

Pediatric Hospitalizations for Ambulatory Sensitive Conditions in Portugal

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Abstract

Introduction: Hospitalizations can reveal consequences on child development, potentiate infections, and increase hospital costs. About 30% of pediatric hospitalizations can be avoided with adequate outpatient care. Ambulatory care sensitive conditions allow for analyzing these hospitalizations and monitor morbidity, access, and quality of care. The aim of this study was to characterize the hospitalizations in Portugal due to conditions sensitive to a pediatric outpatient clinic.

Methods: Hospitalizations were characterized using two methodologies, with episodes of children under 18 years old in 2017 from the Administração Central do Sistema de Saúde database and the patient classification system by a diagnostically related group. A descriptive analysis was performed of the variables gender, age, region, length of stay, and main diagnosis and determined the prevalence, rate of hospitalization, and financial impact.

Results: Ambulatory care sensitive conditions represent 13.1% and 17.5% of all pediatric hospitalizations, with the two methodologies applied, with a delay of four days, male prevalence (52%), up to at the age of 4 (> 30%), in the Northern region (> 30%) and the highest rate in the Lisbon region (> 30 hospitalizations/10,000 inhabitants). The main causes are gastroenteritis, urinary tract infection, ear, nose and throat infections, asthma, seizures, and epilepsy. The financial impact is over four million euros.

Discussion: The results reveal a potential difference in care needs by region and an indispensable adequacy of the supply and distribution of health resources.

Keywords: Ambulatory Care/statistics & numerical data; Child; Health Care Costs; Hospitalization/statistics & numerical data; Patient Admission/statistics & numerical data; Portugal

Introduction

Hospitalization of a child should be the last resort in accessing health care as it may reveal consequences for child development such as anxiety, eating, behavioral problems, sleep disorders,¹ and increase the risk of infections associated with health care, causing damage to the child's immune system.² A hospitalization that cannot be avoided should, therefore, be as short as possible, ensuring a better quality of life for the child and caregivers.¹ One of the ways to evaluate avoidable hospitalizations is through the study of ambulatory care sensitive conditions (ACSC),³ a concept initially developed in the US in 1980.⁴ This indicator aimed to evaluate the access of the indigent population to health care and, subsequently, the effectiveness and quality of care.⁵ Currently, its systematic analysis enables you to monitor morbidity, access and quality of care, the identification of needs, and the distribution of existing health resources.^{6,7} Although the issue of access to health care in children has gained increased political interest in recent years, there are still few studies of ACSC hospitalizations (ACSCH) focusing on the pediatric age.⁷ Profile analysis of these ACSCH may be a tool for monitoring child morbidity, conditions of access to care, identifying the needs of the Portuguese pediatric population, and enhancing a better distribution of health resources.⁶

Definition, explanatory factors, and ACSCH reduction measures

Ambulatory care sensitive conditions is used as an indirect indicator of outpatient care performance, and as a direct indicator of potentially avoidable hospital production, if adequate and effective ambulatory care was guaranteed.⁸ They can be defined as specific conditions including chronic diseases (*e.g.* asthma, diabetes), communicable diseases and acute diseases

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(e.g. pneumonia, appendicitis)⁹ for which hospitalization could be avoided¹⁰ or reduced if outpatient care were timely, adequate, and effective.^{11,12} Although adequate outpatient care provision may result in a reduction in ACSC,¹³⁻¹⁵ some studies indicate that hospital admissions are more related to the patient individual characteristics than to quality of care,^{10,16} regardless of the type of health system in place.¹⁰

To consider a hospitalization as avoidable, it is necessary to validate whether there is technology and knowledge to avoid such hospitalization and whether the respective measures depend on outpatient care.^{3,5} However, there are several methodologies for identifying ACSC that can be used in different realities.⁵ According to some authors,³ the criteria that can be used in its definition are evidence of use in the literature, relevant hospitalization rate (> 1 hospitalization/10,000 inhabitants), precision in diagnosis classification, primary care responsibility to prevent hospitalization, and the need for hospitalization if the diagnosis is confirmed.^{3,15} Regardless of methodology, ACSC can be influenced by four major characteristics: those concerning health care providers (such as the number of family doctors and their number of visits, and continuity of care), socioeconomic and demographic (gender, age, and educational level), geographical (different regions, distance to a health unit, population density), and epidemiological characteristics (prevalence and severity of diseases).^{3,5}

The following measures can be highlighted as interventions for the reduction or minimization of the ACSC: increasing the literacy of the patient and their caregivers, promoting health,¹⁰ avoiding the onset of the disease, which can be achieved, adherence to the vaccination plan and the definition of campaigns and programs that allow the adoption of healthy lifestyles,^{3,12,17,18} early diagnosis and treatment,^{3,10} controlling acute episodes of disease through sensitization and population screening actions,^{12,17} and proper management of chronic disease,^{3,10,12,17} monitoring symptoms and reducing potential associated complications.¹⁷ From existing measures and in accordance with the guidelines from the Direção Geral da Saúde,¹⁹ the most effective approach for a pediatric population should be primarily at the level of health literacy and health promotion, enabling caregivers and the children themselves in priority areas such as nutrition, physical activity, vaccination, and the appropriate use of medication.

Ambulatory care sensitive conditions hospitalizations at the pediatric age

Pediatric health care is a priority area, with children being a group of greater fragility and vulnerability due to different social and health determinants.^{20,21} The most common

causes of ACSC are asthma, diabetes, gastroenteritis, and other bowel complications (Table 1).^{3,7,17,22-24}

Other areas also need particular attention, such as child and youth abuse²⁵ and mental health, growing public health concerns. It is estimated that 20% of children have evidence of mental health problems, which may develop pathological symptoms and only 20% of them receive adequate treatment.²⁶

This study aimed to characterize the pediatric hospitalizations for ambulatory care sensitive conditions in Portugal, considering the patient demographic characteristics, episodes length of stay, and hospital charges.

Methods

Data source and sample definition

An observational, retrospective, and descriptive study (in a period of time, structured, and quantitative) was designed,⁵ with the hospitalizations of more than 24 hours in pediatric secondary care units (between 0 months and 17 years of age, like defined by the methodologies used), in the year 2017. The ACSC were calculated according to the American pediatric quality indicators (PDI)²⁷ - a list considering the specific characteristics of pediatric age and adapted to international classification of disease 10th version (ICD-10) - and the European,¹¹ a list validated for the European population and adapted to ICD-10. The source of the information was the Administração Central do Sistema de Saúde (ACSS) database of hospital morbidity. This database contains all the hospital and inpatient episodes, registered with ICD-10 codes, in which are included the codes for the main diagnosis and for other several secondary diagnoses, which complete the clinical condition of each admission. This coding was intended for the collection of administrative and clinical data and is performed by coding physicians. Then, the ICD-10 codes for each episode are grouped and categorized with a single code of diagnostic related group (DRG), bringing with it the advantage of obtaining a systematic, normalized, and transversal characterization for the entire national health system.

Inclusion criteria were the episodes of hospitalization of the population living in mainland Portugal, under 18 years old and having the primary diagnosis code for ICD-10 included in the ACSC lists of PDI or Bardsley and colleagues.¹¹ These criteria were defined according to the methodologies already described. The exclusion criteria were the admission date equal to discharge date and date of birth equal to date of admission. After

applying the inclusion and exclusion criteria, as seen in the flowchart (Fig. 1), the study population was 45,624 hospitalization episodes.

The study was performed with the variables gender, age, region (nomenclature of territorial units for statistical purposes, NUTS II),²⁸ length of stay, and main diagnosis.

Table 1. International ACSC studies with results for the pediatric population.

Country	Reference and ages	Year	ACSC list	% ACSC / ACSCH	More frequently ACSC
Portugal	3. All ages	2000-2012	Caminal <i>et al.</i> ³	Data only available for total population, including pediatric age: 4.4% of total admissions	COPD (20.9%), cardiac insufficiency and acute lung edema (20.5%) and diabetes (15.1%)
			CIHI (<i>Canadian Institute for Health Information</i>) ³	Data only available for total population, including pediatric age: 32.5% of total admissions	Pneumonia (23.8%), hypertensive heart disease (20.6%), heart failure (12.6%) and COPD (12.2%)
UEA	7. < 14 years	1990-1995	Six conditions (based on Weissman <i>et al.</i> and Casanova, Starfield) ⁷	30% of total admissions, 10.9 hosp /1,000 hab	Asthma (27.0%), gastroenteritis and dehydration (22.7%) and pneumonia (21.9%)
Brazil	23. < 20 years	1999-2006	Defined by Brazilian Minister of Health (2008) ²³	Not indicated in the study	Infectious gastroenteritis and complications (60.5 hosp / 10,000 hab in 1999, 53.3 hosp / 10,000 hab in 2006), asthma (33.1 hosp / 10,000 hab in 1999, 22.6 hosp / 10,000 hab in 2006), and bacterial pneumonia (7.4 hosp / 10,000 hab in 1999, 18.0 hosp / 10,000 hab in 2006)
Brazil	42. All ages	2002-2009	Defined by Brazilian Minister of Health (2008) ⁴²	Data only available for total population, including pediatric age: 7.74 hosp /1,000 hab in 2002 and 8.81 hosp / 1,000 hab in 2009	Up to 9 years old: Gastroenteritis (2.0 hosp / 1,000 hab in 2002, 1.61 hosp / 1,000 hab in 2009), lung diseases (1.13 hosp / 1,000 hab in 2002, 1.76 hosp / 1,000 hab in 2009) and asthma (1.06 hosp / 1,000 hab in 2002, 0.76 hosp / 1,000 hab in 2009) <i>More than 10 years:</i> Kidney / urinary tract infection (0.78 hosp / 1,000 hab in 2002; 0.94 hosp / 1,000 hab in 2009)
Brazil	20. < 5 years	2010	Defined by Brazilian Minister of Health (2008) ²⁰	60% of total admissions: < 1 year: 48.6% 1-4 years: 65.5% > 5 years: 60%	Infectious gastroenteritis and complications (35.6%), bacterial pneumonias (12.8%) and asthma (9.2%)
Spain	12. < 14 years	1993-1994	Based on project by Codman research group, validated by pediatricians ¹²	Valencia: 21% of all pediatric hospitalizations Catalonia: 15% of all pediatric hospitalizations	Valencia: Gastroenteritis (2.35 hosp / 1,000 hab), nose, ear and throat infections (1.80 hosp / 1,000 hab) and pneumonia (0.97 hosp / 1,000 hab) Catalonia: Acute bronchitis (1.82 hosp / 1,000 hab), gastroenteritis (1.74 hosp / 1,000 hab) and pneumonia (1.32 hosp / 1,000 hab)
England	11. All ages	2001-2011	27 conditions (based in 13 validated lists), divided into three groups: acute, chronic, and preventable by vaccination ¹¹	18.2% (2001) total admissions 19.1% (2011) total admissions	Nose, ear and throat infection (168.5 hosp / 100,000 hab in 2001, 205.2 hosp / 1,000 hab in 2011), angina (149.8 hosp / 100,000 hab in 2001, 87.8 hosp / 1,000 hab in 2011), COPD (142.8 hosp / 100,000 hab in 2001, 161.3 hosp / 1,000 hab in 2011), seizures and epilepsy (128.5 hosp / 100,000 hab in 2001, 148.2 hosp / 1,000 hab in 2011), and asthma (125.5 hosp / 100,000 hab in 2001, 124.9 hosp / 1,000 hab in 2011)

ACSC - ambulatory care sensitive conditions; ACSCH - ambulatory care sensitive conditions hospitalizations; COPD - chronic obstructive pulmonary disease; hab - inhabitants; hosp - hospitalizations.

For gender and main diagnosis, the frequencies of hospitalization episodes were also determined. For the identification of regions, the NUTS II nomenclature (North, Center, Lisbon, Alentejo and Algarve) was used. The frequency of episodes and hospitalizations per 10,000 inhabitants were determined for each region. For age and length of stay, in addition to the frequency of hospitalization, the parameters of the mean, standard deviation (SD), minimum (min) and maximum (max) values were also identified. In length of stay, it was also determined quartile 1 (P25), median (P50), quartile 3 (P75), and interquartile distance (IQ).

Cost estimation

The DRG price,²⁹ was used to estimate the financial impact of the ACSCH. This is only indicative of the true hospital cost in the absence of another more extensive method.³⁰ Based on this DRG price, a financial representativity (RF) formula was used³, where the i represents the ACSCH:

$$RF = \sum_i (\text{DRG price } i \div \text{DRG average delay } i) \times \text{Days of stay observed } i$$

Ambulatory care sensitive conditions hospitalizations incidence and rates

The incidence of ACSCH was determined by the number of episodes of hospitalization per study variable - diagnosis, age, gender, and region, represented by the i -, using as denominator the total number of ACSCH:

$$\text{ACSCH } i = \text{Number of ACSCH } i \div \text{Total number of ACSCH}$$

To determine ACSCH rate by region, the annual population^{3,7} was obtained using data from the Instituto Nacional de Estatística based on the 2011 census.³¹ It was considered the resident population under 18 years, where the i represents the region:

$$\text{Tx ACSCH } i = \text{Number of hospitalizations } i \div \text{Resident population } i$$

Regarding causes of hospitalization, ICD-10 diagnostic codes were used regarding the PDI indicators, and the conditions provided by Bardsley and colleagues¹¹ (Table 2). Only diagnostic codes from version ICD-10 were used (the methodologies in use only refer to ICD-10 codes), and episodes with version 9 were eliminated. Only 0.29% of episodes were coded using ICD-9 and were not included in the study. Data analysis and treatment were performed using the IBM SPSS Statistics 24 software and Microsoft Office Excel 2016.

Results

Overview of hospitalizations for ambulatory care sensitive conditions

The average age of the pediatric population under study was 6.2 years (min 0, max. 17, SD = 6.0), with a mean of 4.8 days of stay (min. 1, max. 815, SD = 9.3, P25 = 2, P50 = 3, P75 = 5, IQ = 3). Most hospitalizations were male children, with 54.2% (24 714 episodes) of all episodes. Analyzing hospitalization by region there was a higher incidence in the North and Lisbon regions, with, respectively, 35.7% (16,288 episodes) and 34.5% (15,741 episodes) of the total episodes of hospitalization. Regarding the causes of pediatric hospitalization, the most frequent primary diagnostic codes were acute bronchiolitis, with 8.7% of the total episodes of hospitalization, followed by intestinal infections (2.9%), tonsil and adenoids infection (2.9%), acute appendicitis (2.6%), and urinary tract infection (2.3%).

Ambulatory care sensitive conditions hospitalizations by age, gender, and length of stay

According to pediatric quality indicators, ACSCH represented 13% (5,934 episodes) of all pediatric age hospitalizations. There was a higher incidence at age groups under 4 years, representing 34.8% (2,065 episodes) of ACSCH, more frequent in males, accounting for 52.2% (3,097 episodes) and with an average length of stay of 4.0 days (P25 = 2, P50 = 3, P75 = 5, IQ = 3). Using the methodology of Bardsley and colleagues,¹¹ the ACSCH represented 17.5% (7,984 episodes) of all pediatric hospitalizations. Ambulatory care sensitive conditions hospitalizations were more frequent in the age groups under 4 years, representing 38.5% (3,076 episodes) of all ACSCH, males were more frequently hospitalized, with 52.2% (4,166 episodes) and the average length of stay of ACSCH was 4.4 days (P25 = 2, P50 = 3, P75 = 5, IQ = 3) (Table 3).

Ambulatory care sensitive conditions hospitalizations by diagnosis

The most frequent ACSCH according to the PDI methodology were gastroenteritis, urinary tract infection and asthma, corresponding respectively to 46.6% (2,767 episodes), 24.4% (1,449 episodes) and 15.1% (897 episodes) of all ACSCH (5,934 episodes). Regarding the methodology of Bardsley and colleagues,¹¹ the most frequent ACSCH were urinary tract infection, gastroenteritis, and ear, nose and throat infections, corresponding respectively to 17.7% (1,415 episodes), 12.7% (1,017 episodes) and 12.4% (990 episodes) of

all pediatric ACSCH (7,984 episodes). Seizures and epilepsy were the fourth most frequent with 12.4% (989 episodes), followed by asthma with 11.4% (908 episodes) (Table 4).

The diagnosis of asthma and gastroenteritis had a higher prevalence in ages under 4 years, with 52.62% (472 episodes) and 42.93% (1,188 episodes), respectively. Diabetes and bowel perforation were more prevalent in the ages of 10-14, corresponding to 43.51% (104 episodes) and 40.72% (237 episodes), respectively. Regarding urinary infection, the prevalence was higher in children aged 15-17, with 65.7% (952 episodes).

Ambulatory care sensitive conditions hospitalizations by region

According to PDI, regarding the regional distribution, it was observed that the region with the highest incidence was the Northern region, both in ACSCH and overall pediatric hospitalization episodes, with, respectively, 39.9% (2,367 of a total 5,934 ACSCH episodes) and 5.19% of the 45,624 total episodes. However, analyzing the rate of ACSCH per 10,000 inhabitants, it was observed that the Lisbon region has the highest rate of ACSCH, with 33.1 hospitalizations/10,000 inhabitants. Therefore, there is a higher incidence of ACSCH in the Northern and Lisbon regions, with values greater

Table 2. Main international classification of diseases, 10th revision, clinical modification diagnostic codes for ambulatory care sensitive conditions of the two methodologies under study: Bardsley and colleagues¹¹, American pediatric quality indicators (PDI)²⁷

PDI methodology	
Asthma	J4521; J4522; J4531; J4532; J4541; J4542; J4551; J4552; J45901; J45902; J45990; J45991; J45998
Short-term diabetes complications	E1010; E1011; E10641; E1100; E1101; E11641; E1110; E1111
Gastroenteritis	A080; A0811; A0819; A082; A0831; A0832; A0839; A084; A088; A09; K523; K5289; K529
Bowel perforation	K352; K353
Urinary tract infection	N10; N119; N12; N151; N159; N16; N2884; N2885; N2886; N3000; N3001; N3090; N3091; N390
Bardsley and colleagues methodology	
Acute	
Cellulitis	L03, L04, L08; L88, L980, L983
Dehydration	E86
Dental conditions	A690, K02-K06, K08, K098, K099, K12, K13
Ear, nose, and throat infection	H66, H67, J02, J03, J06, J312
Gangrene	R02
Gastroenteritis	K522, K528, K529
Nutritional deficiencies	E40-E43, E55, E643
Pelvic inflammatory disease	N70, N73, N74
Perforated ulcer/bleeding	K250-K252, K254-K256, K260-K262, K264-K266, K270-K272, K274-K276, K280-K282, K284-K286
Urinary tract infection/pyelonephritis	N10, N11, N12, N136, N390
Chronic	
Angina	I20, I240, I248, I249
Asthma	J45, J46
COPD (chronic obstructive pulmonary disease)	J20, J41-J44, J47
Congestive heart failure	I110, I50, J81
Seizures and epilepsy	G40, G41, O15, R56
Diabetes complications	E100-E108, E110-E118, E120-E128, E130-E138, E140-E148
Hypertension	I10, I119
Anemia	D501, D508, D509
Preventable by vaccination	
Flu	J10, J11
Pneumonia	J13, J14, J153, J154, J157, J159, J168, J181, J188
Tuberculosis	A15, A16, A19
Other (tetanus, diphtheria, rubella, measles, polio, hepatitis B, and others)	A35-A37, A80, B05, B06, B161, B169, B180, B181, B26, G000, M014

Adapted from Bardsley M, Blunt I, Davies S, Dixon J. *BMJ Open* 2013;3:e00200711 and Agency for Healthcare Research and Quality. *Pediatric quality indicators overview*.²⁷

Table 3. Characterization of ambulatory care sensitive conditions by age category, sex, and length of stay

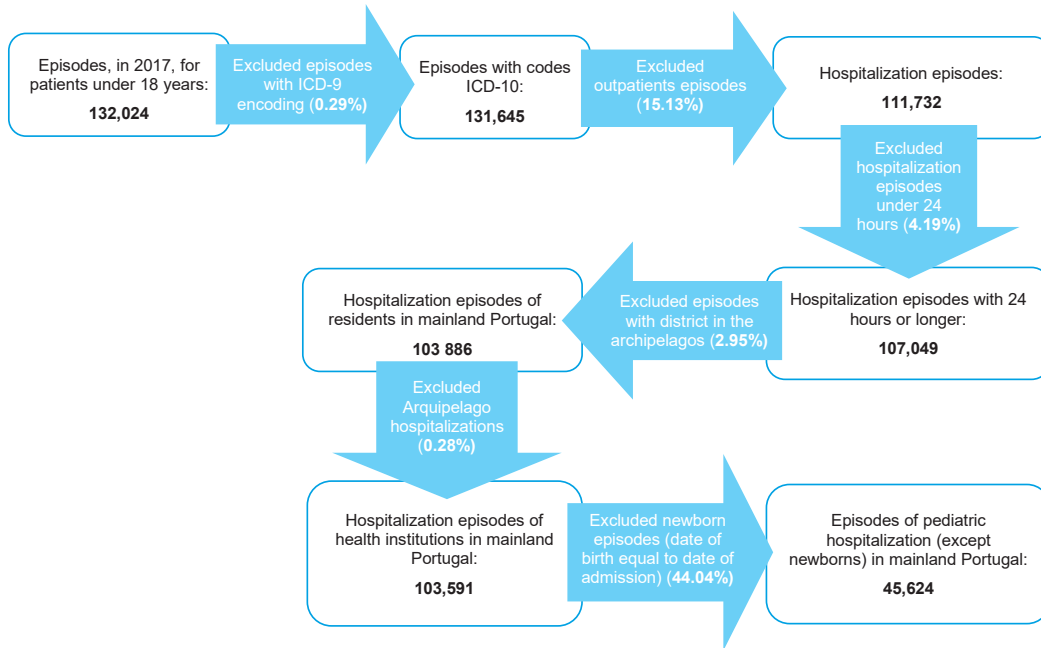
Frequency	Age				Gender		Length of stay				
	0-4 years	5-9 years	10-14 years	15-17 years	Male	Female	Mean (days)	Quartile 1 (P25)	Median (P50)	Quartile 2 (P75)	Interquartile distance
ACSCH - PDI											
Absolute frequency (number of episodes)	2,065	1,044	777	2,048	3,097	2,837					
Relative frequency (%) for total ACSC (5,934 episodes)	34.8	17.6	13.1	34.5	52.2	47.8	4.0	2	3	5	3
Relative frequency (%) for total hospitalizations (45,624 episodes)	4.5	2.3	1.7	4.5	6.8	6.2					
ACSCH - Bardsley and colleagues											
Absolute frequency (number of episodes)	3,076	1,402	1,048	2,458	4,166	3,818					
Relative frequency (%) for total ACSC (7,749 episodes)	38.5	17.6	13.1	30.8	52.2	47.8	4.4	2	3	5	3
Relative frequency (%) for total hospitalizations (45,624 episodes)	6.7	3.1	2.3	5.4	9.1	8.4					

ACSCH - ambulatory care sensitive conditions; ACSCH - ambulatory care sensitive conditions hospitalizations; PDI - American pediatric quality indicators.

Table 4. Characterization of ambulatory care sensitive conditions hospitalizations, by main diagnosis.

Main Diagnosis	Absolute frequency (number of episodes)	Relative frequency (%) for total ACSC	Relative frequency (%) for total hospitalizations (45,624 episodes)
ACSCH - PDI (5934 episodes of ACSC)			
Gastroenteritis	2,767	46.6	6.1
Urinary tract infection	1,449	24.4	3.2
Asthma	897	15.1	2.0
Bowel perforation	582	9.8	1.3
Short term diabetes complications	239	4.0	0.5
Total	5,934	100.0	13.0
ACSCH - Bardsley and colleagues (7,984 episodes of ACSC)			
Urinary tract infection / pyelonephritis	1,415	17.7	3.1
Gastroenteritis	1,017	12.7	2.2
Ear, nose, and throat infection	990	12.4	2.2
Seizures and epilepsy	989	12.4	2.2
Asthma	908	11.4	2.0
Cellulitis	599	7.5	1.3
Pneumonia	598	7.5	1.3
Dental conditions	408	5.1	0.9
Short term diabetes complications	398	5.0	0.9
COPD (chronic obstructive pulmonary disease)	206	2.6	0.5
Dehydration	186	2.3	0.4
Other (tetanus, diphtheria, rubella, measles, polio, hep. B and others)	99	1.2	0.2
Flu	64	0.8	0.1
Tuberculosis	40	0.5	0.1
Anemia	28	0.4	0.1
Congestive heart failure	12	0.2	0.0
Perforated ulcer/bleeding	10	0.1	0.0
Pelvic inflammatory disease	8	0.1	0.0
Hypertension	7	0.1	0.0
Nutritional deficiencies	2	0.0	0.0
Total	7,984	100.0	17.5

ACSCH - ambulatory care sensitive conditions; ACSCH - ambulatory care sensitive conditions hospitalizations; PDI - American pediatric quality indicators.



ICD - International Classification of Diseases

Figure 1. Flowchart with the application of the inclusion and exclusion criteria.

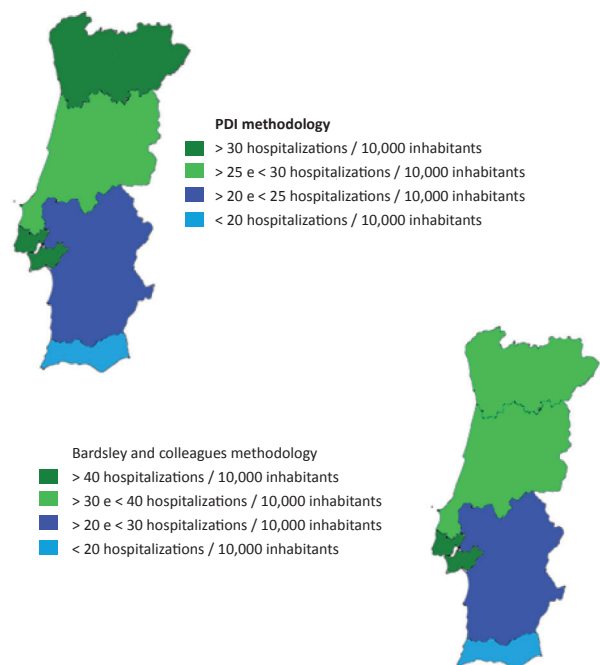
than 30 hospitalizations/10,000 inhabitants and a lower incidence in the Algarve region, with values below 20 hospitalizations/10,000 inhabitants. Using the methodology of Bardsley and colleagues,¹¹ it was observed that the highest incidence, both in total ACSCH and the total hospitalizations, was also in the Northern region, corresponding, respectively, 36.8% (2,936 of a total 7,984 ACSCH episodes) and 6.4% of 45,624 total episodes. However, it is the Lisbon region that has the highest rate of ACSCH, with 47.2 hospitalizations/10,000 inhabitants. Therefore, there is a higher incidence of ACSCH in the Lisbon region, with values greater than 40 hospitalizations/10,000 inhabitants and a lower incidence in the Algarve region, with values below 20 hospitalizations/10,000 inhabitants (Fig. 2).

Cost related to hospitalization for ACSCH

The financial representativeness of the ACSCH identified by PDI corresponded to a total estimated cost of 4,268,453 euros in 2017, with 23,156 days of hospitalization. The diagnosis that contributed most to total costs were gastroenteritis, with 1,368,604 euros, and urinary tract infection, with 1,109,912 euros, both with more than 7,000 days of hospitalization. According to the methodology of Bardsley and colleagues,¹¹ an impact of 6,232 833 euros for a total of 27,311 days of hospitalization was estimated. In this methodology, it was also urinary tract infection, with 1,101,708 euros, that contributed most to total cost of ACSCH, with also more than 7,000 of hospitalization.

Discussion

Using ACSCH as an indirect indicator of the access and effectiveness of ambulatory care demands a clear perspective of its purpose and limitations. The



ACSCH - ambulatory care sensitive conditions; ACSCH - ambulatory care sensitive conditions hospitalizations.

Figure 2. Pediatric age ambulatory care sensitive conditions rate per 10,000 inhabitants in mainland Portugal, 2017.

concept of an avoidable admission is different than adequate and/or mandatory admission. Admitting a diabetic child for a hypoglycemic coma is simultaneously mandatory, adequate, and avoidable. It is potentially avoidable if the technology and knowledge exists in the ambulatory setting to avoid the hypoglycemia, which means having capillary glycemia monitoring devices, treatment (insulin), and the capacity to use these adequately. It implies health literacy, training by health professionals, and timely access to healthcare. It is only if all of these are in place that the hospitalization might be avoidable. This leads to the next important consideration when using ACSC: they cannot be reduced to zero, although considered avoidable, a percentage, yet to be determined, will always occur. This derives from the multifactorial determinants of ACSC, as some combinations of comorbidities drastically increase the risk of being hospitalized.³² Furthermore, the existence of different ACSC lists and the diversity of diagnostic codes makes it difficult to understand avoidable hospitalizations and to easily employ this indicator for the assessment of ambulatory care performance.⁸ Different lists have different sensitivities and specificities and are tailored to each healthcare system. This is a challenge for the international comparability of results. ACSCs are a useful indicator to measure the differences in performance at relatively aggregated levels (national, regional, local) but not at the individual level. This is, therefore, the rationale for using this indicator to fulfill the objectives of this study.

In mainland Portugal, in 2017, the incidence of pediatric ACSCs was lower than what was observed in other countries, such as Spain (with 20%),¹² Brazil (with 60%),²⁰ and the US (with 30%).⁷ However, none of these studies were conducted with the same methodology or ACSC list, so it is difficult to compare the result with the ones obtained in this study. Those results could indicate better access and effectiveness of ambulatory care in Portugal, but the lack of further determinants measurement does not allow to fully attribute the results to ambulatory care. The absence of studies in the pediatric population also makes it difficult to compare the results.

The analysis of the most frequent causes shows that asthma does not have the initially expected prevalence. However, it has a higher prevalence in ages under 4 in both methodologies. As a chronic disease, without proper treatment, it can lead to hospitalization.³³ However, in recent years, there has been a reduction in these hospitalizations in the pediatric population, remaining only in situations where the population is most disadvantaged and with limited access to preventive care.³³ The results seem to confirm these

data, which could mean improved ambulatory care for chronic respiratory diseases. Effectively, childhood asthma in Portugal costs about 929.35 euros per child with chronic asthma, especially due to asthma attacks and uncontrolled asthma.³⁴ In our study, the total cost for asthma was about 500,000 euros. Therefore, a better control of these causes may reduce hospital healthcare costs and avoidable admissions.

A higher prevalence of gastroenteritis and urinary infection agrees with recent result as the main causes of pediatric hospitalizations in Portugal.² These two diagnoses, although they can be considered as avoidable admissions, in younger ages they can also be adequate and mandatory for intravenous therapy and to avoid other complications. Regarding the age of children hospitalized for ACSC, in both methodologies most of them were aged 4 years or younger. This age group includes neonatal episodes, due to being used in the methodologies under study. This can lead to results that may not be subject to extrapolation to other pediatric ages, as intrinsic factors of vulnerability, associated with inexperience or lack of follow-up of families, often leads to inappropriate hospitalizations.¹⁴ Further studies should consider the segregation of this group to better understand the results. The existence of a higher incidence in children aged 15-17 was not expected, since the literature shows that, at the pediatric age, ACSCs are more prevalent in children under 5 years old,^{3,7,17,22-24} and that these hospitalizations decrease with age,²² contrary to the adult population. Nowadays, new lifestyles and the widespread dissemination of information in non-credible networks are factors that can potentiate non-adherence to treatment and new dietary options, which may be an explanation for the obtained results. In PDI, a higher prevalence of bowel perforation was also found, in the ages 10-14, referring to acute appendicitis with peritonitis. In this case, nonspecific symptoms and difficulty in assessing can lead to late diagnosis and the need for surgical intervention.³⁵ Another cause could be iatrogenesis, when carrying out invasive diagnostic tests in patients with adjacent disease identified.³⁶ This diagnosis is not defined in the methodology of Bardsley and colleagues,¹¹ probably because it was not identified as preventable or had enough cases to justify it.

Regarding gender, both methodologies identified a higher incidence in males, which is in line with previous studies in the Portuguese population.^{3,5,37}

Regarding length of stay, the results are similar in both methodologies, with an average of four days of hospitalization. Other studies conducted with the Portuguese adult population identified an average of eight days.^{5,37} Therefore, at the pediatric age, the

length of stay may be shorter compared to the global population.

The results obtained were different for each methodology, as already identified previously in Portugal,³ confirming that different lists with different diagnostic codes for the determination of ACSC may give rise to different results.^{5,10,30} Regarding the comprehensiveness of the lists, the methodology of Bardsley and colleagues¹¹ identifies, in addition to chronic conditions, a wider set of conditions such as acute and preventable by vaccination. Therefore, it was initially expected that this would result in a higher number of ACSCH and, given the characteristics of the pediatric population, this seems to be the most suitable methodology. However, these conditions should be validated by a group of experts, and it could also be interesting to consider other factors like abuse or mental health causes.^{25,26}

As for the regional analysis of ACSCH, the highest incidence was found in the Northern region. However, when considering the hospitalizations rate, using populational data as denominator, the highest rate is in Lisbon. There may be several explanations for these facts. Firstly, the primary care coverage is different in the North and Lisbon regions, secondly, the hospital availability, and more specifically its geographical proximity to the population increases ACSCH, which may explain the incidence in the North.³⁸ The data in this study does not coincide with other studies,³⁷ which shows that the region with the highest rate is Alentejo. However, these data are not specific for the pediatric age, which may explain the different results.

Concerning the financial impact of pediatric ACSCH, agreement was found with other studies that identified a considerable financial volume associated with these avoidable hospitalizations - a total cost of over 4,000,000 euros. Reducing these hospitalizations could increase the sustainability of health services, as the associated costs could be redirected to ambulatory care resources, prevention, surveillance, and health promotion measures,^{3,12,17,18} in particular potentially avoidable hospital use.

The use of administrative data may be a limitation to the study as systematic differences in clinical coding may occur between different encoders and hospitals, as to different hospital information systems may lead to a different capacity to analyze the admissions, the lack of registration of all the necessary codes and the complexity of classification may lead to dubious situations. Furthermore, the financing purpose of the clinical coding may introduce further biases.^{18,20,21,30,39,40} Another limitation is the absence of variables that are essential for the characterization of populations with

avoidable hospitalizations, such as the socioeconomic variables,⁴¹ which may enable a deeper study of the explanatory factors of these hospitalizations. Other national databases could be used to cross-check this information. However, it was outside the scope of the study. In addition to the lack of socioeconomic data, the lack of specific health unit data, like the number of beds, the distance between residence and hospital and the availability of primary care, may also be a limitation,^{18,20,40} as these characteristics may also allow a better identification of ambulatory care provision in each region.

The use of the census information as a denominator for determining the ACSCH rate for a different year (2011) than the data analyzed (2017) may also lead to biases in identifying the incidence of ACSCH in different regions.⁴⁰ The population estimates for the year 2017 were not used because the age division did not correspond to that of the present study. Another limitation is the lack of a validated list for the Portuguese population. The use of validated lists for other countries,^{5,22} with different characteristics, may potentiate the omission of important conditions for the pediatric Portuguese population.¹⁰

For the calculation of the financial impact, other methodologies may be used, such as the reference price of the DRG ordinances, the prices of hospital contracts or the cost values of the hospitalizations concerned.³ The way in which ACS tabulated prices are calculated seems to be a better proxy for financial impact of the ACSCH,³ as it considers the price of each DRG hospitalization according to its severity and length of stay.

The present study only considered the division of mainland Portugal into NUTS II. Future studies should be able to make a more detailed analysis of each district and country, and the respective socioeconomic conditions of its resident population, to better understand this phenomenon.

In addition, to deepening the characteristics of patients and health facilities, future studies on multiple hospitalizations and multiple chronic health conditions for the Portuguese pediatric population may also be analyzed. This information is important for the study of ACSC, since there is indication in the literature that a higher burden disease and the existence of comorbidities may lead to a higher number of ACSC.

Concluding, ambulatory care sensitive conditions hospitalizations were an important phenomenon in Portugal in 2017. They accounted for 13%-17.5% of all pediatric hospitalizations with an estimated financial impact between 4-6 million euros. The most frequent admissions were for gastroenteritis, urinary tract infection, asthma, and infection of ears, nose and throat. There was a considerable regional variation which may

signal unmet needs. The limitations of this study only allow for seeing the big picture and, therefore, further studies could detail more interesting results.

WHAT THIS STUDY ADDS

- In Portugal, no specific studies were found for the characterization of ambulatory care sensitive conditions hospitalizations in the pediatric age.
- This study is an attempt to reach consensus on the definition and measures to reduce avoidable hospitalizations in the pediatric age.
- This characterization of avoidable hospitalizations is a first step in the study of ambulatory care sensitive conditions, as it allows to identify the specificities of this population. After this initial study, further research may be conducted to deepen the theme of ambulatory care sensitive conditions in the pediatric age, so that it is possible to define the appropriate action measures to improve the performance of the units as well as the access and quality of healthcare.

Conflicts of Interest

The authors declare that there were no conflicts of interest in conducting this work.

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Protection of human and animal subjects

The authors declare that the procedures followed were in accordance with the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).

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Confidentiality of data

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Hospitalizações por Condições Sensíveis aos Cuidados de Ambulatório em Portugal

Introdução: Os internamentos podem revelar consequências no desenvolvimento infantil, infeções e custos hospitalares. Aproximadamente 30% dos internamentos pediátricos podem ser evitados com adequados cuidados de ambulatório. As condições sensíveis aos cuidados de ambulatório permitem analisar estes internamentos e monitorizar morbilidade, acesso e qualidade dos cuidados. O objetivo deste estudo foi caracterizar, em Portugal, os internamentos pediátricos evitáveis por condições sensíveis ao ambulatório.

Métodos: Foram caracterizados de acordo com duas metodologias os episódios de internamento de menores de 18 anos nos hospitais públicos de Portugal continental no ano de 2017, através da base de dados de morbilidade hospitalar da Administração Central do Sistema de Saúde e do sistema de classificação de doentes por grupos de diagnóstico homogêneos. Realizou-se uma análise descritiva das variáveis sexo, idade, região, duração de internamento, diagnóstico principal e determinou-se a incidência, taxa dos

internamentos e impacto financeiro.

Resultados: As condições sensíveis aos cuidados de ambulatório representam 13,1% a 17,5% dos internamentos pediátricos, tendo em consideração as duas metodologias usadas, com internamentos de quatro dias, maior prevalência no sexo masculino (52%), até aos 4 anos (> 30%), na região norte (> 30%) e maior taxa na região de Lisboa (> 30 internamentos / 10 000 habitantes). As principais causas são gastroenterite, infeção urinária, infeções dos ouvidos, nariz e garganta, asma, convulsões e epilepsia. O impacto financeiro é superior a quatro milhões de euros.

Discussão: Os resultados revelam uma potencial diferença de necessidades por região e uma indispensável adequação da oferta e distribuição de recursos em saúde.

Palavras-chave: Admissão do Paciente/estatística & dados numéricos; Assistência Ambulatorial/estatística & dados numéricos; Criança; Custos de Cuidados de Saúde; Hospitalização/estatística & dados numéricos; Portugal