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Organizational aspects of primary care related to avoidable hospitalization: a systematic review

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Abstract

Background. Often used indicators for the quality of primary care are hospital admissions rates for conditions which are potentially avoidable by well-functioning primary care. Such hospitalizations are frequently termed as ambulatory care sensitive conditions (ACSCs).

Objective. We aim to investigate which characteristics of primary care organization influence avoidable hospitalization for chronic ACSCs.

Methods. MEDLINE, Embase and SciSearch were searched for publications on avoidable hospitalization and primary care. Studies were included if peer reviewed, written in English, published between January 1997 and November 2013, conducted in high income countries, identified hospitalization for ACSC as outcome measures and researched organization characteristics of primary care. A risk of bias assessment was performed to assess the quality of the articles.

Findings. A total of 1778 publications were reviewed, of which 49 met inclusion criteria. Twenty-two primary care factors were found. Factors were clustered into four primary care clusters: system-level characteristics, accessibility, structural and organizational characteristics and organization of the care process. Adequate physician supply and better longitudinal continuity of care reduced avoidable hospitalizations. Furthermore, inconsistent results were found on the effectiveness of various disease management programs in reducing hospitalization rates.

Conclusions. Available evidence suggests that strong primary care in terms of adequate primary care physician supply and long-term relationships between primary care physicians and patients reduces hospitalizations for chronic ACSCs. There is a lack of evidence for the positive effects of many other organizational primary care aspects, such as specific disease management programs.

Key words: Access to health, chronic disease, continuity of care, hospitalization, primary care, quality of care.

Introduction

In many countries, primary care serves as the entry point of the health care system where the vast majority of health needs are satisfied and complaints treated. The main goal of primary care is to keep people healthy by prevention and timely treatment of illness and disease and manage and coordinate care for chronic illnesses to prevent deterioration of a patient's health (1,2). There are several theoretical models on how primary care can be organized and which characteristics it should include. One of the most cited models was developed by Starfield *et al.* and implies that organization of primary care incorporates a set of features and characteristics, which are summarized into four main primary care domains: first contact of care, longitudinality, comprehensiveness and coordination (3,4). First contact refers to primary care as the first source of care for the population when health care needs arise. This domain includes that primary care is accessible and used by the population when in need. Longitudinality is described in Starfield's model as long-term person-focused care over time. This continuous care approach implies that there is a regular source of care over time and patients build a long-term relationship with providers to create a mutual acceptance of each other's needs and expectations. Furthermore, primary care should be comprehensive to the needs of the population in terms of a wide range of services, which are appropriate to deal with all sorts of health problems in the population. Lastly, primary care should coordinate care services across health care levels, so that patients receive appropriate care for all their health problems. This coordination can for instance be enabled through proper information systems. Each of the domains has a structural feature, indicating the achievement of the domain within the system and a process feature, indicating the actual performance of the domain (4). Starfield's model of primary care domains is often used to assess the strength of a primary care system. Strengthening primary care to realize a more accessible, continuous, comprehensive and well-coordinated system is on many policy agendas both for improving patients health, quality of care and bending the cost curve by reducing hospital expenditures (5–7).

To assess the actual performance of primary care, the number of hospital admissions per capita for conditions that are potentially avoidable with good primary care can be used as indicator of primary care quality (8,9). Such hospitalizations are frequently termed as ambulatory care sensitive conditions (ACSCs). ACSCs are a range of conditions where appropriate and timely ambulatory care or primary care may prevent or reduce the need for much more expensive secondary care (10). Hospitalization for these conditions might be avoided by preventing the onset of the illness, controlling acute disorders or managing chronic diseases to avoid complications (7,11,12). There is no consensus about which conditions should be included in the set of ACSCs (13); however, for chronic diseases, the following conditions are generally considered as ambulatory care sensitive: diabetes, asthma, chronic obstructive pulmonary disease (COPD), angina, hypertension and congestive heart failure.

There is an extensive amount of literature on the association between avoidable hospitalization and primary care. Most research in the field of hospitalization for ACSC involves the relationship with primary care physician supply as a measure of accessibility to primary care. One literature review confirms this relationship between avoidable hospitalizations and access to primary care (14), indicating that primary care as first contact care is reducing potentially avoidable hospitalizations. Another organizational aspect of primary care associated with avoidable hospitalization is continuity of care (15). Having a regular source of care is hypothesized to lower rates of avoidable hospitalization. Patients having a continuous relationship with their primary care physician might feel more unrestricted to express their health problems, including those leading to admissions for ACSC, earlier to their physician, resulting in potential prevention of deterioration of the illness. Although lots of research is undertaken to investigate the phenomenon of ACSC hospitalization, no clear overview exists of the actual contribution of the different primary care characteristics leading to a reduction of the risk for ACSC admissions. Therefore, the objective of this review is to determine and give an overview of which characteristics of primary care organization influence avoidable hospitalization for chronic ACSCs, based on empirical studies that researched this relationship in the literature.

Methods

A systematic search of peer-reviewed studies published in English between January 1997 and November 2013 was conducted using the following electronic databases: PubMed/Medline, Embase and SciSearch. The search strategy combined terms related to primary care ('primary health care', 'family physicians', 'ambulatory care', 'patient-centred care', 'medical home') and avoidable hospitalizations using: 'avoidable', 'preventable', 'ambulatory care sensitive', 'primary care sensitive', as well as: 'hospitalisation', 'hospitalization', 'hospital admission'. In addition to the search across electronic databases, reference lists of included studies were checked to identify potential relevant papers. Furthermore, if papers identified by the search described the protocol of an intervention study, the Internet was searched about the current status of these studies and published papers were obtained if possible. Study protocols were excluded. Only primary empirical studies, both observational and experimental, were considered. Reference lists of systematic reviews, identified in the search, were checked for relevant papers. These papers were included if they met the inclusion criteria.

The search identified a total of 1778 potential articles. All titles and abstracts were screened for inclusion, independently by two reviewers (TvL and MJF). In case of disagreement regarding inclusion or exclusion, the full text article was obtained and reviewed (TvL and MJF). A third researcher (MJvdB) was consulted if there was disagreement.

Studies were eligible for inclusion if they met the following criteria:

1. Hospital admission reported as outcome measure
2. Conditions: ACSC, diabetes (type 1 and 2), COPD, asthma or heart diseases
3. Primary care characteristics are included in analyses;
4. Only studies performed in high income countries were considered for better comparison and generalizability of results between countries [based on World bank (16)].

Studies were excluded if they reported data on emergency department visits, re-admissions or nursing home admissions. Studies investigating admissions for adverse drug events were also excluded, since the focus of this study is on chronic conditions.

Duplicate studies were removed. A total of 49 studies met the inclusion criteria. Details on the progress of study selection are shown in Figure 1.

Information extracted from the remaining 49 studies included: first author, publication date and country; study design; study population; primary care factor; outcome measure and relevant study outcomes (Table 1). All primary care factors were aggregated into clusters. These clusters were created based on the factors observed rather than on forehand specified clusters in order to include all primary care factors and not only those fitting in the pre-specified clusters [e.g. first contact of care, longitudinality, comprehensiveness and coordination (3,4)].

For each study, a risk of bias assessment was carried out determining the potential for selection bias, performance bias, attrition bias, detection bias and reporting bias (66). Studies were rated in low, medium, high or unclear risk of bias. Studies with a low risk of bias include those with a strong design, appropriately performed and clearly and precisely described. Medium risk of bias studies do not meet all criteria, however, this is not likely to cause bias. Studies with a high risk of bias include at least one major flaw in the design that has the potential to cause bias, undermining the validity of the results. A study rated as having an unclear risk of bias had poorly reporting.

Results

Of the 49 articles selected in this review, 30 were conducted in the USA. The others were constructed in the UK (6), Taiwan (3), Korea (1), Canada (3), Germany (2), Italy (2), Spain (1), Australia (1) and New Zealand (1). Half of the studies (25) were published in the last 5 years. The majority was observational of design (37/49). Twelve experimental studies were included, of which three with a randomized design. In 22 studies, a whole range of ACSCs were covered, while the remaining studies focused a few chronic diseases or on total admission rates. Of the 49 studies, 7 focused on children, 7 on elderly and the other 34 articles used all ages or did not specify the participants' age-group. The risk of bias assessment determined that only 2 studies had a high risk of bias, 10 had a medium risk of bias, 36 had a low risk of bias and 1 study had an unclear risk of bias.

After data extraction, 22 unique organizational factors were found. Then, these factors were aggregated to four clusters. Note

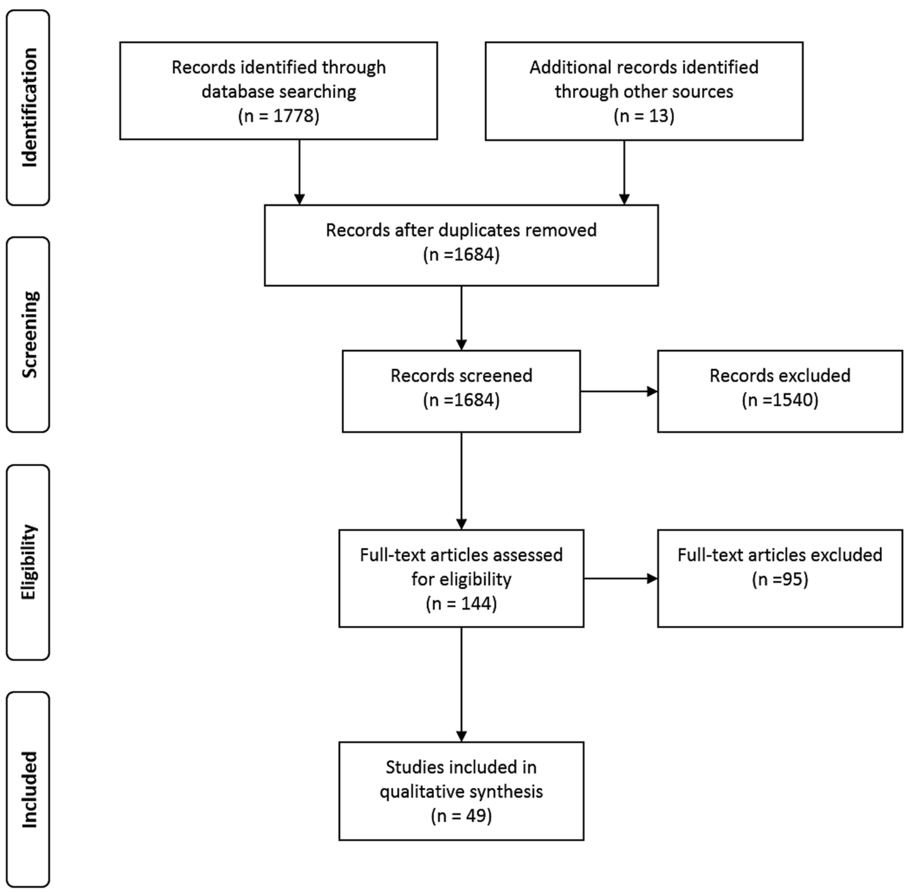

Figure 1. Flow diagram of the literature synthesis process.

Table 1. Characteristics of included articles

Author, year, country, (reference)	Sample size and characteristics	Study design, risk of bias	Outcome measure	PC factor (cluster)	Outcomes	Risk of bias
Basu *et al.* (17), USA	167 622 patients, age 20–64	Cross-sectional	ACSC hospital admissions versus marker conditions	HMO enrolment (1)	OR = 0.75 [CI = 0.69 to 0.81], *P* < 0.01 Medicaid HMO enrollees: OR = 1.84 [CI = 1.55 to 2.18], *P* < 0.01	Low
				Physician supply (no. PCP per 1000 population) (2)	OR = 0.20 [CI = 0.07 to 0.57], *P* < 0.01	
Basu *et al.*, 2012, USA (18)	934 adults in 1995 and 953 in 2005, age 18–64	Cross-sectional	ACSC hospital admissions	HMO enrolment (1)	Private HMO: 1995: β = −0.0432, *P* < 0.05 2005: no association Medicaid HMO: 1995: no association 2005: β = 0.0337, *P* < 0.01	Low
				Physician supply (no. PCP per 1000 population) (2)	1995: β = −0.0178, *P* < 0.05 2005: β = −0.006, *P* < 0.05	
Cooley *et al.*, 2009, USA (19)	7 health plans, 43 PC practices within the health plans, 448 families, 5442 children	Cross-sectional	Hospital admission for 6 chronic diseases: asthma, diabetes, cerebral palsy, epilepsy, ADHD and autism	MHI: -Organizational capacity -Chronic condition management -Care coordination -Community outreach -Data management -Quality improvement (1)	MHI total score: β = −0.189, *P* < 0.01 Organizational capacity: β = −0.201, *P* < 0.01 Chronic condition management: β = −0.191, *P* < 0.01 Care coordination: β = −0.168, *P* < 0.05 No association: community outreach data management, quality improvement	High
Fiorentini *et al.*, 2011, Italy (20)	2 784 099 patients and 3095 GPs Subgroup: 164 574 diabetes patients and 2938 GPs, age 18–74	Cross-sectional	ACSC hospital admissions and subgroup analyses on admission for diabetes	Economic incentives in PC: pay-for-performance, pay-for-participation and pay-for-compliance (1)	No association	Unclear
				List per GP (3)	No association	
				Practice type (3)	No association	
Fishman *et al.*, 2012, USA (21)	1947 patients within PCMH clinics and 39 396 control clinics, age ≥65	Prospective pre-post study with controls	ACSC hospital admissions	Patient-centred medical home (pilot) (1)	Patients in PCMH have lower admissions than control clinics: 12 months: relative difference 75% [CI = 65 to 87], *P* < 0.001 21 months: relative difference 82% [CI = 72 to 93], *P* = 0.002	Low
Pracht *et al.*, 2011, USA (22)	58 counties in Florida	Cross-sectional	Admission for 12 ACSC	HMO penetration (1)	No association	Low
Rosenthal *et al.*, 2013, USA (23)	5 pilot and 34 comparisons practices in Rhode Island	Interrupted time series design	ACSC hospital admissions	Patient-centred medical home (1)	No association	Low

Table 1. Continued

Author, year, country, (reference)	Sample size and characteristics	Study design, risk of bias	Outcome measure	PC factor (cluster)	Outcomes	Risk of bias
Yoon *et al.*, 2013, USA (24)	2 853 030 patients with at least 2 PC visits within 814 VHA PC clinics	Cross-sectional	ACSC hospital admissions	Medical home (1)	Overall MH adoption score: OR = 0.97, $P < 0.05$.	Low
Zhan *et al.*, 2004, USA (25)	932 counties in 22 states in the USA	Cross-sectional	ACSC hospital admissions	HMO penetration (1)	β = −0.0043 [SE 0.0018], $P < 0.05$	Low
				PC physician supply (%) (2)	β = −0.0039 [SE 0.0013], $P < 0.01$	
Ansari *et al.*, 2006, Australia (26)	32 PC partnership areas in Victoria, Australia	Cross-sectional	Age–gender-adjusted ACSC admissions	GP supply (no. PCP per 1000 population) (2)	β = −6.31 [CI = −10.57 to −2.04], $P = 0.007$ Not significantly associated after adjustment	Low
				Self-rated access (2)	β = −20.64 [CI = −32.43 to −8.85], $P = 0.001$ Not significantly associated after adjustment	
Calderon-Larranaga *et al.*, 2011, UK (27)	8229 practices in 152 English care trusts, age ≥15	Cross-sectional	Age–gender-adjusted COPD admissions	Patient reported access (QoF PE7/PE8) (2)	QoF PE7; β = 0.790 [CI = 0.730 to 0.855], $P < 0.001$ QoF PE8; β = 0.902 [CI = 0.850 to 0.957], $P = 0.001$	Low
				No. GPs per 100 000 population (2)	β = 0.998 [CI = 0.998 to 0.999], $P < 0.001$	
				No. nurses per 100 000 population (3)	β = 0.992 [CI = 0.987 to 0.996], $P = 0.001$	
Gulliford, 2002, UK (28)	99 health authorities in England	Cross-sectional	Asthma or diabetes admission per 100 000	No. GP supply per 10 000 population (2)	β = −10.6 [CI = −17.2 to −4.0], $P = 0.002$	Low
Gulliford *et al.*, 2004, England (29)	99 health authorities in England	Cross-sectional	Asthma or diabetes admission per 100 000	No. GP supply per 10 000 (2)	β = −12.0 [CI = −18.0 to −6.1], $P < 0.001$	Low
				Single-handed practices (10% increase) (3)	β = 4.3 [CI = 1.7 to 6.9], $P = 0.001$	
Guttmann *et al.*, 2010, Canada (30)	560 711 patients with asthma, age 2–17 and 6686 patients with diabetes, age <18	Cross-sectional	Asthma or diabetes hospital admission	PC physician supply -No. children per FTE physician (5 categories)	Asthma: 2. ARR = 1.37 [CI = 1.27 to 1.48] 3. ARR = 1.62 [CI = 1.47 to 1.78] 4. ARR = 1.57 [CI = 1.37 to 1.79]	Low
				1. 1500–1999 (high)(ref)	5. ARR = 1.65 [CI = 1.28 to 2.12]	
				2. 2000–2499	Diabetes: 2. ARR = 1.59 [CI = 1.25 to 2.03]	
				3. 2500–2999	3. ARR =1.64 [CI = 1.22 to 2.23]	
				4. 3000–3499	4. ARR = 1.81 [CI = 1.18 to 2.77]	
				5. ≥3500(low) (2)	5. ARR = 1.41 [CI = 0.7 to 2.85]	

Table 1. Continued

Author, year, country, (reference)	Sample size and characteristics	Study design, risk of bias	Outcome measure	PC factor (cluster)	Outcomes	Risk of bias
Laditka, 2004, USA (31)	31 US metropolitan areas, age ≥69	Longitudinal study	ACSC hospital admissions	Physician supply Q1 (ref.) (low) Q2: 4.80/10 000 Q3: 5.19/10 000 Q4: 5.35/10 000 (high) (2)	Q 2: RR = 0.43 [CI = 0.21 to 0.86], *P* < 0.05 Quartiles 3 and 4 were not significantly associated with ACSC	Low
Laditka *et al.*, 2005, USA (32)	642 urban counties in the USA	Cross-sectional	ACSC hospital admissions	Physician supply (no PCP per 100 000 population) (2)	Age <18: β = −0.239, *P* < 0.0001 Age 18–39: β = −0.186, *P* < 0.0001 Age 40–64: β = −0.204, *P* < 0.0001	Low
Magan *et al.*, 2013, Spain (33)	102 346 persons residing in Madrid region, age ≥65	Cross-sectional	ACSC hospital admissions (age–sex standardized)	GP supply (no. PCP per 1000 population) (2) GP workload (no. consultation per year, divided by no physicians multiplied by number working days per month) (3)	No association RR = 1.006 [CI = 1.041 to 1.091], *P* < 0.001	Low
Ricketts *et al.*, 2001, USA (34)	120 PC service clusters in North Carolina	Cross-sectional	ACSC hospital admissions (age–sex standardized)	Physician supply (no. PCP per 1000 population) (2)	No association	Low
Saxena *et al.*, 2006, UK (35)	31 PC Trust's in London	Cross-sectional	Hospital admission per 100 000 for asthma, diabetes HF, hypertension COPD (age standardized)	Total no. GPs (2) Average list size (3) %GPs with >2500 patients (3) %GPs providing condition-specific services (3)	No association	Medium
Schreiber and Zielinski, 1997, USA (36)	1460 ZIP codes in New York state, population age <65	Cross-sectional	ACSC hospital admission (age–sex standardized) rates per 100 population	Physician supply (no. PCP per 1000 population) (2)	Downstate metropolitan: β = 0.345, *P* = 0.0001 Upstate metropolitan, rural-urban: β = 0.1046, *P* = 0.0132 Rural-Urban-suburban, Rural-suburban, Rural-periphery: β = 0.222, *P* = 0.001	Low
Prentice *et al.*, 2012, USA (37)	116 292 patients in total study population and 116 113 in analyses for hospitalization	Retrospective cohort	ACSC hospital admissions	Waiting time: wait until the next available appointment at a VA facility (2)	No association	Medium
Rizza *et al.*, 2007, Italy (38)	492 patients, age ≥18	Cross-sectional	ACSC hospital admissions	No. PCP visits in previous year (2) No. PCP accesses in previous year (2) List size: no. patients/PCP (3)	OR = 0.1 [CI = 0.05 to 0.23], *P* < 0.001; OR = 0.52 [CI = 0.3 to 0.93], *P* = 0.027. OR = 2.25 [CI = 1.62 to 3.13], *P* < 0.001;	Low
Steiner *et al.*, 2012, USA (39)	115 children hospitalized for ACSC and 115 non-hospitalized children, age ≤3 years	Nested case–control study	ACSC hospital admissions	PC visits and preventive care visits (2)	No association	Low

Table 1. Continued

Author, year, country, (reference)	Sample size and characteristics	Study design, risk of bias	Outcome measure	PC factor (cluster)	Outcomes	Risk of bias
Shi *et al.*, 1999, USA (40)	25 653 adults and 11 457 children hospitalized for ACSC	Cross-sectional	ACSC hospital admissions	Having a PCP (2)	Having no PCP: Adults: OR = 4.011 [CI = 3.897 to 4.128], $P < 0.05$ Pediatric: OR = 9.557 [CI = 9.477 to 9.637], $P < 0.05$	Medium
Gary *et al.*, 2004, USA (41)	542 African-Americans with diabetes, age ≥25	RCT	Hospital admission	Intensive intervention group: nurse case manager and CHW	At 24 months: ARR 0.91 [CI = 0.64 to 1.19]	Low
				Minimal intervention group: Usual care (3)	At 36 months: those who had a higher frequency of CHW visits ARR 0.44 [CI = 0.27 to 0.73], $P \le 0.05$	
Griffiths *et al.*, 2010, UK (42)	7456 GP practices in England	Cross-sectional	Non-elective admissions for diabetes, asthma and COPD	Practice nurse staffing: 5 Quintiles: 1st is lowest no. patients per nurse and 5th is the highest nr of patients per nurse (3)	Asthma 1st: $\beta = -0.1295$, $P < 0.001$ 2nd: $\beta = -0.1313$, $P < 0.001$ 3rd: $\beta = -0.1347$, $P < 0.001$ 4th: $\beta = -0.1091$, $P < 0.001$ 5th: $\beta = -0.0856$, $P < 0.01$ COPD 1st: $\beta = -0.0829$, $P < 0.01$, 2nd: $\beta = -0.0600$, $P < 0.001$ 3rd: $\beta = -0.0555$, $P < 0.001$ 4th–5th: not associated Diabetes 1st: $\beta = 0.1269$, $P < 0.01$ 2nd: $\beta = 0.1028$, $P < 0.05$ 3rd: not associated 4th: $\beta = 0.0962$, $P < 0.05$ 5th: $\beta = 0.0991$, $P < 0.05$	Low
				List size per FTE GP (3)	Asthma: $\beta = -0.0186$, $P < 0.001$ COPD: $\beta = -0.0278$, $P < 0.001$ Diabetes: $\beta = -0.0093$, $P < 0.05$	
				Single-handed practices (3)	COPD: $\beta = 0.0407$, $P < 0.01$	
Kralewski *et al.*, 2012, USA (43)	133 703 medicare patients with diabetes	Cross-sectional	Avoidable hospital admission per person per year	Ratio nurse practitioner/PA and physician (3)	$\beta = 0.0437$, $P < 0.01$	Low
				Electronic health record system (3)	Not associated	
				Size (no FTE physicians) (3)	$\beta = 0.0004$, $P < 0.05$	
				No. support services (3)	Not associated	
O'Malley *et al.*, 2007, USA (44)	91 318 medicare beneficiaries, age ≥65	Prospective cohort	Hospital admission for COPD per 10 000 person–years	Practice type (3)	Not associated	Low
				IT (3)	Not associated	
				Access to ancillary services (always/almost always reference) (3)	AHR = 1.10 [CI = 1.00 to 1.20], $P < 0.05$	
				Guidelines (4)	AHR = 0.88 [CI = 0.80 to 0.96], $P < 0.05$	
Chen and Chen, 2011, Taiwan (45)	48 107 diabetes patients, age ≥18	Retrospective cohort	Diabetes-related admissions	COCI: low COCI reference (4)	Medium COCI: OR = 0.58 [CI = 0.56 to 0.59] High COCI: OR = 0.26 [CI = 0.25 to 0.27]	Low

Table 1. Continued

Author, year, country, (reference)	Sample size and characteristics	Study design, risk of bias	Outcome measure	PC factor (cluster)	Outcomes	Risk of bias
Cheng *et al.*, 2010, Taiwan (46)	30 830 patients	Retrospective cohort	ACSC hospital admissions	COCI: low COCI reference (4)	Medium COCI: age ≤18: OR = 0.65 [CI = 0.57 to 0.75], $P < 0.001$; age 19–64: OR = 0.73 [CI = 0.64 to 0.82], $P < 0.001$; age ≥65: OR = 0.66 [CI = 0.57 to 0.77], $P < 0.001$; High COCI: age ≤18: OR = 0.39 [CI = 0.34 to 0.46], $P < 0.001$; age 19–64: OR = 0.41 [CI = 0.35 to 0.48], $P < 0.001$; age ≥65: OR = 0.39 [CI = 0.32 to 0.46], $P < 0.001$	Low
Christakis *et al.*, 2001, USA (47)	252 children with diabetes type 1, age <18	Retrospective cohort	Admission for diabetic ketoacidosis	COCI: low COCI reference (4)	Medium COC: OR = 0.22 [CI = 0.05 to 0.87], $P < 0.05$ High COC: OR = 0.14 [CI = 0.03 to 0.67], $P < 0.05$	Low
Christakis *et al.*, 2001, USA (48)	3559 children with asthma, age <18	Retrospective cohort	Hospital admission	COCI: high COCI reference (4)	Medium COC: HR = 1.61 [CI = 1.10 to 2.38] Low COC: HR = 1.79 [CI = 1.21 to 2.56]	Low
Gill and Mainous, 1998, USA (49)	13 495 patients, age 0–64	Cross-sectional	Admission for chronic ACSC	Provider continuity (4)	OR = 0.54 [CI = 0.34 to 0.88]	Low
Hong and Kang, 2013, Korea (50)	68 469 diabetic patients, age ≥20 years	Retrospective cohort	Diabetes admission	COCI: 100 (high) COCI reference (4)	0.8 ≤ COCI < 1.0: OR = 1.60 [CI = 1.24 to 2.06] 0.6 ≤ COCI < 0.8: OR = 1.95 [CI = 1.54 to 2.46] 0.4 ≤ COCI < 0.6: OR = 1.93 [CI = 1.55 to 2.40] <0.4 COCI: OR = 2.45 [CI = 1.94 to 3.09]	Low
Knight *et al.*, 2009, Canada (51)	1143 diabetic patients, age ≥65	Cross-sectional	Total number of inpatient hospitalization	COCI (4) SECON (4) UPC (4)	ARR = 0.82 [CI = 0.69 to 0.97] ARR = 0.82 [CI = 0.68 to 0.98] ARR = 0.75 [CI = 0.61 to 0.91]	Low
Lin *et al.*, 2010, Taiwan (52)	6471 diabetic patients	Cross-sectional	Diabetes-related short- and long-term ACSC admission	COC (UPC): high continuity reference (4)	Long-term complication: Medium: RR = 1.315 [CI = 1.000 to 1.728], $P < 0.05$ Low: RR = 1.336 [CI = 1.019 to 1.728], $P < 0.05$ Short-term complication: no association	Low
Nyweide *et al.*, 2013, USA (53)	3 276 635 patients, age ≥65 years, at least ambulatory 4 visits	Retrospective cohort	ACSC hospital admissions	COC -UPC -COCI (4)	UPC: HR = 0.98 [CI = 0.98 to 0.98] COCI: HR = 0.98 [CI = 0.98 to 0.99]	Low

Table 1. Continued

Author, year, country, (reference)	Sample size and characteristics	Study design, risk of bias	Outcome measure	PC factor (cluster)	Outcomes	Risk of bias
Manns *et al.*, 2012, Canada (54)	77464 patients in PCN and 77464 patients not in PCN	pre-post study with controls	Hospital admission for diabetes-specific ACSCs	PCN: multiple PCPs and other health care providers working together programs for education, case management, multidisciplinary team (4)	Adjusted IRR = 0.75 [CI = 0.64 to 0.87], $P < 0.001$	Medium
Sommers *et al.*, 2000, USA (55)	543 patients within 18 PC practices, age ≥65 and 2 chronic diseases	Concurrent controlled cohort	No. hospital admissions per patient	Collaboration between physician, nurse and social worker (4)	1st year: no association 2nd year: OR = 0.63 [CI = 0.41 to 0.96]	Medium
Cloutier *et al.*, 2005, USA (56)	3748 children	Prospective cohort	Asthma hospitalization admission	Guidelines within a asthma disease management program (4)	For children with persistent asthma: ARR = 0.611 [CI = 0.372 to 1.002], $P = 0.05$	Medium
Chuang *et al.*, 2011, USA (57)	141 intervention group COPD patients and 141 controls with COPD	Matched intervention	Total hospital admission rates	Disease management program for COPD patients (pilot): -Improve patients screening -Diagnosis -Treatment with supplemental education (4)	Not associated	Medium
Cohen *et al.*, 2012, USA (58)	36000 medicare diabetes patients	Case study	Total hospital discharges	Care improvement plus (chronic special needs plan) -House calls -Nurse care management -Pharmacist -Social services -Transitions of care -Advanced illness program (4)	-Utilization rate per enrollee: 0.49 special needs plan and 0.55 fee-for-service -Admission rate was 9% lower among SNP enrollees compared to FFS enrollees	Low
Davidson *et al.*, 2007, USA (59)	331 diabetes patients	pre-post study without control group	Diabetes-related hospitalizations (metabolic/ infection)	Nurse directed Diabetes Disease Management program (4)	In the prior year: 5 patients had 6 diabetes hospitalizations During the trial: 1 patient had a hospitalization for diabetes Difference $P < 0.001$	High
Greisinger *et al.*, 2004, USA (60)	10980 diabetes patients	Retrospective cohort	All-cause hospital admission	Diabetes care management program (4)	Inverse: OR = 0.84 [CI = 0.70 to 1.00], $P = 0.05$	Low
Hamar *et al.*, 2011, Germany (61)	Intervention: 13486 Comparison: 4582 Insured members, age ≥65	pre-post study with control group	Annualized hospital admission rate per 1000	CCM Program: impact of care calls Intervention group received 2 or more calls and the comparison group 1 or less (initial enrolment call) (4)	1 year follow-up: admission rate in intervention group decreased by 6% compared to an 18.9% increase in the comparison group ($P < 0.05$) Subgroup analyses: HF and CHD significant treatment effect; COPD and diabetes not	Low
Hamar *et al.*, 2010, Germany (62)	Intervention: 17319 Comparison: 5668 ≥1 chronic condition	pre-post study with control group	Annualized hospital admission rate per 1000	CCM program: educating and empowering patients -Health related behaviours -Self-care measures -Adherence to standards of care (4)	-Admission rate in the intervention group decreased by 6.2% compared to 14.9% increase in the comparison group: $P < 0.001$ -Subgroup analyses: HF and CHD significant treatment effect $P < 0.01$; COPD and diabetes rates: not associated	Low

Table 1. Continued

Author, year, country, (reference)	Sample size and characteristics	Study design, risk of bias	Outcome measure	PC factor (cluster)	Outcomes	Risk of bias
Patel *et al.*, 2004, USA (63)	3486 patients at baseline and 2920 patients post-program, age 4–55	Pre-post study without control group	Asthma-related admissions per 1000 asthmatics	Asthma disease management program (4)	Hospitalization rate decreased by 54%: from 81 per 1000 to 37 per 1000, $P < 0.001$	Medium
Rea *et al.*, 2004, New Zealand (64)	26 practices and 83 patients in intervention group and 25 practices and 52 patient in conventional group	Prospective RCT	COPD admission rates	Chronic disease management program for COPD (4)	12 months prior to intervention versus during the trial: admission rates decreased for the intervention group (50–21) and increased (28–35) in conventional care group	Medium
Campbell *et al.*, 1998, UK (65)	1173 patients, age <80 with CHD within 19 general practices	RCT	All-cause admission	Secondary prevention clinics run by nurses: promotion of medical and lifestyle aspects, regular follow-up (4)	OR = 0.64 [CI = 0.48 to 0.86], $P = 0.003$ Only partly explained by cardiac admissions (7% admissions in intervention versus 9% admissions in lcontrol group)	Medium

ADHD, attention deficit hyperactivity disorder; ARR, adjusted rate ratio; CCM, chronic care management; CHD, coronary heart disease; CI, confidence interval; COC, continuity of care; COCI, continuity of care index; CHW, community health worker; FFS, fee-for-service; FTE, full-time equivalent physicians; HF, heart failure; HMO, Health Maintenance Organization; IRR, incidence rate ratio; MHI, medical home index; OR, odds ratio; PC, primary care; PCN, primary care network; PCP, primary care physician; QoF, quality and outcomes framework; RCT, randomized controlled trial; SE, standard error; SECON, sequential continuity; SNP, special needs plan; UPC, usual provider continuity.

that some studies investigated more than one factor from different clusters, and as such can appear more than once in the overview:

1. System-level characteristics: factors related to the organization of the health care system (3 factors investigated in 9 studies);
2. Access to primary care: factors related to timely access and availability of the primary care system (4 factors investigated in 18 studies);
3. Structural and organizational characteristics: factors related to how the primary care practice is organized (9 factors investigated in 10 studies) and
4. Care processes: factors related to how different processes of care are organized (5 factors investigated in 22 studies).

Below the different factors and their association with avoidable admission rates are described in detail, with an overview presented in Table 2.

System-level characteristics

Nine studies investigated the association between avoidable hospitalizations and factors related to how primary care systems are structured in terms of financing and organization, such as additional payments, Health Maintenance Organization (HMO) penetration and 'medical homeness' (17–25). Overall, four out of nine studies reported a decreased hospitalization rate for system-level factors. Four out of the nine articles, all situated in the USA, researched the influence of the medical home concept on lowering admission rates (19,21,23,24). The medical home is a model for organizing primary care in the USA to provide accessible, comprehensive and coordinated care in the community of patients. Indeed, three out of the four studies found significant lower rates of avoidable hospitalization when more 'medical homeness' was incorporated in the health care system (19,21,24). The studies had participants of different age groups. In four other American studies, HMO penetration, a health care plan in the USA including primary care, was researched (17,18,22,25). One showed that HMO penetration was associated with less preventable hospitalizations (25). Two studies found private HMO enrollees less likely to be admitted for ACSC, while Medicaid HMO enrollees had inverse results (17,18). Lastly, an Italian study investigating the relationship between additional financial payments for GP's and avoidable hospitalization did not find a statistical significant association (20).

Care accessibility

Care accessibility, which was studied in 18 articles, includes primary care physician supply, waiting time and the number of visits in primary care. Fourteen studies, all with an observational

Table 2. Results of the associations between primary care factors and hospital admission rates

Domain	Factor	Type of association, # of studies (# experimental)			Total
		Higher rates	No/inconsistent association	Lower rates	
System-level characteristics	Medical home	–	1 (1)	3 (1)	4
	HMO penetration	–	3 (0)	1 (0)	4
	Extra financial payments	–	1 (0)	–	1
Access	PC physician supply	1 (0)	4 (0)	9 (0)	14
	Self-rated access		1 (0)		1
	Waiting time	–	1 (0)	1 (0)	2
	Number of PC visits	–	1 (0)	1 (0)	2
	Having PC physician	–	–	1 (0)	1
Practice characteristics	Workload	1 (0)	–	–	1
	Practice size	1 (0)	–	–	1
	List size	1 (0)	2 (0)	1 (0)	4
	Practice type (single handed)	2 (0)	2 (0)	–	4
	Ancillary and support services	–	1 (0)	1 (0)	2
	Practice nurse supply	1 (0)	1 (0)	1 (0)	3
	Community health workers/case managers	–	1 (1)	–	1
	Condition-specific services	–	1 (0)	–	1
	IT services	–	2 (0)	–	2
Care organization	Continuity of PC	–	–	9 (0)	9
	Disease management programs	–	3 (3)	5 (3)	8
	Prevention clinics	–	1 (1)		1
	Provider collaboration	–	–	2 (1)	2
	Use of Guidelines	–	–	2 (1)	2

The number of studies per primary care factor are presented. IT, Information Technology; PC, primary care.

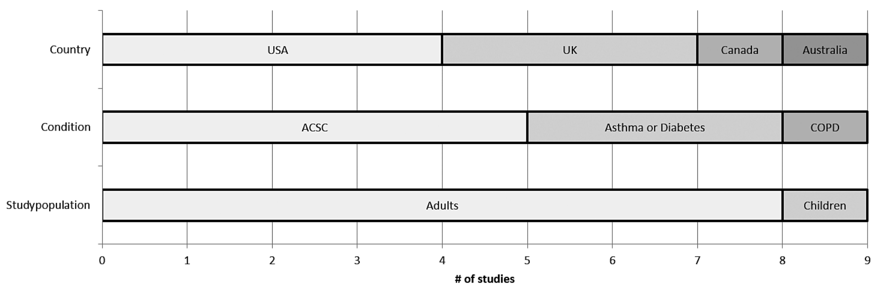

Figure 2. Distribution of the studies that show lower rates of avoidable hospitalization due to more physician supply across countries, conditions and study populations.

research design, investigated the role of supply of primary care physicians in relation to avoidable hospitalization rates, regardless of country and age groups (17,18,25–36) (Fig. 2). Except for 3 studies (33–35), the majority (9/14) of studies confirmed a negative association between the number of primary care physicians per population and hospitalization rates (17,18,25–30,32). In addition to this linear association, in one study, the inverse relationship between supply and avoidable hospitalization rates was only present for supply-rates up to 5.2/10 000, while a further increase in supply did not affect hospitalization rates (31). Moreover, one study found a positive relation, indicating that the more primary care physicians, the higher the rates of ACSC hospitalization (36). Patients with a higher self-rated access had risk to be hospitalized for ACSC (26). Mixed results were reported for the association between both waiting time for an appointment (27,37) and the number of primary care visits and avoidable hospitalization (38,39). Finally, in the USA, not having a regular primary care physician increased the risk of avoidable hospitalization for ACSCs in both adults and children (40).

Structural and organizational characteristics

Of the total 49 studies, 10 investigated the role of primary care practice organization (20,27,29,33,35,38,41–44). Higher workload for GP's, as well as more full-time equivalent physicians in the practice, as a measure for practice size, was associated with higher rates of ACSC hospitalization (33,43). Mixed results were reported for practice type (20,29,42,44), list size (20,35,38,42) and for having access to ancillary or support services (43,44) in relation to the probability of hospitalization for ACSCs. The availability of practice nurses in the practice was associated with reduced admission rates for patients with asthma and COPD, while opposite results were found for diabetes-related admission (27,42,43). However, when the nurse case manager was combined with a community health worker within a managed care program, admission risk significantly decreased for diabetes patients, for those who saw the community health worker (41). No association was found for GPs offering condition-specific services and use of IT services (35,43,44).

Organization of care process

This cluster mainly refers to primary care provider continuity and how care is delivered, e.g. within disease management programs. There is compelling evidence, based on nine observational studies, that higher levels of provider continuity decrease the risk of avoidable hospitalization for ACSC and chronic diseases, regardless of country and age groups (45–53) (Fig. 3).

Collaboration between primary care physicians and other community-based health care providers within for instance primary care networks (54,55) and adherence to guidelines (44,56) were associated with a reduction of hospitalization rates.

The association between disease management programs and avoidable hospitalization was often reported (n = 8), with inconsistent results (57–64). All disease management programs differed in focus, content and intervention. Five found that involvement in a disease management program decreased the rate of avoidable hospitalization (58–60,63,64). Two articles, the same study but different samples, found mixed results depending on the chronic disease researched (61,62), while another study found no effect of a COPD program on hospitalization (57).

In addition, cardiac patient attending in a secondary prevention clinic, which promotes medical and lifestyle aspects and offer regular follow-up, had lower risk for hospitalization, however, only partly due to lower cardiac admissions (65).

Discussion

Based on 49 studies, this review provides insight in the evidence of which characteristics of primary care organization relate to avoidable hospitalization for ACSC. Having an accessible and continuous primary care system appeared to be more important in reducing potentially avoidable hospitalizations than how the primary care delivery is exactly organized.

First, this review of the literature presents compelling evidence for the positive impact of having an accessible primary care system, measured as primary care physician supply, in lowering rates of potentially avoidable hospitalizations. Our findings correspond with a review focusing primarily on accessibility of care (14). However, not all regions with an adequate capacity of primary care physicians had lower rates of hospitalization. One of the studies suggested the supply-induced demand theory as possible explanation of this contradicting result, at least in the USA. When the supply of physicians grows to a point where there is too much competition for patient volumes, physicians might increase the demand for their services at other levels of the system, for instance in the hospital (31). This, however, will primarily occur when primary care physicians are both organizationally and financially tied to the hospital, which is often the case in the USA, but not in other countries like the UK and The Netherlands.

Besides adequate physician supply, this review shows that continuity of care defined as having a long-term relationship with a primary care provider lowers rates of avoidable hospitalization. Provider continuity, regardless how it is measured, reduces rates of hospitalization across the studies and across studied conditions. Continuity of care is often seen as a core dimension of primary care and influences primary care quality, not only in terms of patient outcomes such as hospitalization and emergency department use, but also patient satisfaction (67,68).

There appears to be no clear recipe on how primary care delivery should be organized in order to reduce avoidable

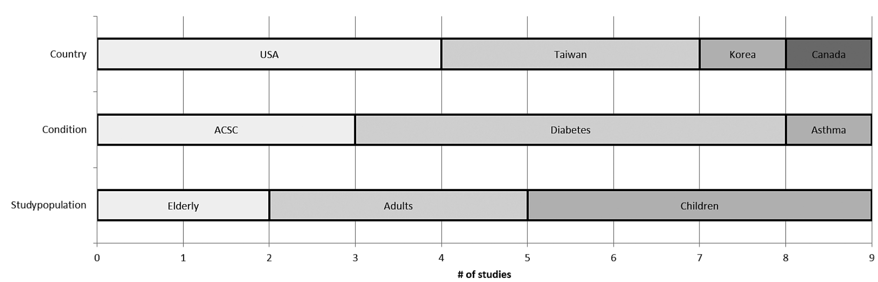

Figure 3. Distribution of studies that show lower rates of avoidable hospitalization due to better continuity of care across countries, conditions and study populations.

hospitalization. Provision of care within for instance disease management programs or special needs plans do not necessarily reduce rates of hospitalization; results are inconclusive. Although such programs often are intended to support self-management and reduce health care utilization, the evidence supporting these claims are, in line with our findings, inconclusive (69). Other organizational features, such as practice type, size, specific services or IT services showed mixed results or were not associated with lowering rates of hospitalization.

In contrast, there is some evidence that comprehensive care, organized according to the medical home concept, established in the USA, reduces the rates of avoidable hospitalization. The medical home concept aims to provide an accessible and continuous primary care system for their patients as well as comprehensive and coordinated care (70). This concept is consistent with our findings about the importance of care access and provider continuity.

Referring back to Starfield's model of primary care domains, strong primary care systems are proposed to be first contact for care, continuous, comprehensive and well-coordinated in order to reduce unnecessary and unwanted outcomes such as avoidable hospitalization (4). Indeed, it can be concluded that the structural feature of first contact of care, that is sufficient primary care physician supply, is associated with lower the risks of avoidable hospitalizations across countries, diseases and study populations. In addition, longitudinality of care over time is also associated with fewer admissions. On the other hand, there is still a gap in knowledge for the other domains (i.e. coordination of care and comprehensiveness). Although, some studies conducted research in these areas, no conclusive evidence was found so far.

Countries differ in the way they organize their primary care system. Tradition and culture often influence the approach in system policy. What might work in one country might not be of much contribution in another. Moreover, results also show that what might work for patients with a certain condition might not work for a patient with another ACSC. The same applies for different study populations: children, adults, elderly, ethnic minorities and so on. Our study gives a state of the art overview of the body of knowledge in literature and identifies clear areas in which initiatives can reduce unnecessary hospitalizations and thereby enhance the quality of care. Further research is required to gain more insight into which factors have a greater importance for specific subgroups.

Limitations

There are some points of consideration when using rates of preventable hospitalization as an indicator of quality of primary care. Although the role of primary care in reducing avoidable hospitalization might be important, other factors outside the health care system might also contribute to admissions for ACSCs. Literature shows that there are many non-primary care factors such as patient, environmental and social factors, related to avoidable hospitalization, and creating barriers for reducing these admissions (15,71). Moreover, primary care is only one type of ambulatory care. Especially when using hospitalization rates for ACSCs, it is important to realize that other outpatient settings might influence these types of hospitalizations and not only primary care. Yet, our results show the influence of primary care on rates of avoidable hospitalization and therefore the possibilities to use it as a measure of primary care quality, bearing in mind possible other influences.

Further limitations for the present study arise from both study methods as well as characteristics of the studies included. This review was only based on published peer-reviewed studies and did not include grey literature or literature in non-English languages. By searching references of included studies, this limitation was however restricted. Most studies were observational of design and only a few were experimental. However, limiting the search to a specific study design might result in not including potentially important factors. In addition, some studies had primary care factors as predictors or covariate in their analyses while this was not the main focus of the study, this was especially true for factors within the practice level, for instance practice size. Some studies had a focus on a specific patient group, such as diabetics or other chronic diseases, but reported all-cause hospitalization or did not specify the diagnosis of hospitalization as outcome measure. We argue that it is justifiable to include these studies since they specifically focus on a patient group aiming to prevent hospitalizations. Lastly, due to the wide variation in types of primary care systems, difficulties arise in determining whether a study has a primary care setting. Although unlikely, articles might accidently be excluded because of unknown or unclear settings, for instance articles not specifying the type of outpatient care.

Conclusions

This study highlights the importance of primary care in reducing hospitalization for several chronic conditions or ACSCs. Our findings suggest that through strengthening primary care by increasing the primary care physician supply and enhancing long-term relations between primary care physicians and patients, potentially avoidable hospitalizations will actually be avoided. This appeared to be even more important than how the actual primary care delivery is organized. Policy goals enhancing these features of primary care might improve quality.

Declaration

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