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Suitability of current definitions of ambulatory care sensitive conditions for research in emergency department patients: a secondary health data analysis

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ABSTRACT

Objective The aim of this study was to investigate the suitability of existing definitions of ambulatory care sensitive conditions (ACSC) in the setting of an emergency department (ED) by assessing ACSC prevalence in patients admitted to hospital after their ED stay. The secondary aim was to identify ACSC suitable for specific application in the ED setting.

Design Observational clinical study with secondary health data.

Setting Two EDs of the Charité—Universitätsmedizin Berlin.

Participants All medical ED patients of the 'The Charité Emergency Medicine Study' (CHARITEM) study, who were admitted as inpatients during the 1-year study period (n=13 536).

Outcome measures Prevalence of ACSC.

Results Prevalence of ACSC in the study population differed significantly depending on the respective ACSC set used. Prevalence ranged between 19.1% (95% CI 18.4% to 19.8%; n=2586) using the definition by Albrecht *et al* and 36.6% (95% CI 35.8% to 37.5%; n=4960) using the definition of Naumann *et al*. (p<0.001). Overall ACSC prevalence (ie, when using all diagnoses used in any of the assessed ACSC-definitions) was 48.1% (95% CI 47.2% to 48.9%; n=6505). Some frequently observed diagnoses such as '*convulsion and epilepsy*' (prevalence: 3.4%, 95% CI 3.1% to 3.7%; n=455), '*diseases of the urinary system*' (prevalence: 1.4%; 95% CI 1.2% to 1.6%; n=191) or '*atrial fibrillation and flutter*' (prevalence: 1.0%, 95% CI 0.8% to 1.2%, n=134) are not included in all of the current ACSC definitions.

Conclusions The results highlight the need for an optimised, ED-specific ACSC definition. Particular ACSC diagnoses (such as '*convulsion and epilepsy*' or '*diseases of the urinary system*' and others) seem to be of special relevance in an ED population but are not included in all available ACSC definitions. Further research towards the development of a suitable and specific ACSC definition for research in the ED setting seems warranted.

Trial registration German Clinical Trials Register Deutsches Register für Klinische Studien: DRKS-ID: DRKS00000261.

Strengths and limitations of this study

- This is the first study to compare different definitions of ambulatory care sensitive conditions (ACSC) regarding their suitability for research in emergency department (ED) populations.
- Our secondary health data analysis included ED data as well as inhospital data of all 13 536 admitted medical patients who attended two tertiary care EDs within 1 year and thus results apply for an unselected and 'real world' ED population.
- Data were available on an individual basis and allowed for stratified analyses as well as analysis of the inhospital course.
- While the inhospital course was available for all inpatients, no information about prior utilisation of primary care services was recorded and no standardised follow-up was conducted.
- Our analysis shows the difficulty to apply and to interpret the ACSC concept in an ED setting and provides a basis for further research towards the development of a suitable and specific ACSC definition for research in an ED setting.

INTRODUCTION

Worldwide, emergency departments (EDs) are challenged by an increasing number of patients.[1–4] The annual growth rate of ED visits in Germany was 4.9% over the last decades, caused by a variety of factors including demographic and social changes[1]: The demographic change induced a higher proportion of patients with multimorbidity and chronic diseases and EDs increasingly need to deal with complex and resource intensive cases.[5 6] Additionally, the number of non-acute ED visits, mainly by younger patients with non-urgent conditions, seems to be increasing.[1 7 8] One consequence of this increase in ED visits is ED crowding. Crowding itself is associated with a decline

in quality of care, an unfavourable patient outcome, and decreasing patient satisfaction.[3 9–14] Furthermore, ED-based healthcare is associated with higher costs as compared with treatment in an outpatient setting.[15] Thus, there is an urgent need to evaluate concepts for the identification of avoidable ED visits and hospitalisations in order to develop evidence-based interventions to keep EDs working effectively and to enable an optimal allocation of scarce healthcare resources.

As EDs are an important interface between different healthcare sectors, their utilisation is—additionally to population-related factors—also determined by the availability and quality of care in the adjacent healthcare sectors.[16] In this context, the number of ambulatory care sensitive conditions (ACSCs) was developed as a surrogate parameter for the quality and availability of primary care services.[17] ACSCs consist of a subset of acute and chronic diagnoses considered not to require hospital admission.[17] These diagnoses contain (1) acute exacerbations of chronic conditions which could have potentially been controlled by adequate treatment before the ED visit, (2) acute conditions which could have been managed in a primary care setting and (3) infectious diseases that occur despite effective immunisation. International data on the prevalence of ACSC in ED patients are sparse and highly depend on the healthcare system, the region, the population under investigation and the definition of ACSC.[18] Different ED populations have been addressed so far:

1. All ED patients.
2. Non-admitted ED patients (outpatients).
3. Admitted ED patients (hospitalised after ED stay).

Furthermore, it has been differentiated between emergency admissions (ie, unplanned hospital admissions) and non-emergency admissions (ie, planned, elective hospital admissions) in some studies. Even though the ACSC concept had been applied in ED patients in order to identify and develop strategies for the reduction of avoidable ED visits, a systematic adaption of the ACSC concept to ED patients is still lacking.[17 19–22]

The aims of this study were the following:

1. To investigate the suitability of existing ACSC definitions in the ED setting by assessing ACSC prevalence based on existing ACSC definitions in patients admitted to hospital via the ED.
2. To develop suggestions towards an optimal ACSC definition for the specific application in the ED setting.
3. To describe the inhospital course of patients with and without ACSC.

METHODS

Participants

The study population consisted of all adult, non-surgical ED patients attending one of the two participating EDs of Charité—Universitätsmedizin Berlin between February 2009 and February 2010 (CHARITEM study; n=34 333). Surgical patients as well as non-admitted patients were excluded from analysis. A more detailed descriptive analysis of demographics as well as clinical characteristics and their relation to presenting complaints were published elsewhere.[23]

Study setting

The Charité—Universitätsmedizin Berlin is a tertiary care university hospital with more than 3000 hospital beds at three different sites in Berlin. The study was performed at two sites, Campus Benjamin Franklin and Campus Virchow Klinikum, located in the southwest and the northern part of Berlin, respectively. Together, the EDs had a total of 191 465 visits in 2014 (Hospital Information System, Charité). As previously published, the catchment areas of both EDs differ: while *Campus Benjamin Franklin* serves a population with a higher socioeconomic status, higher age and a higher proportion of patients admitted to hospital, *Campus Virchow Klinikum* has a younger clientele with lower socioeconomic profile and a higher proportion of migrants and uninsured patients.[16 24] In Germany, patients are allowed to choose their preferred care provider and there are no restrictions or financial drawbacks for primary care or hospital treatment. EDs provide medical treatment independent of the insurance status of the patient.

Study design

This observational clinical study assessed secondary health data of all medical patients who attended the two EDs during the study period (February 2009 to February 2010) who were subsequently admitted to hospital (n=13 536). All electronically available data were retrieved from the hospital information system including time and mode of ED presentation, sociodemographic data, vital signs, laboratory parameters, ED diagnoses and procedures, inhospital diagnoses, length of stay, referral rate to intensive care unit (ICU) and inhospital mortality. Data were subjected to extensive, individual plausibility checks. Implausible data were corrected or excluded if correction was not possible.

ACSC definitions

ACSC definitions were based on their respective ICD-10 codes (International Classification of Diseases, Tenth Revision) derived from the hospital's main diagnoses. The documentation of hospital main diagnoses in Germany is well standardised and of proven high validity as reimbursements for the hospitals are based on these diagnoses and thus they are closely monitored by the health insurance companies.

The following five most common definitions of ACSC were investigated:

1. Purdy *et al* defined ACSC by a subset of 19 different diagnoses. Their definition is used by the British *Institute for Innovations and Improvements* (GB).[17]
2. Freund *et al* published an ACSC definition based on 26 diagnoses built on the work of Purdy *et al* and the definition of the *Agency for Healthcare Research and Quality* (AHRQ; US Department of Health and Human Services).[19]

3. Sundmacher *et al* proposed a core list of 22 ACSC diagnoses.[22] Their selection was the result of a group consensus method (Delphi) with 40 physicians. The primary selection of potential ACSC diagnoses was based on criteria developed by Solberg *et al*, Weissman *et al* and Caminal *et al*.[25–27] and a systematic literature review conducted in 2013 including 12 sources.
4. Naumann *et al* published a list of 32 ACSC diagnoses based on an adaption of the definition by Purdy *et al*.[21]
5. Albrecht *et al* proposed a list of 13 diagnoses based on recommendations of the *German Advisory Council on the Assessment of Developments in the Healthcare System* (Germany) and scientific studies.[28]

A detailed overview of the underlying diagnoses/ICD codes of these definitions is provided in the online supplement to this article (supplementary tables 1–5). Overall ACSC prevalence was defined as the aggregate of all above-mentioned definitions, that is, all ICD-10 codes that were part of at least one of the five investigated definitions.

Endpoints of the description of inhospital course were inhospital mortality, stay on ICUs and length of hospital stay (LOS).

Statistical analysis

Proportions of categorical variables are presented as absolute and relative frequencies. Numeric variables are reported as medians with IQRs. Two-sided exact binomial 95% CIs were computed as measures of precision. ACSC prevalence was analysed overall and stratified by age and gender. Age was categorised into two age groups (<60 years; ≥60 years) for statistical analyses and seven age groups (<30, 30–39, 40–49, 50-59, 60–69, 70–79, ≥80 years of age) for graphical displays. Gender was not known for two patients, age was unknown for one patient. For statistical testing of categorical variables X^2 tests (Pearson's) were applied. For numerical variables, non-parametric tests (Mann-Whitney) were performed. A p value below 0.05 was considered to be statistically significant. All analyses were performed with SPSS V.23 (Statistical Package for Social Sciences; IBM).

Patient involvement

Patients were not involved in the development of the study protocol and the conduct of the study.

Ethical considerations

This work was conducted in strict accordance with Good Scientific Practice Guidelines and the Declaration of Helsinki.[29 30] The protocol of this study was registered in the German Clinical Trials Register (Deutsches Register für Klinische Studien: DRKS-ID: DRKS00000261) and approved by the institutional review board of the Charité (EA2/118/08). The first results of the CHARITEM-study were published in 2013.[23]

RESULTS

Study population

In total, 34 333 medical patients attended the assessed EDs within the study period and of those, 39.43% (n=13 536) patients were admitted to hospital to receive inpatient care. All further analyses are restricted to these hospitalised patients.

The median age of all hospitalised patients was 67 (IQR: 53–75); 54.1% (n=7319) were male. Most patients were of German nationality (87.1%; n=11 791) and were covered by a statutory health insurance (89.5%; n=12 220; table 1A). There were significant differences between characteristics of patients with and without any ACSC regarding age (p<0.001), sex (p=0.001) and health insurance (p<0.001) but not with respect to nationality (p=0.211). Patient characteristics of patients with the respective assessed ACSC diagnoses are detailed in table 1B.

Prevalence of ACSC and single ACSC diagnoses

Overall ACSC prevalence (ie, based on any diagnosis used in any of the assessed ACSC definitions) was 48.1% (95% CI 47.2% to 48.9%; n=6505 patients). ASCS prevalence based on the five investigated definitions differed significantly (p<0.001) ranging between 19.1% (95% CI 18.4% to 19.8%; n=2586; definition by Albrecht *et al*) and 36.6% (95% CI 35.8% to 37.5%, n=4960, definition by Naumann *et al*). For the remaining three ASCS sets, prevalence was 20.2% (95% CI 19.6% to 20.9%; n=2738, definition by Purdy *et al*); 22.6% (95% CI 21.9 to 23.3; n=3061; definition by Freund *et al*) and 24.4% (95% CI 23.7% to 25.2%; n=3308; definition by Sundmacher *et al*).

The 10 most frequent ACSC diagnoses (ICD-10 codes) of any of the assessed definitions are detailed in table 2.

Table 1A Patient characteristics of all inpatients, inpatients with any ACSC when all definitions were combined and for patients without any ACSC

	All inpatients		Any ACSC		Without ACSC		p Value
	n=13 536		n=6505		n=7031		
Median age in years (IQR)	67	(53–75)	68	(58–77)	65	(49–73)	<0.001
Male %	54.1	7319	55.5	3612	52.7	3707	0.001
German nationality %	87.1	11 791	87.0	5657	87.2	6134	0.211
Statutory health insurance %	89.5	12 110	90.1	5861	88.9	6249	<0.001

ACSC, ambulatory care sensitive condition.

Table 1B Patient characteristics for patients with ACSC according to the investigated definitions

	Purdy		Freund		Sundmacher		Naumann		Albrecht	
	n=2738		n=3061		n=3308		n=4960		n=2586	
Median age in years (IQR)	68	(57–76)	67	(55–76)	68	(58–76)	69	(58–78)	68	(60–76)
Male %	56.3	1542	55.7	1705	55.2	1825	55.9	2774	59.1	1529
German nationality %	85.0	2328	85.6	2620	86.1	2848	86.8	4304	85.2	2202
Statutory health insurance %	91.3	2500	90.9	2781	91.5	3027	89.9	4457	92.0	2378

ACSC, ambulatory care sensitive condition.

The most frequent ACSC diagnosis was *stroke* with an observed prevalence of 9.5% (95% CI 9.0 to 10.0; n=1283) which is included in the definition by Naumann *et al* only. *Angina pectoris/ischaemic heart disease* was one of the most frequent diagnosis in all definitions. The underlying ICD-codes for *angina pectoris/ischaemic heart disease* are identical in the definitions of Purdy *et al*, Freund *et al*, Naumann *et al* and Albrecht *et al* (I20, I24.0, I24.8, I24.9) and showed a frequency of 6.5% (95% CI 6.1% to 6.9%; n=882). Only Sundmacher *et al* applied a different definition for '*ischaemic heart diseases*' (I20, I25.0, I25.1, I25.5, I25.6, I25.8, I25.9) with a slightly higher prevalence (6.9%, 95% CI 6.5% to 7.3%; n=935). A high prevalence was also shown for '*acute myocardial infarction*' (4.6%, 95% CI 4.3% to 5.0%; n=624). This diagnosis was included in the definition by Naumann *et al* only. Further frequent ACSC diagnoses were '*convulsions and epilepsy*', '*(congestive) heart failure*', respiratory diseases like '*pneumonia*', '*bronchitis*' and '*chronic obstructive pulmonary disease*' *(COPD)*, '*influenza*' and '*hypertension*'. The prevalence of all ACSC diagnoses in the respective definitions is shown in the online supplement (supplementary table 6). Prevalence of ACSC in age and gender subgroups is also shown in the online supplement of this article (supplementary table 7) and (supplementary figure 1).

Inhospital course

The median LOS was 5 days (IQR: 3–9 days). Length of stay was significantly shorter in patients with any ACSC as compared to patients without any ACSC (p<0.001, table 3A). Of all hospitalised patients; 18.2% (95% CI 17.6% to 18.9%; n=2465) were admitted to the ICU and the overall inhospital mortality was 4.7% (95% CI 4.3% to 5.1%; n=634). The proportion of patients admitted to ICU was higher in patients with any ACSC (21.1%, 95% CI 20.1% to 22.1%; n=1374) than in patients without (15.5%, 95% CI 14.7% to 16.4%; n=1091; p<0.001). The inhospital mortality was higher in patients without any ACSC (5.2%; 95% CI 4.7% to 5.8%; n=369) as opposed to patients with any ACSC (4.1%, 95% CI 3.6% to 4.6%; n=265; p=0.001). The mortality of patients with ACSC differed between ACSC definitions with the highest mortality in ACSC patients as defined by Naumann *et al* (4.2%; 95% CI 3.7% to 4.8%; n=208) and the lowest mortality in ACSC patients based on the definition of Freund *et al* (2.5%; 95% CI 1.9% to 3.1%; n=75; table 3B).

DISCUSSION

This is the first study comparing five different ACSC definitions in the specific setting of EDs. The high prevalence of ACSC when common definitions were combined (48.1%), the substantial differences in ACSC prevalence when common definitions are compared (range between 19.1% and 36.6%) and the absence of frequently observed ACSC diagnoses (eg, diseases of the urinary system, convulsions and epilepsy) in some of the common ACSC definitions clearly point out that the current definitions seem ill-suited for valid research in the ED setting.

Strengths and weaknesses

This is a first comparison of different ACSC definitions and the suitability of their underlying diagnoses in hospitalised ED patients. It is noteworthy that data were available for all medical patients who attended the participating EDs within 1 year on an individual basis and were linked to data on their inhospital course (LOS, mortality). The proportion of patients admitted to hospital was higher as compared to other countries (eg, UK).[31] The reasons for this difference is unclear, as no official hospital statistics on admission rates are available in Germany. A possible explanation for the higher admission rate might be the fact that our EDs are part of a large university hospital in an urban setting and thus an important provider for specialist care in this area. Even though complete diagnostic data were available, ICD-coding of hospital main diagnoses might be affected by reimbursement issues and quality of coding practice. Moreover, the appropriateness of hospitalisation was not assessable in the underlying routine data.[32] However, as the hospital main diagnoses as well as the appropriateness of hospitalisations are continuously monitored by reimbursement companies, the coding of these diagnoses is considered to be a valid indicator for the main reason of hospital admission and the hospitalisation could be considered appropriate for the majority of patients. While the inhospital course was available for all inpatients, no information about prior utilisation of primary care services was recorded and no standardised follow-up was conducted. Furthermore, this is a bi-centre study in a tertiary care setting and results might not be generalisable to other settings or regions.

Table 2 Prevalence of ACSC according to the respective definitions in all inpatients and top 10 ACSC diagnoses for each investigated definition

	Purdy	All inpatients (n=13 536)			Freund	All inpatients (n=13 536)			Sundmacher	All inpatients (n=13 536)			Naumann	All inpatients (n=13 536)			Albrecht	All inpatients (n=13 536)		
#	Diagnoses	n	%	95% CI	Diagnoses	n	%	95% CI	Diagnoses	n	%	95% CI	Diagnoses	n	%	95% CI	Diagnoses	n	%	95% CI
	All ACSC	2738	20.2	(19.6 to 20.9)	All ACSC	3061	22.6	(21.9 to 23.3)	All ACSC	3308	24.4	(23.7 to 25.2)	All ACSC	4960	36.6	(35.8 to 37.5)	All ACSC	2586	19.1	(18.4 to 19.8)
1	Angina	882	6.5	(6.1 to 6.9)	Angina	882	6.5	(6.1 to 6.9)	Ischaemic heart diseases	935	6.9	(6.5 to 7.3)	Stroke	1283	9.5	(9.0 to 10.0)	Angina	882	6.5	(6.1 to 6.9)
2	Convulsions and epilepsy	455	3.4	(3.1 to 3.7)	Convulsion and epilepsy	455	3.4	(3.1 to 3.7)	Heart failure	370	2.7	(2.5 to 3.0)	Angina	882	6.5	(6.1 to 6.9)	Pneumonia	402	3.0	(2.7 to 3.3)
3	Congestive heart failure	386	2.9	(2.6 to 3.1)	Congestive heart failure	386	2.9	(2.6 to 3.1)	Influenza and pneumonia	348	2.6	(2.3 to 2.9)	Acute myocardial infarction	624	4.6	(4.3 to 5.0)	Congestive heart failure	382	2.8	(2.5 to 3.1)
4	Influenza and pneumonia	308	2.3	(2.0 to 2.5)	Influenza and pneumonia	308	2.3	(2.0 to 2.5)	Bronchitis and COPD	337	2.5	(2.2 to 2.8)	Convulsions and epilepsy	455	3.4	(3.1 to 3.7)	Chronic obstructive pulmonary disease	317	2.3	(2.1 to 2.6)
5	Hypertension	266	2.0	(1.7 to 2.2)	Hypertension	266	2.0	(1.7 to 2.2)	Hypertension	296	2.2	(1.9 to 2.4)	Congestive heart failure	386	2.9	(2.6 to 3.1)	Hypertension	266	2.0	(1.7 to 2.2)
6	Perforated/bleeding ulcer	127	0.9	(0.8 to 1.1)	Atrial fibrillation and flutter	134	1.0	(0.8 to 1.2)	Diseases of urinary system	191	1.4	(1.2 to 1.6)	Hypertension	266	2.0	(1.7 to 2.2)	Chronic ischaemic heart disease	146	1.1	(0.9 to 1.3)
7	Dehydration and gastroenteritis	105	0.8	(0.6 to 0.9)	Perforated/bleeding ulcer	127	0.9	(0.8 to 1.1)	Intestinal infectious diseases	183	1.4	(1.2 to 1.6)	Bronchial carcinoma	140	1.0	(0.9 to 1.2)	Diabetes	72	0.5	(0.4 to 0.7)
8	Diabetes complications	75	0.6	(0.4 to 0.7)	Dehydration and gastroenteritis	105	0.8	(0.6 to 0.9)	Gastroenteritis and other diseases of intestines	169	1.2	(1.1 to 1.5)	Atrial fibrillation and flutter	134	1.0	(0.8 to 1.2)	Dehydration	39	0.3	(0.2 to 0.4)
9	Chronic obstructive pulmonary disease	24	0.2	(0.1 to 0.3)	Migraine/acute headache	93	0.7	(0.6 to 0.8)	Diabetes mellitus	111	0.8	(0.7 to 1.0)	Influenza and pneumonia	129	1.0	(0.8 to 1.1)	Ear, nose and throat infections	23	0.2	(0.1 to 0.3)
10	Ear, nose and throat infections	23	0.2	(0.1 to 0.3)	Diabetes complications	75	0.6	(0.4 to 0.7)	Other diseases of the circulatory system	79	0.6	(0.5 to 0.7)	Perforated/bleeding ulcer	127	0.9	(0.8 to 1.1)	Depressive disorders	20	0.1	(0.1 to 0.2)

The frequencies of different diagnoses varied between ACSC definitions as the exact ICD-10 codes are similar but not exactly identical.
ACSC, ambulatory care sensitive condition.

Table 3A Inhospital course of all inpatients and patients with and without any ACSC when all definitions were combined

	All inpatients		Any ACSC		Without ACSC	
	n=13 536		n=6505		n=7031	
Inhospital mortality % (95% CI)	4.7 (4.3 to 5.1)	634	4.1 (3.6 to 4.6)	265	5.2 (4.7 to 5.8)	369
Median length of stay in days (IQR)	5 (3–9)		5 (3–9)		6 (3–10)	
Use of intensive care units % (95% CI)	18.2 (17.6 to 18.9)	2465	21.1 (20.1 to 22.1)	1374	15.5 (14.7 to 16.4)	1091

ACSC, ambulatory care sensitive condition.

Prevalence of ACSC in ED patients

A high prevalence of ACSC was seen when the ICD-codes of all definitions were combined (48.1%). Thus, nearly every second hospitalisation of ED patients would be defined as an ACSC case (according to at least one of the assessed definitions) and thus could potentially be avoided by timely or continuous primary care measures. Moreover, a significant difference in prevalence estimations can be observed when different, common definitions are compared. The higher prevalence of ACSC according to the definition of Naumann *et al* can be explained by the inclusion of diagnoses which are not widely used as ACSC, namely '*stroke*', '*myocardial infarction*' and '*bronchial carcinoma*'.[21] These diagnoses occurred frequently in our cohort and were associated with a high proportion of ICU treatment and inhospital mortality. In our opinion, the degree of preventability of these diagnoses remains debatable and these diagnoses should not be included in future investigations of ACSC in the ED. The most frequent diagnosis based on all definitions except Naumann *et al* was '*angina*' (6.5%). The estimated preventability of hospitalisations for angina is 61%.[22] Substantial heterogeneity occurred due to differences in the underlying ICD-codes and due to different combinations of diagnoses (eg, '*dehydration and gastroenteritis*': 0.8%; '*gastroenteritis and other diseases of intestines*': 1.2%; '*intestinal infectious diseases*': 1.4%; '*dehydration*' only: 0.3%).

It is important to note that some diagnoses occurred frequently in our study of admitted ED patients but were not included in all of the commonly applied ACSC definitions, for example, '*diseases of the urinary system*' (1.4%) were quite frequent in the study of Purdy *et al* (2.1% of all emergency admissions)[17] and it has also been shown by Johnson *et al*, that these diagnoses attributed a great proportion of ACSC-diagnoses (26.9%) in an ED population,[33] but only Sundmacher *et al* included the respective ICD-codes. Further such diagnoses were '*chronic ischaemic heart disease*', '*convulsions and epilepsy*', '*atrial fibrillation and flutter*', '*influenza*', '*perforated/bleeding ulcer*', '*ear, nose and throat infections*', '*dehydration*', '*gastroenteritis and other diseases of intestine*', '*bronchitis*', '*other diseases of the circulatory system*', '*migraine/acute headache*', '*intestinal infectious disease*', and '*depressive disorders*'. We suggest that the underlying ICD-codes of these diagnoses should be included in future investigations of ED-patients.

Other studies of ACSC in ED patients and emergency admissions show that prevalence is, irrespective of the definition used, also dependent on the structure of the healthcare system, the region and the population studied. Two US studies investigated data of the National Hospital Ambulatory Medical Care Survey. Tang *et al* investigated trends in ED visits and ACSC from 1997 to 2007.[34] The authors showed increasing trends regarding ED visit rates while ACSC rates remained stable. Johnson *et al* investigated ACSC in an adult ED population of admitted and non-admitted patients.[33] They reported an ACSC prevalence of 8.4%. Most frequent diagnoses were '*urinary tract infections*' (26.9%), '*COPD/asthma*' (24.2%) and '*pneumonia*' (15%). ACSCs with the highest admission rate were '*diabetes complications*', '*congestive heart failure*' and '*angina pectoris*'. A lower ACSC prevalence as compared with the CHARITEM-study was also shown in the Victorian Admitted Episodes Dataset (Australia; 7.7%).[35] This prevalence is comparable to data from USA showing 7.9% ACSC encounters when the Medical Expenditure Panel Survey was analysed.[15] Chukmaitov *et al* analysed ED data from Florida hospitals in 2005 and reported a prevalence of ACSC of 17.6% in admitted and non-admitted ED-patients.[36] This prevalence is comparable to the results of the present analysis. In data from the Croatian Health

Table 3B Inhospital course of inpatients with ACSC according to the different definitions

	Purdy		Freund		Sundmacher		Naumann		Albrecht	
	n=2738		n=3061		n=3308		n=4960		n=2586	
Inhospital mortality % (95% CI)	2.7 (2.1 to 3.4)	74	2.5 (1.9 to 3.1)	75	2.6 (2.1 to 3.2)	86	4.2 (3.7 to 4.8)	208	3.4 (2.8 to 4.1)	88
Median length of stay in days (IQR)	4 (2–7)		4 (2–7)		5 (3–8)		5 (3–8)		5 (3–9)	
Use of intensive care units % (95% CI)	14.8 (13.5 to 16.2)	406	14.7 (13.5 to 16.0)	450	11.4 (10.3 to 12.5)	377	23.8 (22.6 to 25.0)	1180	15.5 (14.1 to 16.9)	400

ACSC, ambulatory care sensitive condition.

Service Year Book, 23.3% of all outpatient ED visits were ACSC.[37] As only outpatients were included, these data might not be comparable to the analysis of hospitalised patients even though the prevalence of ACSC was similar. For Germany, the proportion of ACSC has been estimated to be 8% in 'emergency hospitalisations'.[22] This analysis is based on the assignment of an 'emergency code' in routine data. One reason for this lower prevalence in administrative data as compared with the presented results might be the differing patient selection. These data do not necessarily reflect a patient group admitted to hospital via the ED as the administrative coding is meant to distinguish between unplanned and elective hospitalisations.[38] Another reason might be that the *Charité—Universitätsmedizin Berlin* as a university and tertiary care hospital and with two inner city EDs might have a different patient population with a higher prevalence of ACSC as compared with the nationwide average. Purdy *et al* investigated 4 659 054 emergency admissions in England (2005, 2006). The prevalence of ACSC was 40.7%, when a wider ACSC definition was applied and 14.1% when a subset of 19 diagnoses was used.[17]

Economic burden and strategies to reduce ACSC admissions

Based on the official hospital statistics in Germany, 1.95 Mio ACSC cases were treated in 2012.[20] The number of ACSC hospitalisations increased by 3.9% in 2013 with 2.03 Mio cases. Prevalence ranged between 9.8% and 13.1% in different federal states. Other sources estimate that about 27% of all 18.6 Mio hospitalisations in Germany were ambulatory care sensitive in 2012.[22] According to a report on ACSC in Germany, 57% of ACSC hospitalisation were attributable to emergency admissions with the highest proportion in Berlin (66%).[20] These data are comparable with data from Australia with a higher proportion of emergency admissions for ACSC diagnoses (61%).[35] Sundmacher *et al* estimated a slightly lower proportion of emergency hospitalisation in all ACSC admissions (42%).[22] The present study demonstrates that a high proportion of ACSC patients were treated on ICUs (21.1%) and that LOS was comparable to non-ACSC patients. These findings together with the overall amount of ACSC cases indicate a high economic burden of inhospital treatment for ACSC. A cost-analysis conducted by Galarraga *et al* showed that the costs of hospitalisations for ACSC diagnoses are higher as compared with ED visits.[15] Furthermore ED visit payments are 2.5 times higher than payments for the same diagnoses in an outpatient setting.[15] Our study also showed a high proportion of unimbursed patients in the ED (13.1%) underlining the economic burden especially from the ED perspective. In a population of 62 379 nursing home inhabitants in South Carolina, mean ED costs were higher in patients with ACSC as compared with non-ACSC patients but mean hospitalisation costs were lower.[39] According to our analyses, about half of all unscheduled hospitalisations from the ED could have been potentially avoided by timely or continuous primary care when all ACSC definitions were combined. Based on estimations by Albrecht *et al*, the mean cost of an ACSC case admitted to hospital is 2551€.[28] As the economic burden of ACSC differs between different healthcare systems, further health economic investigations from different perspectives are warranted to address this topic in more detail. Several strategies for the reduction of ACSC hospital admissions have been proposed. Primary care physicians defined patient-related, system-related and physician-related factors and suggested an improvement of 24 hours availability of primary care, intensified monitoring of high-risk patients and improvement of patient's *'willingness and ability to seek help'*.[40] In another investigation the *'improvement of continuous treatment'* has been identified as the most effective measure to avoid hospitalisations for ACSC.[22] A systematic review on the reduction of ED use analysed 39 studies.[41] In summary, *managed care* and *patient education* revealed to be most effective interventions and might also apply for the avoidance of ACSC in an ED population. The mortality in patients hospitalised for ACSC was 4.1% (95% CI 3.6 to 4.6; n=265) in the present study and thus improvement is necessary from the system's and a patient's perspective. Whether above-mentioned strategies might also improve patient outcomes should be addressed in future research projects.

Future research

The systematic adaption of the ACSC concept to an ED setting is warranted before final recommendations towards an ACSC definition for ED patients could be made. Future research should try to improve even further the data-linkage with other sources of secondary health data and possibly apply a multicentre approach.

CONCLUSION

The assessed ACSC definitions revealed a significant heterogeneity in the respective ACSC prevalence in admitted ED patients and thus these results highlight the need for the development of an optimal, ED-specific ACSC definition. Particular ACSC diagnoses seem to be of special relevance in an ED population but are not included in all existing ACSC definitions (eg, 'convulsion and epilepsy' or 'diseases of the urinary system'). Dedicated research towards the development of a suitable and specific ACSC definition for investigations in an ED setting seems warranted before the concept could be validly used for the identification of potentially avoidable ED visits.

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