC and associated factors across the country. It is important to emphasize that the choice of methodology used to select ACSC codes leads to differences in the results (33,282). Previous studies in Brazil used the country-specific list developed in 2009, which includes conditions not considered in this study, such as vaccine-preventable conditions, angina, gastroenteritis, nutritional deficiencies, and cellulitis, among several others (57).

In Portugal, high-risk clusters for acute ACSC had lower coverage of FHUs and lower physician supply compared with non-cluster areas, indicating that the FHUs might be associated with lower rates of avoidable hospitalizations for acute conditions. This difference, however, could be due to other unobserved factors that are associated with where the FHUs were implemented. Although the supply of primary care physicians is a notable component of access (255), similarities and differences in other dimensions of PHC between countries and for smaller geographic regions should be explored in future studies.

Previous studies have found that the geographic variation in avoidable hospital admission rates were more associated with socioeconomic and health characteristics of the population than with quantitative measures of PHC supply (326,328). For Brazil and Portugal, there were significant differences in the mean values of both PHC supply and socioeconomic characteristic variables between critical and non-critical areas. These differences indicate the existence of complex dynamics leading to the variation in rates and existence of critical areas. This complexity makes the cross-country learning more difficult and it impacts the interpretation of ACSC as an indicator for performance assessment.

In Brazil, municipalities belonging to high-risk clusters of acute avoidable hospitalizations presented higher economic levels and education levels than non-cluster municipalities. At first glance, such direction of association seems contrary to what is expected and discussed

in the literature (106,126,133). However, some studies have found that higher economic and education levels in Brazil are associated with higher rates of hospitalizations in general (333,334). These studies suggest that, in Brazil, people with higher economic levels have better access to health services, including hospitalizations, either because of their understanding of the health system or their financial situation. Therefore, hospitals are used as the preferential access point to the health system for this socioeconomic group.

In Portugal, municipalities in critical areas for acute avoidable hospitalizations presented lower education levels than non-critical municipalities. Low education may lead to decreased quality of life (due to difficulties in obtaining well-paid employment and accessing goods and services), and can hinder the capacity to manage one's own health and adopt healthy lifestyle and behaviors (335). While the effect of education on ACSC hospitalizations in Portugal was the same as found in previous studies (103,126), in Brazil the inverse was found for acute conditions. Whether this is a reflection on PHC and hospital use or associated with other health determinants or health behavior should be explored further.

Municipalities in critical areas had a higher proportion of elderly and lower population density mean in both countries. The former reflects a concerning situation given the ageing of the population globally, especially for Portugal which has one of the largest proportion of elderly in the world (329). As for the latter, most of the clusters were located in the interior of the countries, while the majority of the Brazilian and Portuguese populations live near the coastal regions. In Portugal, the existing FHUs are also concentrated along this region (183). The reduced geographical proximity between primary health centers and patients can help explain the inequality between rural and urban areas. Not having a close provider of health services can be considered a barrier to access, because people can postpone seeking help until the condition requires hospitalization (58). The remoteness of such areas can also be an obstacle to attracting and retaining health professionals (336). For Portugal, it is important to note that the city of Lisbon (the most populated city in the country, with the fourth highest population density) presented high rates of both types of ACSC hospitalizations and was a high risk cluster on its own. The causes and possible associations of this finding should be studied further.

In Brazil, critical areas for acute conditions had a lower proportion of people living in rural areas. Previous studies have pointed out that the highest percentage of families registered at FHUs was in the rural areas of the country (223), and that accessibility and consolidation of PHC is a challenge in large urban centers (224). Both Brazil and Portugal have FHUs

coverage differential across their territories; therefore, the implementation and development of the PHC reforms were not uniform across each country. Results indicate that the PHC reforms, with similar organizational characteristics in different contexts, did not produce similar results between or within countries.

As for the stratification of ACSC between acute and chronic, the Spearman correlation between rates and the chi-square for the municipalities which belong or do not belong to clusters indicated a significant level of agreement between both categories. Nonetheless, the Mann-Whitney test indicated that the mean values of the ecological variables had contrasting differences between both categories for both Brazil and Portugal. Mostly, studies on hospitalizations for ACSC use this indicator as an aggregate of all the conditions deemed avoidable (94,328). Results indicate that, although the identification of critical areas may be done using ACSC as an aggregated indicator, it is important to analyze the characteristics of these areas more deeply and separately when designing interventions, because the heterogeneity of mean values of the ecological variables could indicate that factors associated with each category of ACSC can be different. The findings of this study suggest the importance of using hospitalizations for ACSC to assess performance on a national level, while taking further actions to reduce them locally, given the context of each smaller region.

Strengths and limitations

This study used large national databases covering all hospitalizations registered in public hospitals in Brazil and Portugal in 2015, as well as ecological data on different dimensions that can be associated with avoidable hospitalizations. A further strength of the study is represented by the well validated spatial scan approach used, which allows for local health authorities of both countries to identify critical regions to focus on, with important implications for health policy. This methodology can be expanded to other contexts as necessary. The comparison of hospitalizations for ACSC between Brazil and Portugal is a valuable opportunity to analyze variations between two settings with similar PHC organizations and important differences in country areas, demographics, epidemiologic characteristics, and levels of economic development.

One important limitation of this study is that, because of its ecological approach, it is not possible to establish causal relationships between variables. Nonetheless, this approach seems appropriate to analyze ACSC hospitalizations, because some studies recommend that this analysis should be performed at a group level (159,160). We did not standardize the rates of ACSC hospitalizations, so the composition of populations had impact on results.

Although to standardize rates is common practice to compare distinct contexts, we wanted to identify what are the real geographic areas that should receive more detailed attention. We wanted to identify these critical areas in real populations and analyze if they are related to similar characteristics, including ageing. For example, if prevalence of elderly was the only different characteristic between cluster and no cluster areas, it would mean that it was mostly important to improve older people health care. Our study showed that this is not the case. In addition, the ecologic variables were not standardized either.

The use of routinely collected administrative data is another limitation of this study, because the validity of diagnosis can vary according to ICD coding, across diseases, hospitals, and countries. Furthermore, the analysis performed only covers part of the complicated framework of factors associated with ACSC, because other important unobserved variables were not considered in this study.

Conclusion

Brazil and Portugal presented substantial differences in rates of hospitalization for ACSC, geographic patterns, and characteristics of critical areas. They also presented expressive regional differences with regard to rates of hospitalization for ACSC, indicating that there is room to improve by reducing such events in both countries. The findings of this study show that different areas had different interactions between PHC supply and socioeconomic characteristics for both acute and chronic ACSC; thus, possible actions to reduce avoidable hospitalizations should be defined at a local level.

5.6 Hospitalizations for Ambulatory Care Sensitive Conditions and expansion of PHC reforms in Brazil and Portugal

Abstract

Background

Brazil and Portugal have undergone health care reforms in their primary health care systems, with the implementation of family health units being one of the most important features of the reforms. As hospitalizations for ambulatory care sensitive conditions have been used as health outcome indicators for assessing access and performance of primary health care, previous studies have analyzed the association of the evolution of rates for these hospitalizations with expansion of family health units. The evidence produced in Brazil and Portugal mostly analyzed each country as a whole and for all conditions combined. The objective of this study was to analyze the evolution of these hospitalizations in Brazil and Portugal between 2007 and 2016 and discuss possible indications of the impact of the reforms in the rates differences.

Methods

This was an ecological longitudinal study on hospitalizations for ambulatory care sensitive conditions from 2007 to 2016 in Brazil and Portugal. Descriptive statistics and geographic distribution were used to analyze the evolution of these hospitalizations in each country. The possible associations between these rates and differences in population covered by family health units were analyzed through Spearman's correlation analysis, Kruskal-Wallis tests and linear regressions. Analysis were performed by region and for each condition separately.

Results

Between 2007 and 2016, rates of hospitalizations for ambulatory care sensitive conditions increased around 24% in Portugal and decreased 25% in Brazil; these variations were higher than the ones observed for all conditions. Differences were found in variation of rates per conditions within and between both countries. For some regions of Brazil and Portugal, there were indications that higher coverage of family health units was associated to lower or reduced rates of hospitalizations for ambulatory care sensitive conditions. These results were not consistent for all conditions.

Conclusion

Brazil and Portugal presented opposite directions of avoidable hospitalization rates between 2007 and 2016, with significant regional differences. For some specific conditions and regions, there were indications of association of expansion of the primary health care reform to better results regarding hospitalizations for ambulatory care sensitive conditions, but no scientific evidence to affirm the reforms had a positive effect overall. This study shows that nationwide health policies assessment is challenging, and that local and targeted actions may be more efficient to reduce avoidable hospitalizations.

Introduction

The health care reforms that Brazil and Portugal have undergone aimed at improving health care delivery by strengthening PHC on its principals of comprehensiveness, continuity and integration, serving as first contact to the health system. One of the main elements of the reform in both countries was the implementation of FHU. In Brazil, the municipality is the administrative level responsible for the implementation and management of the PHC reform, denominated ESF. By December/2019 it was estimated that 64% of the Brazilian population was covered by FHU, but their expansion in terms of covered population has not shown substantial changes in the last years (172), with significant regional differences in population covered (81). In Portugal the expansion of FHU did not have specific geographic criteria or assessment of population needs, as it was based on voluntary self-selection of professional (45). By 2019 full coverage of the Portuguese population by the reform was not reached, with 710 thousand people without a general practitioner assigned to them in April (198), which corresponds to 6.9% of the Portuguese population.

Studies in both countries have analyzed if the implementation and expansion of these PHC reforms have effects on health outcomes related to PHC access and quality, including ACSC. A previous study indicated that rates of ACSC hospitalizations in Brazil declined 24% between 1999 and 2007, which was 2.5 times higher than the decline in other hospitalizations (149). Other study also indicated such decline for chronic ACSC in the same time period (112), and also found that availability of FHU was associated to lower ACSC rates at the municipal level, while private and non-profit hospital beds were associated to higher rates (112). This association was also observed at the state level even when controlling for confounding variables (149). Some studies conducted at the municipal level in Brazil did not find the same reduction of ACSC rates or did not agree with the association of the expansion of FHU with reduced ACSC hospitalization rates for more recent years (42,337). A more recent study applied panel data analysis, controlling for other variables, and found a reduction of 42% on ACSC hospitalization rates between 2000 e 2014, but without evidence that this reduction was associated to FHU expansion (44).

In Portugal there was an increase in ACSC hospitalization rates between 2000 and 2015 (45), and some of the possible factors behind this increase include population ageing and the increase in chronic conditions and in multi-morbidity (122,285). An econometric analysis performed by the Portuguese Health Regulation Authority have found no evidence that FHUs were associated to fewer ACSC hospitalizations when compared to classic health

centers (197). Another study performed multiple regression analysis and have not found that the supply of GPs was associated to reduced ACSC hospitalizations in small areas (338). A more recent study employed the difference-in-difference methodology to investigate whether the implementation of FHU affected rates of ACSC hospitalizations between 2000 and 2015, but it has not found significant impact (45), in line with findings from previous studies. All these studies have included control variables in their analysis, such as purchase power and age distribution, to name a few. These studies discuss that there are other factors beyond availability of PHC resources that can be associated to reduced ACSC hospitalizations.

Substantial work has been developed for Brazil about the association of FHU coverage and ACSC; to perform analysis for the whole country at once using similar methodologies would likely yield similar results than the ones already reported by the literature. For Portugal, studies with different methodologies have found no significant evidence that quantitative values of the PHC reform had produced reductions on ACSC hospitalizations. The data unavailability on FHU coverage per year does not allow for replicating the longitudinal methodologies used for Brazil in Portugal.

The comparison of both countries is also complicated as both countries initiated their reforms in different times: in 2006 only 8,3% of Brazilians municipalities did not have FHU according to DAB; while in Portugal this was the first year in which FHU were implemented, with 43 in the whole country (339). Between 2007 and 2015 the expansion of FHU was also different in both countries: during this period, data from DAB indicates that for every 100 FHU that were opened in Brazil, 36 have been closed or reformulated out of the PHC reform; while in Portugal only 3 for every 100 FHU were closed or reformulated (339). Only 1.8% of Brazilian municipalities did not have a functioning FHU in 2016, while 54.7% of Portuguese municipalities have not implemented FHU by the end of 2015 (45).

An adaptive approach must be employed to take into consideration these differences in the expansion when comparing ACSC hospitalizations between countries. In addition, both countries have specific features of health care delivery that may be associated to health outcomes: for Portugal one example are the Local Health Units (LHU), which although are not part of the PHC reform, integrate hospitals and PHC and have shown potential association with reduced hospital readmissions (340,341). The objective of this study was to analyze the evolution of ACSC hospitalizations in Brazil and Portugal between 2007 and 2016 and discuss possible indications of the impact of PHC reforms in the rates differences.

Methods

This was a longitudinal study on ACSC hospitalizations from 2007 to 2016 in Brazil and Portugal. The analysis took into consideration findings reported throughout this thesis. In Study 5.1 the implications for analyzing a set of conditions in a group or each condition individually were discussed; in this study ACSC will be analyzed separately. The conditions selected were diabetes, COPD, hypertension, heart failure, pneumonia and urinary tract infection; both because they are the most common in Brazil and Portugal (Study 5.2) and because it includes the conditions routinely analyzed individually by the OECD (146). The identification of these hospitalizations was done according to the AHRQ methodology (60).

The study 5.5 found evidence of geographic differences within both countries and between acute and chronic ACSC. Section 2.6 discussed the geographic differences in PHC expansion within each country. For this reason, the analysis was conducted taking the municipality as unit of analysis and separately by region.

The outcome studied was the evolution of ACSC hospitalization rates, with the main independent variable being PHC reform expansion, represented by population covered by FHU. The first part of the study consisted of descriptive statistics analysis: first the yearly trends of rates of ACSC hospitalizations per 100,000 adults from 2007 to 2016 in Brazil and Portugal were described and compared, both for all ACSC combined and per each individually, as well as the variation per ACSC from 2007 to 2016. Secondly, the geographic distribution of ACSC rates was analyzed for the first and last year of analysis, taking the distribution by quartiles of 2007 as a baseline for 2016. Finally, the possible association between ACSC hospitalization rates and FHU coverage for 2015 was analyzed for Brazil and Portugal and for each of their five regions.

Brazil and Portugal had different PHC reform expansion experience and data availability. Therefore, different statistical analysis were employed for each country in the third part of the study. Around half of the municipalities in Brazil did not present variation in FHU coverage for the analyzed period and socioeconomic variables at the municipality level were only available for 2010 (the last year of census). Therefore, no regression models were built for Brazil due to lack of data and variance in the independent variable (FHU coverage) at the time-series. To analyze differences in ACSC hospitalization rates, the Kruskal-Wallis non-parametric test was used to compare mean rates of hospitalization per condition, region and year. Municipalities were separated in three groups according to their FHU coverage in

each year: group 1 had less than 50% of the population covered, group 2 had between 50 and 99% of the population covered, and group 3 had full coverage (100% of the population).

For Portugal there was no available data on coverage by FHU for the whole period 2007 to 2016, but only for the year of 2015, retrieved from the periodic publication on number of patients registered on PHC services (254). The reform in Portugal started in 2005 and only 3% of all FHU implemented were closed, therefore it was assumed that coverage data of 2015 represents the expansion evolution in Portugal during the analyzed period. The FHU coverage was an extension of the dummy variable proposed by Dimitrovavá, 2020 (45), calculated as indicated in Study 5.5 (number of users registered on FHU/Population, in %). Given that, the trend analysis was achieved by a cross-sectional regression analysis with variation of ACSC hospitalization rates by condition in %, between 2007 and 2016 as dependent variable and FHU coverage in 2015 as independent variable. Additional variables were introduced at the regression models according to the dimensions discussed in Study 5.1: purchase power in 2011, hospital beds per 1,000 people in 2016 (both obtained at SP website) and variation in rates for all hospitalizations from 2007 to 2016, in %. LHU were also introduced in the analysis for Portugal, given the evidence found in previous studies regarding their association with reduced hospital readmissions. This information was introduced as a discrete variable indicating how many years have passed since the implementation of LHU until 2016; the matching of LHU with municipalities was done according to their catchment area (342–347).

Similarly as it was done for Brazil, mean variations in Portugal were compared between municipalities using the Kruskal-Wallis non-parametric test, with municipalities categorized by group according to the population covered by FHU in 2015: group 1 had no FHU implemented, group 2 had between 1 and 50% of the population covered and group 3 had more than 50% of the population covered.

Results

Brazil and Portugal had, respectively, in average 9,073,775 and 816,076 adult hospitalizations for all conditions per year during the period 2007 to 2016. Figure 8 present the evolution of rates of ACSC hospitalizations per 100,000 adults in Brazil and Portugal between these years. Rates in Brazil reduced 25%, from 746 to 563 ACSC hospitalizations per 100,000 adults, with higher decreases observed from the year 2011; in Portugal, the ACSC hospitalization rates increased 24% during the period, reaching the maximum value of 1,219 ACSC hospitalizations per 100,000 adults in 2015. The decrease of ACSC

hospitalization rates in Brazil was 2.3 times the decrease of rates for all hospitalizations, while in Portugal the increase of ACSC hospitalization rates was 1.6 times the increase of rates for all hospitalizations. In 2016, the ACSC hospitalizations represented 8.6 and 10.7 of all hospitalizations in Brazil and Portugal, respectively. These values in 2007 were 10 and 9.9.

Figure 8. Trends of rates of ACSC hospitalizations per 100,000 adults; Brazil and Portugal, 2007 to 2016

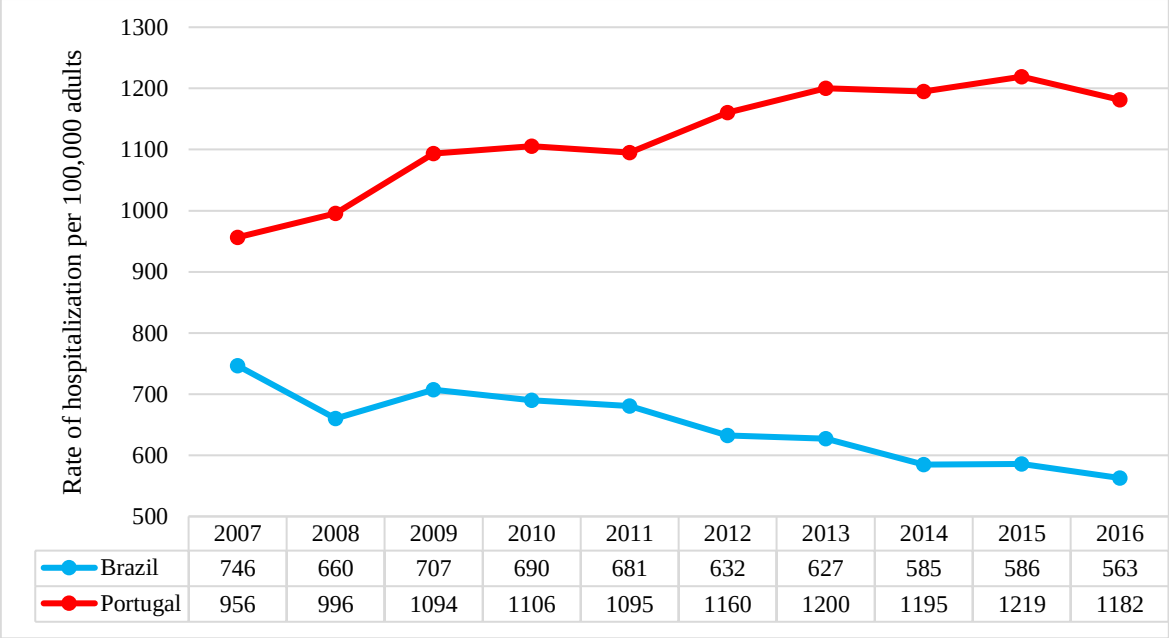

Table 23 presents rates of ACSC hospitalizations per conditions and the variation in rates between 2007 and 2016. For both countries, rates for pneumonia and urinary tract infection (acute conditions) have increased between 2007 and 2016; for Brazil these are the only conditions for which the variation goes in a different direction than the trend observed for all conditions combined. In Portugal, rates for heart failure and hypertension also increased. The highest reductions in Brazil were for COPD, hypertension and heart failure, while in Portugal it was for diabetes. For both Brazil and Portugal, the highest rates found during the period analyzed were for pneumonia; this condition had the highest increase for Brazil. The highest increase for Portugal was for urinary tract infections.

Table 23. Trends of rates for each ACSC per 100,000 adults and variation in % (2007 to 2016), Brazil and Portugal, 2007 to 2016

Country	ACSC	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Δ (%)
BR	Diabetes	39.0	38.1	38.7	38.5	39.3	36.9	37.6	35.5	36.5	34.8	-11%
PT		147.5	146.9	142.3	134.4	124.4	123.9	125.8	112.8	104.9	90.6	-39%

Country	ACSC	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Δ (%)
BR	COPD	175.7	133.9	126.7	117.9	112.7	95.3	91.4	81.0	80.7	74.2	-58%
PT		128.0	128.0	130.2	128.6	124.9	138.5	130.7	129.6	132.0	115.6	-10%
BR	Hypertension	104.4	88.7	88.3	82.9	77.4	70.4	63.6	57.8	53.3	45.6	-56%
PT		18.2	20.3	20.5	21.7	23.2	23.2	26.6	24.2	23.9	23.0	+26%
BR	Heart Failure	160.8	119.8	108.9	102.2	97.1	87.4	82.0	74.2	70.7	69.2	-57%
PT		208.5	219.1	228.3	233.8	229.2	258.5	274.7	280.0	287.0	291.3	+40%
BR	Pneumonia	172.1	186.1	237.5	236.0	242.6	228.3	238.8	222.0	223.9	224.0	+30%
PT		343.5	351.6	423.0	412.7	418.4	433.3	432.5	430.1	448.0	441.2	+28%
BR	Urinary Tract Infection	94.4	93.6	107.0	112.6	111.5	114.2	114.1	114.2	120.5	115.1	+22%
PT		110.9	129.7	149.3	174.5	174.7	183.0	209.8	218.1	223.3	219.8	+98%

Figure 9 presents the variation in rates per municipality for Brazil and Portugal; the scales correspond to quartiles of the ACSC hospitalizations rates found in 2007. In Brazil, the municipalities in the center of the south half of the country had higher rates in both periods, while in the north half the transition to lower quartiles is more visible. The number of municipalities with ACSC hospitalization rates lower than the median value of 2007 went from 2,785 to 3,634 between 2007 and 2016. In Portugal, the north half of the country presented higher rates for both years, especially for municipalities further of the coastal area. There is a marked transition from lower to higher quartiles for municipalities in the south region and in the coast of the center of the country. The number of municipalities with ACSC hospitalization rates higher than the median value of 2007 in Portugal went from 139 to 204 between 2007 and 2016.

Figure 9. Distribution of ACSC hospitalization rates by quartiles, Brazil and Portugal, 2007 and 2016

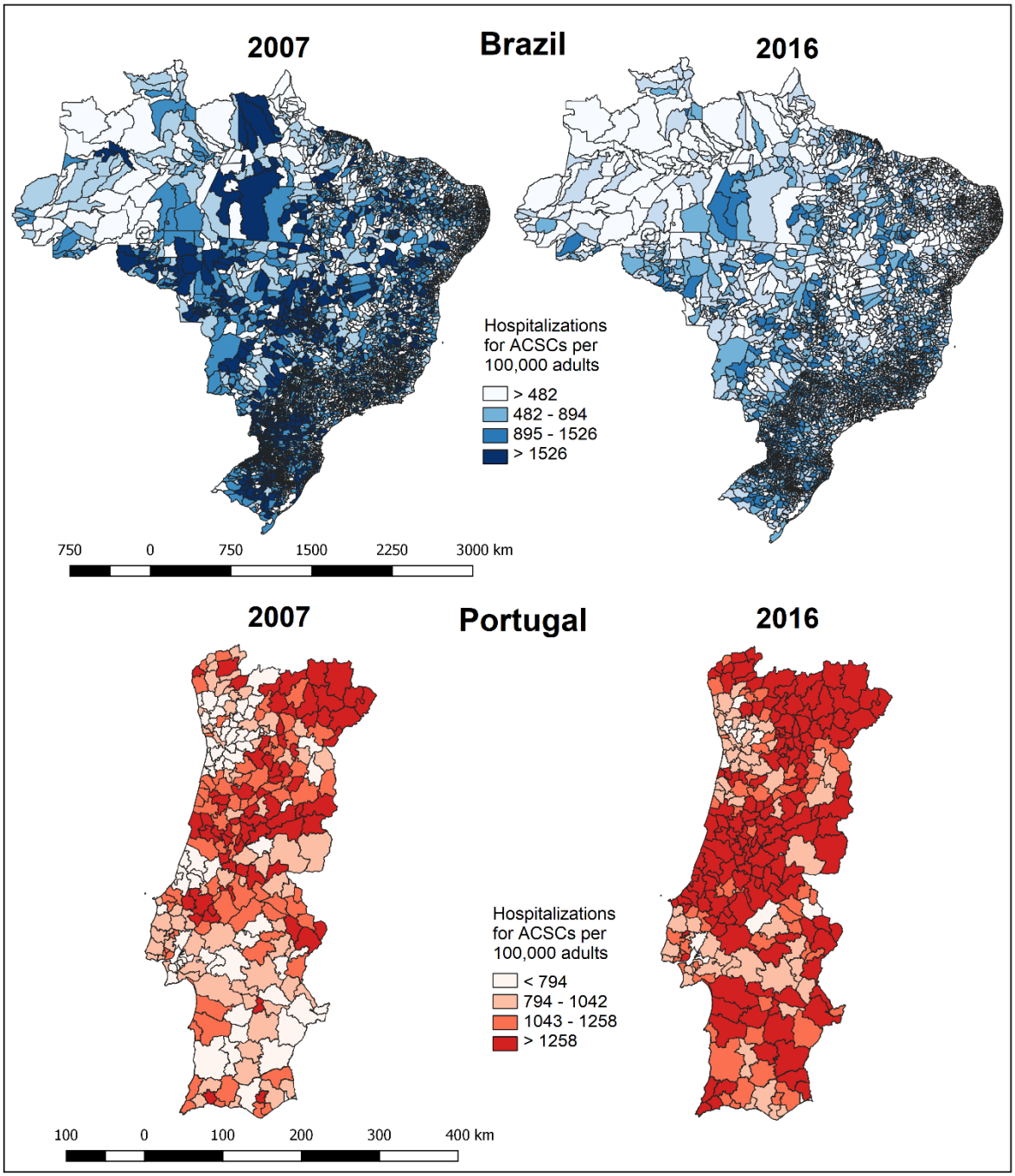

Table 24 presents the correlation between the FHU coverage and rates of hospitalization for each ACSC in 2015. For Brazil there were significant and inverse correlations between FHU coverage and hospitalizations for diabetes, hypertension and urinary tract infection. In the analysis by region, there were varying and opposite correlations among conditions and regions, without clear patterns.

For Portugal there were significant and inverse correlations between FHU coverage and hospitalizations for diabetes, health failure and pneumonia. In the analysis by region, the North region of Portugal had significant inverse correlations for all conditions analyzed.

Table 24. Correlation between FHU coverage and hospitalization rates for each ACSC, Spearman's coefficient (ρ), 2015

Country/ Region		Diabetes	COPD	Hypertension	Heart Failure	Pneumonia	Urinary tract infection
Brazil	**ρ**	**-0,040***	**0,009**	**-0,040***	**0,021**	**-0,036**	**-0,060***
	Sign.	**0,003**	**0,511**	**0,003**	**0,119**	**0,007**	**0,000**
North	x	-0,134*	-0,113*	-0,197*	0,039	0,006	-0,114*
Northeast	x	0,023	-0,022	-0,034	0,010	0,000	-0,057*
Center-West	x	-0,109*	0,135*	0,019	-0,042	0,067	0,052
Southeast	X	-0,055*	0,155*	-0,117*	0,121*	0,060*	0,012
South	X	-0,031	0,140*	0,006	-0,17	0,107*	0,063*
Portugal	**ρ**	**-0,272***	**0,027**	**-0,136**	**-0,299***	**-0,299***	**-0,136**
	Sign.	**0,000**	**0,657**	**0,023**	**0,000**	**0,000**	**0,023**
Alentejo	ρ	0,098	0,098	-0,160	-0,098	0,072	0,347*
Algarve	ρ	-0364	-0,277	-0,486	-0,400	-0,324	-0,547*
LVT	ρ	0,104	0,200	-0,406	0,341	0,109	0,092
Center	ρ	-0,293*	-0,037	-0,170	-0,216*	-0,188	0,022
North	ρ	-0,410*	-0,320*	-0,285*	-0,550*	-0,475*	-0,480*

* P-value < 0.005

Table 25 shows which FHU coverage group presents the highest and the lowest hospitalization rate per ACSC, region and year, for Brazil. Only the differences flagged as statistically significant by the Kruskal-Wallis test (p-value < 0.05) are shown in the table. For the Southeast e South regions, the municipalities with 100% of the population covered by FHU (group 3) presented lower mean hospitalization rates for diabetes and hypertension than municipalities that did not reach full coverage (groups 1 and 2). On the other hand, group 3 municipalities in these regions had higher mean rates for COPD, pneumonia and heart failure. Municipalities in group 3 in the North region had the highest mean rates for heart failure and pneumonia, while Center-West municipalities in group 3 had the lowest rates for these conditions. In the Northeast region there were few differences in mean hospitalization rates between groups of municipalities throughout the analyzed years for most ACSC, except for urinary tract infection, in which municipalities with lower FHU coverage (groups 1 and 2) had significantly higher mean hospitalization rates.

Table 25. Differences in mean hospitalization rates between FHU coverage groups, per region, ACSC and year, Brazil, 2007 to 2016

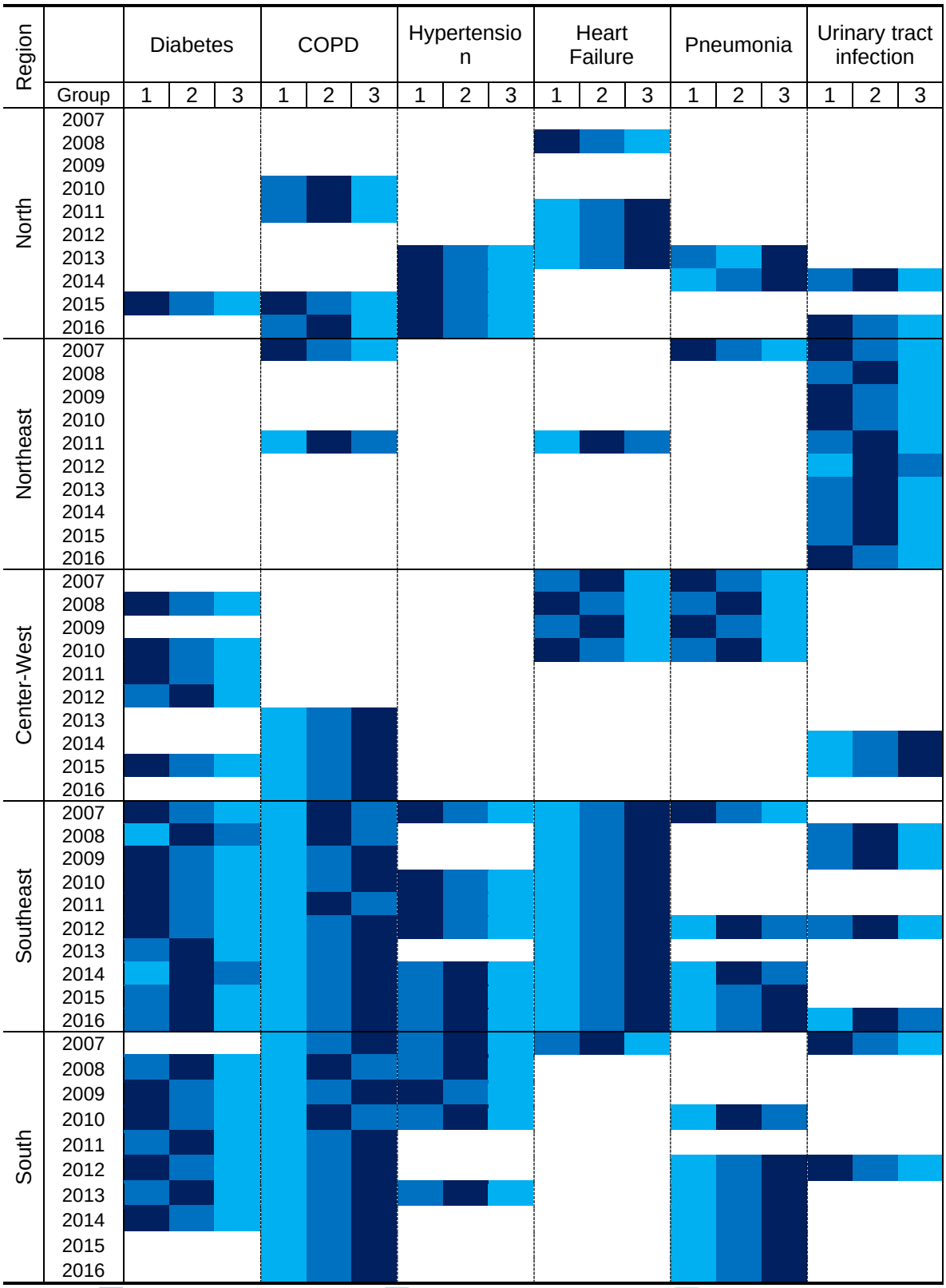

Table 26 shows the regression models built for Portugal by region, with variation of ACSC hospitalization rates in % between 2007 and 2016 as dependent variable. For some regions there were no regression model adjusted using the variables analyzed and these cases were omitted from the table. There were no LHU in Algarve and LVT regions, therefore the variable *years since implementation of LHU* was not included for these regions. There were no models adjusted for hypertension for any of the regions.

Regression models were built for the Center region for all the conditions, with high values of R^2 and adjusted R^2, and with the variation of all hospitalizations included as positive coefficients. FHU coverage was only included in the model for urinary tract infection in the North region, together with years of ULS, indicating that lower coverage in 2015 and fewer years since implementation of LHU were associated to higher increase of hospitalization rates from 2007 to 2016. Models for this condition were also adjusted for the Alentejo and Center regions, with purchase power being included as negative coefficients. Hospital beds supply was only included in the model for pneumonia in the North region with negative coefficient. There were no models adjusted for Algarve or LVT for any of the conditions.

Table 26. Regression models for Portugal, by ACSC and region

Diabetes							
Region		B	Beta	Sig.	95% CI	R^2	Adjusted R^2
Alentejo	Constant	-26,649		0,316	-79,47/26,17	0,174	0,157
	LHU Years	13,598	0,417	0,002	5,18/22,02		
Center	Constant	-32,079		0,000	-41,72/-22,44	0,533	0,527
	Variation all hosp.	1,153	0,730	0,000	0,91/1,4		
COPD							
Region		B	Beta	Sig.	95% CI	R^2	Adjusted R^2
Center	Constant	425,388		0,018	74,17/776,61	0,705	0,697
	Variation all hosp.	8,544	0,850	0,000	7,3/9,79		
	Purchase power	-5,752	-0,152	0,017	-10,44/-1,06		
Heart failure							
Region		B	Beta	Sig.	95% CI	R^2	Adjusted R^2
Center	Constant	11,077		0,652	-37,63/59,78	0,853	0,851
	Variation all hosp.	9,304	0,924	0,000	8,44/10,16		
North	Constant	50,750		0,000	28,64/72,86	0,093	0,079
	Variation all hosp.	0,809	0,304	0,010	0,2/1,42		
Pneumonia							
Region		B	Beta	Sig.	95% CI	R^2	Adjusted R^2
Center	Constant	-50,328		0,373	-162,14/61,49	0,862	0,860
	Variation all hosp.	22,181	0,928	0,000	20,21/24,15		
North	Constant	-122,92		0,009	-214,73 -31,1	0,239	0,204
	Variation all hosp.	0,789	0,297	0,007	0,22/1,36		
	Purchase power	2,317	0,517	0,001	1,05/3,59		
	Bed per 1,000 people	-11,066	-0,428	0,004	-18,38/-3,76		
Urinary tract infection							
Region		B	Beta	Sig.	95% CI	R^2	Adjusted R^2
Alentejo	Constant	761,219		0,000	395,1/1127,3	0,135	0,117
	Purchase power	-6,024	-0,367	0,008	-10,4/-1,65		

Center	Constant	834,321		0,005	264,7/1404	0,804	0,799
	Purchase power	-8,518	-0,117	0,027	-16,06/-0,97		
	Variation all hosp.	11,924	0,910	0,000	10,57/13,28		
North	Constant	197,928		0,000	150,1/245,8	0,311	0,279
	Variation all hosp.	1,619	0,339	0,002	0,61/2,63		
	LHU years	-18,736	-0,401	0,000	-28,38/-9,09		
	FHU coverage	-1,232	-0,351	0,002	-1,98-0,49		

Table 27 presents the means and standard deviation of the variation of ACSC hospitalization rates between 2007 and 2016 for regions and conditions by FHU coverage group. The Kruskal-Wallis test showed that for municipalities in Alentejo without FHU (group 1) there was a mean increase in hospitalization rates for diabetes, while municipalities that implemented FHU (groups 2 and 3) the rates decreased. For the North region, municipalities without FHU (group 1) had higher mean increase in urinary tract infection hospitalization rates than municipalities that implemented FHU; municipalities that reached higher levels of FHU coverage (group 3) had higher mean increase than other municipalities (group 2).

Table 27. Differences in variations of ACSC hospitalization rates between FHU coverage groups, from 2007 to 2015, per region and ACSC, mean and standard variation, Portugal

Region	FHU coverage group	n	Diabetes	COPD	Hypertension	Heart failure	Pneumonia	Urinary tract infection
Alentejo	1	42	**56* (145)**	35 (112)	116 (159)	79 (123)	80 (96)	286 (219)
	2	2	**-55* (20)**	-6 (0)	38 (4)	16 (5)	46 (76)	164 (142)
	3	14	**-11* (43)**	-7 (114)	0 (72)	5 (27)	85 (105)	199 (210)
Algarve	1	10	17 (119)	13 (69)	138 (369)	55 (87)	32 (41)	73 (126)
	2	2	-35 (4)	9 (13)	10 (25)	8 (5)	13 (27)	64 (61)
	3	4	-39 (7)	4 (15)	182 (221)	4 (23)	39 (35)	46 (41)
LVT	1	1						
	2	9	-26 (29)	-8 (55)	94 (226)	15 (36)	30 (50)	102 (78)
	3	8	-23 (21)	-21 (25)	99 (142)	33 (40)	43 (26)	147 (90)
Center	1	62	-5 (139)	85 (444)	102 (172)	86 (344)	444 (2387)	342 (618)
	2	14	23 (210)	345 (1196)	-2 (52)	492 (1647)	961 (3430)	669 (1759)
	3	24	-21 (61)	28 (71)	61 (129)	246,(880)	447 (1948)	377 (980)
North	1	37	-16 (60)	106 (194)	117 (242)	70 (102)	43 (69)	**187* (168)**
	2	7	-34 (22)	69 (89)	111 (72)	97 (74)	53 (31)	**38* (30)**
	3	42	-12 (43)	45 (111)	206 (264)	64 (55)	50 (89)	**99* (111)**

* Significant difference by Kruskal-Wallis test between means of ACSC hospitalizations variations between FHU coverage groups (p-value <0.05)

Discussion

The findings of this study show that ACSC hospitalization rates decreased in Brazil and increased in Portugal between 2007 and 2016, and these variations were higher than the decrease/increase of all hospitalizations for each country. Trends and rates were associated

to the FHU expansion and coverage for some regions and some conditions in both countries, but there were found no patterns that allow to affirm the effectiveness of the PHC reforms nationwide when measured using ACSC hospitalizations as indicator for performance.

For Brazil, there was significant negative correlation between FHU coverage and ACSC hospitalization rates for some conditions and regions, in line with findings from other studies (348). Despite the possible impact of FHU coverage in providing better health care in terms of access, diagnosis, monitoring and treatment of conditions, it was not possible to isolate such effects in the analysis of trends for ACSC hospitalization rates.

There were found varied results in differences in mean hospitalization rates between FHU coverage groups both per region and per condition in Brazil. These results indicate differences in the possible effect the PHC reform had within the country. These varied results can also be driven by the expressive disparity of Brazilian municipalities and regions regarding population size, demographic density and geographic distribution, and social, economic and political development (348).

Except for the Northeast region, the municipalities with full coverage of FHU had lower mean rates of diabetes and hypertension. While it is not possible to affirm that such differences are consequence of FHU, it is important to notice that these are priority areas of the PHC in Brazil: as part of the National Program for Hypertension and Diabetes (called HIPERDIA), patients with hypertension and diabetes can be registered at a computerized follow-up system restricted to health system units (349), aiming to provide integrated care. There is evidence of the positive impact of policies and practices developed in the FHS context for diabetes and hypertension: access to care, measured as number of consultations and utilization of health care services, was higher in FHU teams that joined the More Doctors Programme (PMM) (350).

There was no data available for Portugal on FHU expansion per year; however, as the first FHU were implemented in Portugal in 2006 and very few of them closed down until 2015, it is fair to assume that the FHU coverage in 2015 represent the expansion of the PHC reform during the period analyzed. As stated, most of the FHU were implemented in the North region of Portugal, and for this region the correlation analysis showed that higher increase in rates was associated to lower FHU coverage for all conditions. The regression and Kruskal-Wallis analysis found further evidence of the role FHU coverage may have had on the variation on rates of hospitalization for urinary tract infection in the North region. The analysis of this condition is particularly relevant for Portugal as it had the highest increase

among the conditions analyzed, with rates nearly doubling from 2007 to 2016. A previous study also found a statistically significant effect of FHU for this condition, discussing that FHU patients might have had faster and easier access to PHC, which helped to avoid the hospitalization (45).

A previous study in the North region in Portugal analyzed the possible impact of FHU development and rates for chronic ACSC (according to the Canadian list (32)); and results indicated a positive association between these two dimensions (294). The same study did not found impact of the introduction of LHU on ACSC hospitalization rates.

For the other regions of Portugal there were no indications that FHU coverage had played an important role in trends of ACSC hospitalizations. For the Center region the regression models had a high level of adjustment, with the variation in rates of all hospitalizations being the main driver of the variation in ACSC hospitalization rates. These results show that the increase of ACSC hospitalization rates in this region was mostly associated to the increase in hospitalization rates in general. As ACSC hospitalizations represent around 10% of all hospitalizations in Portugal, it cannot be implied that such increase was driven by variations for the six conditions analyzed in this study. The factors behind the increase of total hospitalizations for this particular region should be further investigated.

The previous studies that have found no statistically significant evidence that the implementation of FHU had a significant impact on reducing rates for ACSC hospitalizations suggest that other characteristics beyond availability of PHC resources are associated to these health outcomes (45,197,338). Dimitrovová et al. (45) discusses that FHU in Portugal were implemented in municipalities with better health outcomes, younger population, and greater purchasing power, due to the voluntary aspect of the PHC reform in Portugal. As implementation was not random, there are confounders that make the nationwide evaluation of FHU in health outcomes challenging for Portugal.

Brazil and Portugal presented geographic disparities in evolution of ACSC hospitalization rates between 2007 and 2016, with specific regions presenting higher variations. The mentioned variations can be associated to the PHC reforms, measured as FHU coverage, as the analysis have shown negative correlation for specific conditions: diabetes, hypertension and urinary tract infection for Brazil, and diabetes, heart failure and pneumonia for Portugal. The results of the correlation analysis for 2015 may not hold true to analysis for the years before and may not apply to the upcoming years.

The impossibility of including factors that may affect primary care practices and ACSC hospitalization rates was a limitation of this study. While the population covered is a good estimation of access, there are other factors associated to the health care delivery and health system organization which could not be included in the analysis. In both countries the PHC is also delivered through non-adopting health teams, and their performance was not included here. Nonetheless, results suggest the potential to reduce the number of ACSC hospitalizations by focusing of specific regions and conditions.

Conclusions

Brazil and Portugal presented opposite directions of ACSC hospitalization rates between 2007 and 2016, with significant regional differences. There were indications that the expansion of FHU promoted by the PHC reforms was associated to lower rates of ACSC hospitalizations; but these results were not consistent neither within or between Brazil and Portugal nor for all conditions analyzed. The findings of this study show that the assessment of health policies at a national level using a composite indicator is challenging and reaffirm the need of local and targeted actions to reduce avoidable hospitalizations.

Chapter 6. Discussion

The assessment of performance of health systems is necessary to identify influencing aspects and points of improvement, to subsequently define actions to achieve improved health outcomes. The analysis of comparable information supports evidence-based decisions as it provides references on health system performance and explanations for variations at national and international levels, being this process crucial to strengthen health services delivery. ACSC hospitalizations indicates suboptimal capacity of primary health care into avoiding some hospitalizations. The analysis of ACSC hospitalizations has been emerging as a valuable tool for assessing quality of PHC: it has been used by international organizations and has been incorporated into evaluation processes in different countries. The aim of this thesis was to discuss dynamics of hospitalizations for ACSC in Brazil and Portugal, having as backdrop the PHC reforms underwent in both countries. The results of this investigation were presented as a compilation of studies with varied objectives and methodologies.

The main results are summarized in the following paragraphs and discussed in detail in the subsequent subsections. Each subsection refers to one of the specific objectives of this thesis.

Findings of the literature review in Study 5.1 agree that strengthening PHC and promoting access provides opportunities to reduce avoidable hospitalizations. The inter-country comparison of ACSC hospitalizations can suggest health policy implications and potential points of improvements to reduce these events, as demonstrated by the health policy implications found in Study 5.1, and in findings of Studies 5.2 to 5.6. However, to compare ACSC hospitalizations between countries is not a straightforward task, and a model was built which indicates dimensions to be accounted for in this comparative exercise, in the scope of methods, population and health system (Study 5.1). The model can assist future studies aimed at performing inter-country comparison of ACSC hospitalizations. Different methodological choices can significantly alter results and, consequently, the interpretation of this indicator both for in-country and inter-country analysis (Study 5.2).

Around 7 and 10% of all hospitalizations in Brazil and Portugal were classified as ACSC in 2015, respectively (Study 5.2). The concept of ACSC indicates that there was knowledge and technology in the outpatient setting to avoid the need for hospitalization, and these values represent opportunity gains that could be potentially achieved. The impact these

events have in an economic perspective was investigated by estimating costs (Studies 5.3 and 5.4), with findings indicating these events lead to substantial financial burden to health systems and economic burden to society. Brazil had lower crude ACSC hospitalization rate and more homogeneously distributed among age groups than Portugal (Study 5.2). Brazil and Portugal had large variation of ACSC hospitalization rates within the countries (Study 5.5). These findings could indicate variable access and quality of care and inefficient use of resources. Both countries had similarities regarding which conditions were more common on ACSC hospitalizations (Study 5.2).

Between 2007 and 2016, ACSC hospitalization rates decreased in Brazil and increased in Portugal (Study 5.6). For both countries there were indications that expansion of PHC reform (analyzed using FHU coverage as proxy) may be associated to reductions in ACSC hospitalizations (Studies 5.5 and 5.6). These results however did not apply to all conditions, neither to all geographic areas within each country, and for some conditions were discordant between both countries. Because positive results were found only for specific circumstances (e.g., hypertension and diabetes in the South region of Brazil, urinary tract infections in the North region of Portugal; Study 5.6), it is more suitable to define possible actions to reduce ACSC hospitalizations at the local level (Study 5.5). Overall, there was no robust evidence of the association between expansion of PHC reforms in Brazil and Portugal and reduction of ACSC hospitalizations.

6.1 Key findings and implications of the findings

6.1.1 ACSC hospitalizations for assessment and inter-country comparison purposes

The first specific object of this thesis was to discuss conceptual and methodological aspects of comparative research on ACSC. It is understandable why reducing avoidable hospitalizations is a pressing matter on national and international agendas, and to understand how dynamics of health and welfare in countries may be associated to positive experiences in terms of health outcomes can bring important insights. Therefore, the comparative approach on ACSC hospitalizations can assist health decision-makers learning and drawing valuable lessons.

To reach benefits from the objective proposed in this thesis, it was necessary to understand both the potentials and limitations of inter-country comparisons on ACSC hospitalizations.

For that, a scoping review was used in Study 5.1 to identify studies that compared ACSC hospitalizations between countries. The review demonstrated that the comparisons could provide information of health policy implications that can assist reducing ACSC hospitalizations. Study 5.1 found agreement in the literature that strengthening PHC and promoting access provides opportunities to reduce avoidable hospitalizations. The use of ACSC hospitalizations as a health care performance indicator is particularly facilitated as this information is usually readily available through administrative databases; therefore, is it possible to identify point of improvement in a specific setting, using others for benchmarking. Such results ratify the relevance of the comparative exercise developed in studies 5.2 to 5.6.

However, there are relevant obstacles in the inter-country comparison of ACSC hospitalizations. The discussion section in Study 5.1 summarized dimensions to be accounted for when performing such comparisons, and the model presented can assist future studies that seek to compare ACSC hospitalizations between countries. The use of comparative data at an international level has been increasingly popular in health system performance assessment (79); and one notable example of this approach for ACSC hospitalizations is the work of OECD in collecting and reporting this data. The OECD has been collecting data from its member countries since the 1960s and, as described in section 2.4 of this thesis, initiated the HCQI project in 2001, with analysis on avoidable hospitalizations included to compare quality of care among countries (146). Inter-country comparisons of different health outcomes, including ACSC hospitalizations, are challenging given the multitude of methodological aspects and explanatory factors to consider.

For the context of this thesis, the dimensions identified in Study 5.1 were applied as much as possible, according to the objective of each study and data availability. Given the impact on results of which conditions are analyzed, a single list was selected (AHRQ) and used for Studies 5.2 to 5.6, to ensure comparability. The methodology selected have strengths (described in the methods section of studies 5.2, 5.3 and 5.5), which have been acknowledged by the General Directorate of Health Care of France, as in 2018 they published a French quality indicator that was a direct adaptation from the AHRQ list (34). This AHRQ methodology also included secondary diagnosis in the identification of avoidable hospitalizations, somewhat addressing the challenge of including comorbidities in the analysis of avoidable hospitalizations, as mentioned in Study 5.1.

Nearly all the ACSC lists included in Table 8 of Study 5.2 were developed more than 10 years ago; as health knowledge, technologies and population demands are constantly changing, the regular update of ACSC list is an important matter for the usefulness of the concept as an assessment indicator (46). As mentioned in studies 5.2, 5.3 and 5.5, the list developed by AHRQ is revised and updated regularly: for studies 5.2 to 5.6, the AHRQ methodology was applied accordingly to the versions that were available at the time of analysis (versions 6.0 and 7.0). Previous versions included a PQI associated to angina (*PQI 13- Angina Without Procedure Admission Rate*), however this was retired from version 6.0 onwards.

The retirement of this pathology from the AHRQ methodology was justified by shifts in coding practices; the use of observation services for chest pain classified as outpatient stays; and possible inadvertent incentivization of performance of more procedures, as the PQI 13 excluded hospitalizations that involved procedures, and the AHRQ methodology is used by healthcare systems and insurers to track quality within their groups of providers (351). Effective from version v2019 implemented in 2019 (after studies 5.2 to 5.6 were developed), the PQI associated to dehydration was also retired (*PQI 10- Dehydration Admission Rate)*, under the justification of limited evidence base in the literature on the use of this indicator for quality improvement, rarity of events, advancement in medical technology and significant analytical work for refinement (352).

If studies 5.2 to 5.5 did not include dehydration as ACSC, results would not be affected significantly, as these conditions had a crude rate of less than 50 hospitalizations per 100,000 adults for Brazil and Portugal. It was also not one of the main five pathologies for either country: for that reason, it was not included on Study 5.6. However, if angina was included in the analysis, results of studies 5.2 to 5.5 would have been significantly altered, especially for Brazil: as indicated in Table 11 of Study 5.2, if angina was included in the list of conditions analyzed, standardized hospitalization rates for Brazil would increase 16.24% (from 415 to 483 per 100,000 adults). In 2015, there were 135,109 hospitalizations classified as angina in Brazil (using the ICD codes of Table 9 of Study 5.2); given that the cost of each avoidable hospitalization was estimated at US$ PPP 1,919 for Brazil in Study 5.4, avoidable hospitalizations for angina would represent a cost of US$ PPP 259 million in 2015. Since the geographic distribution of the hospitalizations for this condition in Brazil was not analyzed, it is not clear how results of studies 5.5 and 5.6 for Brazil would have been impacted.

A country-specific ACSC list for Portugal was developed and published in 2020 by Sarmento et al. (46). A modified Delphi panel approach was designed, and 84 experts participated in the panel that lasted from September 2017 to May 2018 (for more details on the methods for the list development, see: Sarmento et al. 2020 (46)). The final list consisted of 40 conditions; four of which were novel conditions suggested by the experts and not presented in previous lists. These new ACSC included uterine cervical cancer, thromboembolic venous disease, voluntary termination of pregnancy and colorectal cancer: the latter had the fifth highest hospitalization rate in Portugal in 2017 among the conditions proposed by the new list (46). According to this methodology, the hospitalization rate for 2017 was 1,685 hospitalizations per 100,000 adults, which is higher than rates found in Studies 5.2 and 5.3 for 2015 (1,253 hospitalizations per 100,000 adults); this difference is explained by the wider range of conditions considered ACSC by the list developed in 2020. Nonetheless, the conditions analyzed in studies 5.2 to 5.6 of this thesis represented 70.5% of all ACSC hospitalizations in 2017, according to Table 4 on Sarmento et al. 2020 (46). This comparison considered the broad denomination of the following conditions, but exact ICD codes between lists may vary: chronic obstructive pulmonary disease, diabetes mellitus, heart failure, hypertensive disease, pneumonia, urinary tract infections. Therefore, findings regarding ACSC dynamics in Portugal can be considered satisfactory representative of what would be found if the new list was applied.

A country specific list for Brazil was developed in 2009 (57). The conditions analyzed in studies 5.2 to 5.6 of this thesis accounted for 54.6% of all ACSC hospitalizations in Brazilian cities with over 100,000 inhabitants in 2014 according to the Brazilian list (353) (this comparison lacks accuracy, as it was also done according to denomination of conditions and not their specific ICD codes). Other conditions that accounted for a high volume of avoidable hospitalizations according to the Brazilian list were gastroenteritis, skin infections and cerebrovascular diseases: these account for 21.6% of all ACSC hospitalizations in 2014, according to Table 2 on Pereira et al. (353). The comparison of Brazil and Portugal would be impacted if these conditions were included, since gastroenteritis and skin infections accounted for 5% of all ACSC hospitalizations registered in Portugal in 2017 according to the Portuguese list (46). For cerebrovascular diseases, while ICD-10 codes I64 and I67.4 were classified in the Brazilian list as *cerebrovascular disease* (57), these codes were classified in the Portuguese list under the *hypertensive disease* category (46). The ICD-10 codes in the Brazilian list that compose the group denominated *Hypertension* (I10 and I11) were included in the Portuguese list under *hypertensive disease* and *heart failure*.

This discussion of lists, conditions and diagnostic codes illustrates an important challenge in the analysis of ACSC hospitalizations that is commonly overlooked: it is tempting to adopt the ACSC concept, consider it a solid and autonomous construct, apply it to a specific context without critical thinking, and interpreting results based on quantitative values that may not reflect what the concept of *avoidable hospitalization* first intended. Such challenge is exacerbated when performing ACSC comparison between countries and attempting to interpret findings.

For instance, the Brazilian list, although specific for the country, was not employed in this thesis as many conditions would not be relevant for the Portuguese context, and the comparison exercise could be undermined. On the other hand, the opportunities of identifying high-risk clusters (as performed in Study 5.5) or estimating costs for lost-productivity (as presented in Study 5.4) for Brazil were lost, as well as the benefits of such analysis for the specific setting. Future studies have to acknowledge that the use of different definitions of ACSC hospitalizations have a significant impact on results: in Study 5.2 it was shown that the inclusion of other conditions would increase the crude rate of ACSC hospitalizations by 34 and 18% for Brazil and Portugal, respectively.

Another important dimension for inter-country ACSC hospitalizations comparison addressed in Study 5.1 was how to observe and analyze data. For this thesis, ACSC hospitalizations were observed and reported using different metrics, namely absolute number, crude and standardized rates, proportion according to all hospitalizations and economic value. Most of the studies reviewed in Study 5.1 were based on standardized rates, to account for differences in population structure. In Study 5.2 both crude and standardized rates were presented, however for Studies 5.5 and 5.6 the analysis was conducted using crude rates, as the objective was to understand the real situation withing each country and then discussing their experiences.

The methodological choice on how to account for differences in population structure impacts on results and the understanding of the information. In fact, results of Study 5.2 showed that if only hospitalizations for people aged less than 75 years were deemed avoidable, then Brazil and Portugal would have virtually the same ACSC hospitalization rates. These results show both the impact that different population profiles have in results, and the importance of tackling specific age groups when designing interventions to reduce ACSC hospitalizations.

Study 5.1 discussed the importance of accounting for different features of health services and system, including remuneration schemes, workforce distribution, coordination with other levels of care and dynamics between public and private providers. In section 2.6 of this thesis, some of these features were discussed in more detail in the context of PHC reforms in Brazil and Portugal. However, due to data unavailability and being outside the scope of the studies in Chapter 5, such features were not included in the analysis of this thesis.

Study 5.1 have found disagreements on which health system features to target in order to reduce ACSC hospitalizations; namely, there were mixed reviews whether ACSC hospitalizations were driven by availability of general practitioners, PHC facilities and availability of hospitals. Such debate was in line with mixed findings from previous literature on single-country studies (61,354,355). A systematic review have found mixed results regarding the association between supply of medical workforce and avoidable hospitalizations for type 2 diabetes (61). The ten articles selected in this review had a combined total of 12 measures for the relationship between PHC resourcing and ACSC hospitalizations, 7 of which had a significant inverse association, thus providing inconclusive support that more resources in PHC was associated to lower ACSC hospitalizations (61).

A study in a region of France aimed to assess the impact of PHC on geographic variations of ACSC hospitalizations and, by splitting the region in two zones (according to socioeconomic characteristics) and performing two separate analysis, authors found that the set of PHC variables associated with rates of ACSC hospitalizations differed significantly between the two zones (355). More specifically, the protective role of consultations with general practitioners was only observed for the zone with lower unemployment rates and higher median income per year. Authors argue that underlying mechanisms leading to ACSC hospitalizations depended on socioeconomic characteristics, therefore the role of PHC in potentially reducing these events is geography dependent (355). Another study questioned the validity of using ACSC hospitalizations for assessing performance of PHC, since a substantial share of the variance for rates in Finland were explained by socioeconomic and health factors at the individual level, as well as population health indicators and hospital care organization at the population level (354). Authors discussed that the use of ACSC hospitalizations for benchmarking PHC providers demands caution, and that other variables not associated to PHC must be taken into consideration.

It is noteworthy that, as the number of studies increased (as indicated in Figure 1), researchers have become more critical of ACSC as a tool for assessing health services

delivery (156–158,354–356). As discussed in Study 5.1 and throughout this thesis, how to interpret the indicator must take into account the setting in which the analysis takes place. For example: during the COVID-19 pandemic in 2020, many countries had significant disruptions in their urgent care and inpatient hospital production (357–361), due to reasons ranging from reorganization of emergency and hospital care, changes in health-seeking behaviours and health care facilities being overwhelmed with the surge of COVID-19 cases requiring care (362–365). If future studies perform a time series analysis of ACSC hospitalization rates with the inclusion of year 2020, it is plausible to assume the ACSC hospitalization rate would significantly drop during the pandemic period: such reduction was not driven by improvements in PHC or ambulatory care quality, but by lack of hospital access. Although extreme and exceptional, this example serves to illustrate that the reduction of ACSC hospitalizations should not be irrespective of specific contexts of the setting that go beyond the PHC domain. Such argument is also acknowledged by the PHC reforms of Brazil and Portugal: to reduce ACSC hospitalizations is not a direct objective of the reforms, but instead it is expected these events are reduced by constant improvements in health care delivery.

The framework of ACSC hospitalizations encompasses different levels of the health system, not only PHC, which further complicates its application in a comparative approach. Such challenge applies to health system performance assessment in general, as defining the boundaries of health systems is a key debate when considering international frameworks for inter-country comparisons (79).

Study 5.1 identified several caveats when performing inter-country comparison of ACSC hospitalizations, and the findings of Study 5.2 illustrated how different methodological choices can impact results and, consequently, the analysis of this indicator. These findings, together with the limitations of ACSC presented in section 2.4 of this thesis, demonstrate that comparing ACSC hospitalizations between countries is not a simple task.

Papanicolas et al. (366) lists three key tasks for performing inter-country comparisons of health systems overall: to define what constitutes the analyzed health systems, to account for data limitations, and to interpret results in light of national policies, values and priorities. Comparative exercises provide opportunities to reflect on the situation of a setting and to identify potential improvements, if the challenges for inter-country comparison are addressed (366). The reviewed studies in Study 5.1 showed that inter-country comparison can provide good indications of opportunities to reduce avoidable hospitalizations. The

interpretation of findings of Studies 5.2 to 5.6 were done in the light of the sociodemographic and economic characteristics of Brazil and Portugal and the PHC reforms, considering the methodological limitations associated to ACSC hospitalizations.

6.1.2 ACSC hospitalizations in Brazil and Portugal

The second specific objective of this thesis was to compare ACSC hospitalizations in Brazil and Portugal in the dimensions of occurrence, rates, causes, sociodemographic characteristics, costs of hospitalizations ad economic impact, geographic distribution and variations. Findings of Study 5.2 indicated that in Brazil and Portugal, 7 and 10% of all hospitalizations in 2015 could have potentially been avoided given that timely and effective care was provided at the outpatient setting. These values were similar to what was found in other studies with varied lists for Portugal (367), but lower than values obtained used the country-specific list for Brazil (44). Nonetheless, these values represent opportunity gains that could be potentially achieved by strengthening PHC.

Portugal had a higher crude ACSC hospitalization rate than Brazil in 2015 (1,254 and 598 per 100,000 adults, respectively); however, both countries had similar standardized rates. Findings of Study 5.2 indicates the reason behind this situation: in Portugal, more than 80% of all ACSC hospitalizations were for people aged 65 years or older. Age is a known risk factor associated to ACSC hospitalizations, which is expected given that the elderly population is more susceptible to health complications resulting from the biological ageing process. Results regarding ACSC hospitalizations being more common among older age groups in Portugal were similar to what was observed in other countries in Europe (95,258,325), which have similar population structure by age groups. These findings further suggest the need of paying closer attention to age groups regarding ACSC hospitalizations, especially the elderly. To monitor and reduce avoidable hospitalizations among this age group is especially important given that, after hospitalization, older people are at increased risk of disability, cognitive impairment and decline (368–370). Elderly people are also at higher risk of potentially avoidable readmissions (371,372).

Older people account for a substantial share of PHC patients worldwide (373), and as populations age and the burden of chronic conditions increases, the demand on health systems also increases. Chronic conditions can be managed at the PHC level, and there is increased risk of ACSC hospitalization associated to number of chronic conditions and affected body systems that a patient presents (122). Care provided in a community-based and continuous approach, as it is advocated by the PHC reforms in both countries, have the

potential of reaching the elderly and addressing their needs before the hospitalization is necessary. This is particularly relevant for a country like Portugal, which is one the most unequal European countries for the elderly population (374).

Results of Study 5.2 showed that ACSC hospitalizations were more homogenously distributed across age groups in Brazil than in Portugal. As indicated by the analysis of standardized rates, these findings were related to the fact that Brazil in Portugal present different population structures (as described in section 4.1 and shown in Table 20 in Study 5.5).

Differences in distribution of ACSC hospitalizations across age groups also reflected in the costs these events represented for each country. According to Study 5.4, the total cost of ACSC hospitalizations in 2015 in Portugal was 250 million euros (84% corresponding to direct costs); in Brazil it was 3 billion reais for Brazil (77% corresponding to lost productivity costs). For Portugal, the total estimated costs of ACSC hospitalizations corresponds to 6% of the total budget of public hospitals in Portugal in 2015 (312). For Brazil, the fixed PAB in 2013 (as explained in section 2.6) was 5.3 billion reais (236), and the estimated costs of ACSC hospitalizations corresponds to more than 50% of this value. These examples, although not comparable with each other, provides a better understanding of the economic and social pressure these events represent. Such results regarding the pressure ACSC hospitalizations represent are in line with the findings of the few other studies that also estimated costs for ACSC hospitalizations (33,43,82,258,295).

The impact of differences in the Brazilian and Portuguese populations on ACSC hospitalizations are further exacerbated by the disparate socioeconomic characteristics of both countries, as indicated in the introduction section of Study 5.5 and the discussion section of Study 5.6.

In Study 5.5, the evidence of association between economic level and critical areas for ACSC hospitalizations were opposite between acute and chronic conditions for Brazil and Portugal. The review performed in Study 5.1 also found disagreements on how socioeconomic status and epidemiologic profile of populations were associated to ACSC hospitalizations. A systematic review on association between socioeconomic inequalities and ACSC for chronic conditions found that very few studies reported non-significant or contrasting results regarding this association (375). It is important to acknowledge that socioeconomic status was not the primary exposure of interest in any of the studies in Chapter 5. Despite this thesis having produced no concluding evidence on the association

between economic level and ACSC hospitalizations for Brazil and Portugal, it is expected that higher ACSC hospitalization rates are found among less privileged social groups, given the previous literature on systematic differences in health between people according to their socioeconomic position in its different measures (335) and on association between socioeconomic status and ACSC hospitalizations (375).

Not only Brazil and Portugal present different characteristics to each other in terms of population structure and socioeconomic development, both countries also have extreme differences in variation within country regarding geographic characteristics. Such contrast is reflected in the large variation of ACSC hospitalization rates within the countries. Findings in Study 5.5 showed that the variation of rates in municipalities between percentiles 5 and 95 varied 26 and 36-fold for acute and chronic ACSC in Brazil, respectively. These values for Portugal were 5 and 3-fold. Despite the remarkable difference in rates variation between Brazil and Portugal, findings of Study 5.5 showed that there is room for improvement in both countries: as some regions can achieve lower rates of ACSC hospitalizations, these can be considered benchmarks within each country of feasible goals.

To illustrate potential ACSC hospitalization reductions, a possible analysis is to assume each municipality in Brazil and Portugal had the ACSC hospitalization rates of the upper limit of the nearest lower quintile, according to Figure 6 of Study 5.5 (i.e., municipalities in the fifth quintile had ACSC hospitalization rates equal to the upper limit of the forth quintile, municipalities in the fourth quintile had ACSC hospitalization rates equal to the upper limit of the third quintile, and so on; municipalities in the first quintile maintain their rates). In this analysis, the hypothetical number of ACSC hospitalization would be 605,359 and 89,463 for Brazil and Portugal, respectively. These would represent a hypothetical reduction of 28% for Brazil and 10% for Portugal, in relation to their actual values in 2015 (from Studies 5.2 to 5.5).

Other studies also reported geographical variations in ACSC hospitalization rates on countries such as Finland (97), France (258), Italy (84) and Spain (268). The health systems of these countries, similarly to the Brazilian and Portuguese, work under the premise of universal health coverage, with PHC performing gatekeeping function. Such substantial geographical variations in the ACSC hospitalization rates could be signs of variable access and quality of care and inefficient use of resources, therefore a source of concern for health managers and decision-makers (376).

Results of Study 5.5 indicate the need of focusing on specific geographic areas in order to develop mechanisms that could assist in reducing ACSC hospitalizations; nationwide solutions would unlikely account for each area specificities. This study also showed that Portugal had a more evident pattern in geographic distribution of ACSC hospitalization than Brazil; future studies that analyze the dynamics behind such variations in further detail in each country can potentially identify sources for the variations in access and quality.

Brazil and Portugal presented similarities regarding which conditions had the highest frequencies among ACSC hospitalizations, notably pneumonia, urinary tract infection and congestive heart failure being the most frequent ones. Although the discussion in Section 2.1 remarked the rising pressure on health systems due to chronic conditions as one of the pillars of this thesis motivation, pneumonia and urinary tract infection are classified under PQI 91- Acute conditions. The term *pneumonia* used throughout this thesis refers to bacterial pneumonia, for which many effective treatments are available (as opposed to viral pneumonias). The identification of pathogens causing the infection is not a straightforward task, and there is no point-of-care testing widely available to diagnose pneumonia (377,378). To diagnose pneumonia in the PHC setting can be challenging as the condition may be difficult to distinguish from other conditions (379). As for urinary tract infections, they are among the most frequent infections of clinical practice worldwide (380). This condition is mainly treated with antibiotics: diagnosing and defining therapeutics have been described as some of the main challenges in treating urinary tract infections (381,382). Urinary tract infections present high recurrence rates and increasing antimicrobial resistance (380,383,384). In particular, complicated urinary tract infections constitute a huge burden on health care systems (380).

The most common conditions in Brazil and Portugal are included in most of the existing ACSC lists (as indicated in Table 8 of Study 5.2), therefore, it is reasonable to discuss that actions tacking these specific conditions could produce significant reductions in ACSC hospitalizations in both Brazil and Portugal, despite of different definitions of ACSC proposed by lists.

The comparison of ACSC hospitalizations in Brazil and Portugal in these different dimensions indicated that there is room for improvement by reducing ACSC hospitalizations in both countries, and the similarities in most frequent conditions and standardized rates may represent possible starting points for inter-country learning endeavours. The findings

of the comparison must be interpreted in light of the organization of the health systems of each country, i.e., against the backdrop of the PHC reforms conducted.

6.1.3 PHC reforms and ACSC hospitalizations

The third specific objective of this thesis was to analyze the evolution of ACSC hospitalizations in Brazil and Portugal and the possible associations with the PHC reforms. Studies 5.5 and 5.6 analyzed these possible associations between differences in ACSC hospitalization rates and in FHU coverage in Brazil and Portugal, and the findings were discordant between conditions, geographic areas within each country and between Brazil and Portugal.

Study 5.6 showed that rates of ACSC hospitalizations in Brazil decreased 25% between 2007 and 2016, which was 2.3 times the decrease of rates for all hospitalizations during the same period. The significant improvements in socioeconomic and sanitary condition in Brazil since the end of the military period (as explained in Section 2.6) may help explain improvements in health observed in Brazil (192). The decrease on rates of ACSC hospitalizations in Brazil was also described in a study Pinto et al. (81), which found a reduction of 45% in rates between 2001 and 2016. Although the authors acknowledged that it was not possible to isolate the effects of PHC in such trends, it is likely that there was an association with increased coverage by the PHC reform, given the improves in diagnosis and monitoring of chronic conditions and facilitated access to medicines (81). Findings of Study 5.6 indicated that rates for the four chronic conditions analyzed decreased between 2007 and 2016 (while increased for the two acute conditions), and that for diabetes and hypertension there were significant inverse correlations between hospitalization rates and FHU coverage in 2015. On the other hand, results of Study 5.5 showed that the FHU coverage of high-risk municipalities for chronic ACSC was significantly higher than non-cluster municipalities, which went against the idea of reduced ACSC hospitalization rates due to better care provided as intended by the PHC reforms, as well as the findings of previous studies (112,149). Such findings illustrate one of the dimensions presented in Study 5.1: the methodological choice of different snapshots (longitudinal and cross-sectional analysis) depends on the research question and can produce different conclusions.

The evidence of Studies 5.5 and 5.6 for Brazil show that although ACSC hospitalization rates overall decreased between 2007 and 2016, it did not apply to all conditions and there was no robust evidence this overall decrease was driven by the PHC reform expansion.

Previous studies have found that higher FHU coverage was associated to lower ACSC hospitalization rates for Brazil as a whole (149,175) and for specific regions (332,385–387). A systematic review on the impact of the PHC reform on avoidable hospitalizations discussed that some studies did not find significant evidence on the expected effect (192). Authors attributed the mixed results to differences in research setting, selection of conditions, number of hospital beds and health care workers, confounder adjustment and situation of municipalities previous to the reforms (192).

Some of the studies that found inverse associations between FHU coverage and ACSC hospitalization rates had older period of analysis (149,175): there is the possibility of ACSC hospitalizations stabilizing when reaching adequate levels of FHU coverage (388,389). The FHU coverage promoted by the PHC reform increased much more in the Northeast than in the Southeast Region between 1999 and 2004 (390); as the Northeast may had have achieved adequate levels of FHU coverage before 2007, this may be the reason why there were no significant findings regarding lower rates of avoidable hospitalizations for the Northeast region in Study 5.6. As discussed in Section 2.6, it appears that the PHC reform in Brazil have reached a plateau, in which coverage has been growing much more slowly in recent years (2013). Therefore, the period analyzed in this thesis may have not allowed for the positive impacts of the PHC reform on ACSC hospitalizations to be observed.

Previous studies argued that the increase in number of hospital beds in the Northeast region or the increased access to hospital care in the North region may explain increased ACSC hospitalization rates in some states and municipalities of these regions (149). Similarly, small municipalities in the South Region may have higher ACSC hospitalization rates as these justify the supply of hospital beds (385). Such indications may be reflecting of the positive association between hospitalizations and hospital bed supply (89,391). Because hospital beds were not included in the analysis of Study 5.6 for Brazil, it was not possible to determine if the lack of conclusive results was affected by hospital care supply. A study applied panel analysis to investigate associations of avoidable hospitalizations in Brazil between 2000 and 2014 with expansion of the PHC reform at the municipal level, and included hospital beds in their analysis (44). Authors found that increased FHU coverage was not significantly associated with a reduction in ACSC hospitalizations for any of the analyzed conditions; they discussed that better access to PHC may have facilitated access to hospitals, possibly through referrals and increased case detection (44).

The possible positive effect of the FHU coverage in Brazil in ACSC hospitalizations reflects the qualities associated to the PHC reform, such as longitudinality, family focus and community orientation. Although the reform did not have the explicit focus on those socioeconomically disadvantaged, the expansion of FHU coverage was more intense in municipalities with lower levels of economic development (172,392). Activities developed by FHU teams in the community are also targeted for at-risk populations, which are more likely to have lower socioeconomic status (172). The use of health care provided by FHU is usually greater among people from a lower socioeconomic level and without health care plan coverage (172,393). With the potential of the PHC reform in Brazil to address health inequalities, it is likely to have an impact on ACSC hospitalizations, given the association with socioeconomic factors.

When performing the analysis per condition and by region, results of Study 5.6 provide some indications that the FHU coverage may have played a role in reducing ACSC hospitalizations. For example, municipalities in the South and Southeast regions that had reached full population coverage by FHU had the lowest hospitalization rates for hypertension and diabetes for virtually the whole period analyzed. Such results may indicate good quality practices in diagnosis and treating these specific conditions; a specific program for control of hypertension and diabetes (HIPERDIA) was formulated within the PHC reform in Brazil, and some recent studies in the South region have found high frequency of health promotion actions and satisfaction of users regarding these two conditions (394–396). However, municipalities in the South and Southeast regions might have started in better situations, i.e., had lower rates before the period analyzed, and such characteristics were unrelated to FHU coverage. The interpretation of these findings must take the local context into consideration; this is especially necessary for Brazil, given its marked heterogeneity of economic resources, health access, availability of professionals and investments, and sociodemographic characteristics.

The geographic socioeconomic inequalities in health in Brazil are exacerbated by the severe economic crisis the country faces, and neoliberal health policies (239). Current health reforms taken by the Brazilian government threatens the constitution right of universal health care, as it includes austerity measures, as well as strategies to increase privatization and deregulation (239). Primary health care faces severe setbacks given the introduction of privatizing elements in assistance and management, erasure of social participation, and relaxation on labor laws (397).

Findings of Study 5.6 indicated that ACSC hospitalization rates overall increased for Portugal between 2007 and 2016; such increases were likely due to the ageing of the population and increase of multimorbidity (198). Similarly, as for Brazil, there were found no robust evidence that differentials in PHC reform expansion were associated to ACSC hospitalization trends. In the longitudinal perspective, there was found significant association of higher FHU coverage and lower hospitalization rates only for urinary tract infection in the North region, according to the regression models and Kruskal-Wallis tests performed in Study 5.6. This was the condition that presented the highest increase of rates between 2007 and 2016, followed by heart failure and pneumonia.

A study by Dimitrotová et al. (45) analyzed variations in ACSC hospitalization rates and differences between municipalities with or without FHU, using the difference-in-differences approach and controlling for trends before the PHC Reform and also for the age and socioeconomic characteristics of the population. Such study reached the same conclusions: the presence of FHU did not have statistically significant impact on variations of ACSC hospitalization rates, except for urinary tract infection (45). A study in the Center region of Portugal suggested that the adoption of a Guidance Standard Clinic on the treatment of urinary tract infections (398) altered the medical prescription standards for more effective therapeutics, and that FHU had better compliance with the Guidance and better resource management (399). Another study found that that FHU at the LVT region also had adequate prescribing habits according to the Guidance (400).

Findings of Study 5.5 showed that critical areas in Portugal for acute ACSC had lower physician supply and FHU coverage, as well as higher proportion of elderly, lower population density and higher rurality, indicating that ACSC hospitalization rates were influenced by both health system and demographic factors combined, as it was already known in the literature and discussed in Section 2.3 of this thesis. In Study 5.6, the variable purchase power was statistically significant in the regression models built for specific regions for acute ACSC. These results indicate the implications that the socioeconomic dimensions have when analysing ACSC hospitalizations, reinforcing the importance of integrating the social sector in health policies in order to reduce inequalities associated to avoidable hospitalizations.

The analysis of ACSC hospitalizations according to geographic distribution of FHU in Portugal has a bias according to the municipalities in which these units were implemented. According to analysis from *the Relatório Primavera 2019* (198), municipalities without FHU

presented higher ACSC hospitalization rates between 2006 to 2015 than those with USF model A, which, is its turn, had higher rates than municipalities with FHU model B. However, these differences already existed before the PHC reform, both for ACSC hospitalizations as a whole and for conditions separately (diseases of the circulatory system, diseases of the respiratory system and diabetes). Therefore, it is not possible to conclude that the implementation of FHU had a role in variations of ACSC hospitalization rates, since these results can be reflecting of the initial situation of the municipalities.

As explained in section 2.6, the FHU are constituted voluntarily with health professionals hired as civil servants and the health centers are run by the state. Given the voluntary basis for FHU constitution, it is not surprising that these are unequally distributed across Portugal: half of the municipalities in Portugal did not have FHU by 2018; the FHU implemented were notably concentrated across the coast (198). Population in geographic areas without FHU had higher proportion of elderly and mortality rates, lower levels of education, income and purchase power and lower population density (198). In 2016, while the rural areas of Portugal had physician density of 3.4 per 1,000 people, urban areas had 5.6 per 1,000 people (37). The unequal distribution of health workforce is a key health workforce policy concern for many countries (401). It is common for rural regions and socioeconomically disadvantaged urban regions to have lower supply of physicians than more affluent regions, and especially when compared to capitals (401). Health professionals may rather not work in socioeconomically disadvantaged areas due to concerns regarding their professional prospects (such as career development opportunities) and personal lives (lifestyle choices, professional and educational opportunities for their families) (37).

In Study 5.6, the only significant association of PHC coverage and lower ACSC hospitalization rates was in the North region: nearly half of the FHU (218) and three of the eight LHU functioning by 2018 were in this region: the number of years since implementation of LHU was inversely associated to urinary tract infection hospitalization rates in the North region, according to regression model coefficients of Table 26 in Study 5.6. This region was also the only one with statistically significant and inverse correlation between FHU coverage and ACSC hospitalization rates for all conditions analyzed. The underlying mechanisms leading to lower ACSC hospitalization rates may depend on the demographic and socioeconomic characteristics of municipalities with FHU in interaction with care provided by FHU and LHU. In this thesis was not possible to isolate the effect of either factor, therefore being unable to reach conclusions regarding the positive effect of the PHC reform.

Studies 5.5 and 5.6 showed that, for specific regions in both countries, higher coverages of FHU were associated to lower ACSC hospitalization rates, which could be interpreted as better access and quality of care facilitated by the PHC reforms. It is important to reiterate that reducing hospitalizations was not a direct aim of the PHC reforms in neither Brazil nor Portugal (44,45). Although it was not possible to evaluate quality of care regarding features of care other than quantitative measures (due to data unavailability and being outside the focus of the studies), results highlight the possible contribution of PHC reforms to improved health system performance in specific regions and for specific conditions. The findings also illustrate the complexity of using ACSC hospitalization as an indicator for assessing and comparing performance.

The positive experiences with reduced ACSC hospitalization rates for some conditions in specific areas of each country can prompt cross-country learning of policies and practices. For Brazil and Portugal, the shared learning is facilitated by their historic ties, the use of the same language, collaboration of academic institutions and exchange of professional, as well as technical collaborations agreements signed between both the Brazilian and the Portuguese Ministries of Health (402).

6.2 Strengths/limitations of the thesis and future studies

Each study in Chapter 5 had their own individual strengths, as explained on their own discussion sections; the discussion promoted by the findings of this thesis benefited from the different research approaches, metrics and objectives sought, combined with the individual strength of each study. At the comparative perspective, the use of uniform methodologies in Studies 5.2, 5.4 and 5.5 produced comparable results while allowed the observation of the specificities of each country. The methods employed in Studies 5.2 to 5.6 were explained in detail, therefore can be reproduced in future studies for other settings, both for single and multi-country studies.

Regarding sources of information, the use of administrative databases of hospitalizations in public hospitals follows roughly consistent procedures within countries; these databases are used for reimbursing hospitals; therefore, a sufficient level of reliability was assumed. As the information available from such databases for Brazil and Portugal were analogous, it allowed the comparison of data.

The data obtained from the hospitalization database is however susceptible to quality issues. In Portugal, one study identified that the number of coded secondary diagnoses

increased over the years: this increase was related to severity of the clinical case of patients, but rather coding practices (403). This same study also found inconsistences in how certain pathologies were coded; namely, changes in coding protocols leading to different ICD-9-CM codes being used throughout the years (403). A qualitative study explored the perceptions of medica coders regarding possible problems with health records that may affect the quality of data, which included the lack of or unclear documented information; the variability in diagnosis description; and the lack of solutions to solve these problems (404).

In Brazil, the main problems regarding reliability of hospitalization data are insufficient information on diagnosis of episode, inconsistent codification according to the ICD, and eventual frauds to increase the reimbursement for health institutions (405). Despite some studies discussing that the data has a high level of reliability, main problems still exist, especially the high level of incompleteness of secondary diagnosis (406). One study analyzed the quality of hospitalization data for the appropriate recording of hospitalizations for ACSC, by comparing those with medical records. Results showed that nearly 20% of hospitalizations for ACSC (according to medical records) were not identified as it in the hospitalization database (407).

These issues in quality of data and coding practices is a common limitation in studies using hospitalization data, which can impact in the development and management of health services, as well as conclusions of epidemiological and health services research.

The use of a single ACSC list is another aspect that further strengthened the comparison proposed by this thesis. The databases provided anonymized data of the patients; for this reason, it was not necessary to obtain ethical approval at any stage of this thesis, which was convenient in terms of timeline. On the other hand, important individual characteristics of patients could not be used in the analysis, e.g., their education level, socioeconomic status, experiences with health care, etc. Overall, the analysis of this thesis was performed at the ecological level, which may hinder the capacity of establishing causal relationships. As discussed in section 2.4, ACSC hospitalizations as an indicator for PHC quality is more suitable for analysis at the macro level.

The results of this thesis and their discussion have two main limitations. The first limitation is regarding the indicator itself: the definition of ACSC impacts in research findings and their interpretation; different methodologies to identify ACSC would yield different results. The second limitation is regarding the study designs: the ecologic approach used, the inclusion of a limited number of variables, and the exploratory/descriptive focus did not allow for

causal relationships between variables being established. In addition, the analysis has not been fully-comprehensive: the implementation and PHC reforms were not fully captured by the chosen variables, and the inclusion of factors outside the control of health systems was limited.

There are many research decisions that can influence results, affect the comparison of countries, and strengthen or hinder the usefulness of the findings. In this thesis, the research objective was not to provide a ranking of which country had higher quality of PHC, nor how to design specific interventions to reduce ACSC hospitalizations. The aim of this thesis was not reaching conclusions regarding these topics; however, they did give indications on which demographic groups, specific geographic areas, and conditions to focus on. The results regarding impact of the PHC reforms lack scientific robustness but provide clues that serve as important contributions to the health system. Future focused studies to deepen the knowledge in these dimensions are needed and encouraged.

PHC reforms were represented using FHU coverage, as the implementation of FHU were the most visible aspect of the reforms in both countries. Although coverage can be considered a good proxy for access, this approach was however limited, as there are many other features of the reforms that were not included in this thesis due to the complexity of proceeding with such comparative analysis with insufficient/unavailable/not-comparable data (e.g., ACS, NASF, PMM for Brazil; FHU Models A and B, URAP, UCC for Portugal). The performance of PHC units that did not adhere to the reforms was also not included in this thesis.

The framework of ACSC hospitalizations determinants is complex. There were factors that are prominently associated to avoidable hospitalizations e.g., socioeconomic factors, specific health care practices, that were not investigated deeply in this thesis due to data unavailability and for being outside the focus of this thesis. Another component not included on this thesis was how the private sector interacts with ACSC hospitalizations: this is a common limitation on studies using secondary data on hospitalizations, as the private sector rarely discloses such information. Around 23% of the Brazilian population in 2017 (38) and 26% of the Portuguese population in 2016 (39) were covered by private health insurance.

Regarding methodological choices, special attention must be given to the methods for cost estimation introduced in Study 5.3 and used in Studies 5.3 and 5.4. Although the assessment of productivity losses is common in analysis of cost-of-illness (300–302,304,306,308,309,408), this estimation method can be considered controversial as it

attributes a monetary value for human life. It also assumes that people over the retirement age have no economic value as they have no associated wage in the estimations. The criticisms of methods attributing economic values to life have been already raised years ago (409,410); nonetheless, these are still employed in disease analysis and included in decision-making processes (411,412). Regardless of the demographic characteristics of the patient, the potentially avoidable hospitalization is an unfortunate stressful event for patients and family; although ACSC hospitalizations lasts, in average, 6 and 10 days in Brazil and Portugal (as shown in Study 5.2), the impact of these events lasts beyond the length of the hospitalization itself. Deaths resulting in ACSC hospitalizations are undoubtfully a great loss and in no way the purpose of this thesis was to underplay the severity of such event. The economic estimation though the human capital approach and YPPL was used to convey the message of the impact ACSC hospitalizations represent. Few qualitative studies have been produced to collect and analyze perspective of patients (132,413), going beyond the provider-centred data. Not only future studies using qualitative data could produce evidence on potential causes of ACSC hospitalizations and possible interventions, but also address the human welfare dimension that lacks in ACSC studies using ecological data.

Future studies that combine information at both the aggregated and the individual level are encouraged to produce more robust scientific evidence regarding ACSC hospitalizations and enhancing its use for health assessment purposes, especially given the financial impact such indicator can have as a result of its introduction in health care assessment processes, not only for Brazil and Portugal, but for other countries that incorporated or plan to incorporate it.

Mechanisms to improve PHC, such as assessing the performance of health services delivery, are highly important for Brazil and Portugal. Financial constrains have been introduced in some sectors in Brazil, including public health, which threatens the improvement of care and access to it, especially given the huge inequalities Brazil faces. In Portugal, reforms on the health sector have aimed to tackle the increasing costs, promote better resource allocation and rationalize hospital care use (39). PHC has the potential to solve health issues at the outpatient level, moving away for the idea of solving problems through hospitalizations, and to strengthen PHC can be helpful in this sense. By 2019 there were not conducted any evaluation of the creation of FHU in terms of health outcomes in Portugal (45), therefore the analysis of ACSC is a valuable tool to assist in such effort.

Assessing health services holds several challenges, including what goals should be measured, e.g., health inequalities, coverage, equitable financing, quality, consumer satisfaction, allocative and technical efficiency, cost containment of political acceptability (7). The inter-country comparison is even more challenging given the existence of two often-disparate realities. Although methodologies for inter-country health system performance comparison have been developed in the last years (79), there is still room for improvement to use international comparisons for improvement. This thesis can help developing knowledge towards this direction. This is fundamental for future studies to use ACSC more effectively as a tool for health assessment and informed decision-making.

Chapter 7. Conclusion

This thesis discussed dynamics of hospitalizations for ambulatory care sensitive conditions in Brazil and Portugal. By the different approaches employed, it produced evidence of the potential of ACSC hospitalizations in health care assessment, its implications, and its usefulness in inter-country comparison.

The caveats of ACSC hospitalization comparisons between countries and possible ways of mitigating these limitations were discussed in this thesis, which is essential for future studies to use this information more efficiently for purposes of health assessment and decision-making processes. The interpretation of ACSC hospitalizations as the indicator itself brings methodological challenges, and their discussion is an important contribution of this thesis.

The results of this thesis indicated that Brazil and Portugal have points of similarities regarding ACSC hospitalizations in causes and standardized rates. The estimation of lost productivity associated to ACSC hospitalizations was not investigated before this thesis, which produced evidence of significant impact that these events represent on health systems and societies.

It was concluded that the PHC reforms undertaken in Brazil and Portugal did not produce the same results neither within or between countries and not for all conditions. It was argued in this thesis that focused actions can be more effective to reduce such events, with examples in both countries serving as valuable clues for the cross-learning process. The comparison of country experiences, although challenging, brings benefits that can assist in the implementation of interventions.

It is important to reduce ACSC hospitalizations given the impact these events represent for health systems and society. More knowledge in ACSC hospitalizations inter-country comparison is crucial to move towards actionable leaning and health policy changes, so the full potential of this promising indicator is achieved.

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