REVIEW

Continuity of Outpatient Care and Avoidable Hospitalization: A Systematic Review

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ABSTRACT

OBJECTIVES: Continuity of care (COC) is a core element of primary care, which has been associated with improved health outcomes. Hospitalizations for ambulatory care–sensitive conditions (ACSCs) are potentially preventable if these conditions are managed well in the primary care setting. The aim of this article is to conduct a systematic review of literature on the association between COC and hospitalizations for ACSCs.

STUDY DESIGN: Systematic literature review.

METHODS: All published literature was searched for in PubMed and MEDLINE using PRISMA guidelines for collecting empirical studies. Studies published in English between 2008 and 2017 that measured the association between COC and at least 1 measure of ACSC hospitalizations were included in this review.

RESULTS: A total of 15 studies met the inclusion criteria and applied claims data to examine the association between COC and ACSC hospitalizations. Most studies (93.3%) demonstrated a statistically significant association of higher COC in the outpatient setting with reduced likelihood of hospitalization for either all ACSCs or a specific ACSC. A strong association was observed among studies focusing on patients with a specific ACSC. Additionally, most studies used the Bice-Boxerman COC index to measure COC and measured COC before a period of measuring ACSC hospitalizations.

CONCLUSIONS: This systematic review identified that increased COC in outpatient care is associated with fewer hospitalizations for ACSCs. Increasing COC is favorable for patients who are managing a specific ACSC.

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An ambulatory care–sensitive condition (ACSC) is defined as a condition for which timely and effective primary care or outpatient care can potentially reduce the risk of subsequent hospitalization.[1-4] Hence, a hospitalization for an ACSC is also called a preventable hospitalization or avoidable hospitalization.[5,6] The Agency for Healthcare Research and Quality developed a set of Prevention Quality Indicators consisting of 16 ACSCs (eg, asthma, bacterial pneumonia, congestive heart failure, chronic obstructive pulmonary disease [COPD], dehydration, diabetes, hypertension, kidney/urinary tract infection, ruptured appendix) as indicators to measure the occurrence of potentially preventable hospitalizations and to track trends in hospitalizations for ACSCs to assess the quality of primary healthcare.[7]

In the United States, 1426 per 100,000 Americans were hospitalized for ACSCs in 2014, although the hospitalization rate for ACSCs has been decreasing slightly since 2005.[8] Previous literature has found that patients with ACSC hospitalizations had higher expenditures than those without this type of hospital admission.[9] Hence, hospitalizations due to ACSCs have become a critical discussion topic, because they not only reflect primary care quality[1] but also relate to the cost consciousness[10] in healthcare delivery systems. Additionally, ACSC hospitalizations have been used to measure the performance of primary care in healthcare systems around the world.[7,11-13] Therefore, it is imperative to decrease the risk of ACSC hospitalizations for patients in the current healthcare system, in which costs of inpatient admissions are rapidly increasing.[9,10]

Continuity of care (COC), a core element of primary care,[14,15] represents a constant curative relationship between a patient and a care provider that is characterized by trust and responsibility.[16] Maintaining a continuous therapeutic relationship between patient and physician when treating chronic diseases has been proven to be associated with higher satisfaction, better compliance, and reduced hospitalizations and emergency department (ED) visits.[17-21] Patients who have a stable connection with their healthcare providers for chronic disease treatment may improve their health outcomes because their providers are familiar with their disease conditions and understand their needs.[21,22]

TAKEAWAY POINTS

This review analyzed findings using PRISMA guideline indicators to assess the association between continuity of care (COC) and hospitalization for ambulatory care–sensitive conditions (ACSCs).

- Higher COC was statistically significantly associated with fewer ACSC hospitalizations and specific-ACSC hospitalizations.
- The Bice-Boxerman COC index is most commonly used to measure COC in studies using claims data sets.
- Most studies assessed COC before measuring ACSC hospitalizations.

Although studies have recognized COC as being positively associated with healthcare outcomes, the association between COC and all ACSCs (or a specific ACSC) is not well reviewed systematically. To our knowledge, there have been no review articles in this decade discussing the relationship between COC and ACSC hospitalizations. Therefore, this systematic review evaluated the association between COC and ACSC hospitalizations across studies published approximately in the past decade to provide a comprehensive, evidence-based perspective for clinicians and researchers who are interested in conducting research related to COC and ACSCs.

METHODS

A systematic search of the PubMed and MEDLINE databases was conducted from January to February 2018 based on Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines[23] (**Figure 1**). The initial search was limited to articles published in English from January 1, 2008, to December 31, 2017, that included COC in the title or abstract. After that, article titles or abstracts were reviewed to identify studies that included hospitalizations or admissions. Subsequently, combinations of terms relating to hospitalizations or admissions (ie, avoidable, preventable, and ambulatory care–sensitive conditions) were identified in the title or abstract. Article titles and abstracts were reviewed to assess whether the remaining articles met inclusion criteria, excluding studies and reports that had nonrelevant outcomes or that did not actually measure COC. Lastly, duplicates, books, reports, editorials, and review articles were removed. The remaining articles were assessed entirely and included in this review if criteria were met. We identified further relevant studies by searching the reference lists of included studies and using the Web of Science Core Collection to explore all potentially relevant research that cited the included studies.

A data extraction form was created to collect relevant study information from each article, including lead author name, year of publication, study design, number of study samples, age of the sample, and samples with or without a specific disease. Relevant information also included data resources, COC measurement, cutoff point for COC level, COC measuring period, healthcare outcomes measuring period, primary healthcare outcome(s) of interest, and significant results. Two researchers (Y.H.K. and W.T.L.) performed the initial search, conducted the appraisal of articles, extracted data from studies, and recorded findings in data extraction forms. Researchers summarized and synthesized these findings to evaluate inferences and conclusions made on the association between COC and ACSC hospitalizations across studies.

Figure 1 presents a diagrammatic flow of the process and search terms used to conduct the review. The search of PubMed and MEDLINE resulted in the identification of 3076 articles that mentioned COC. After applying exclusion criteria (ie, language was not English, title or abstract did not include "hospitalization[s]" or "admission[s]"), 482 articles remained. The titles of these articles were reviewed for relevance to outcomes of interest including "avoidable," "preventable," or "ACSC(s)," and 88 articles were retained. From the eligible articles, we excluded 50 duplicates, 3 reports or editorials, 2 review articles, and 20 articles that did not actually measure COC. Thus, 13 studies were selected.[24-36] After manually hand searching the reference lists of included studies, 2 additional articles[37,38] were selected for this review. Full articles from these 15 studies were then evaluated for inclusion. Summaries of these studies are presented in the **Table**[24-38]; an expanded version of the Table is in the **eAppendix** (available at **ajmc.com**).

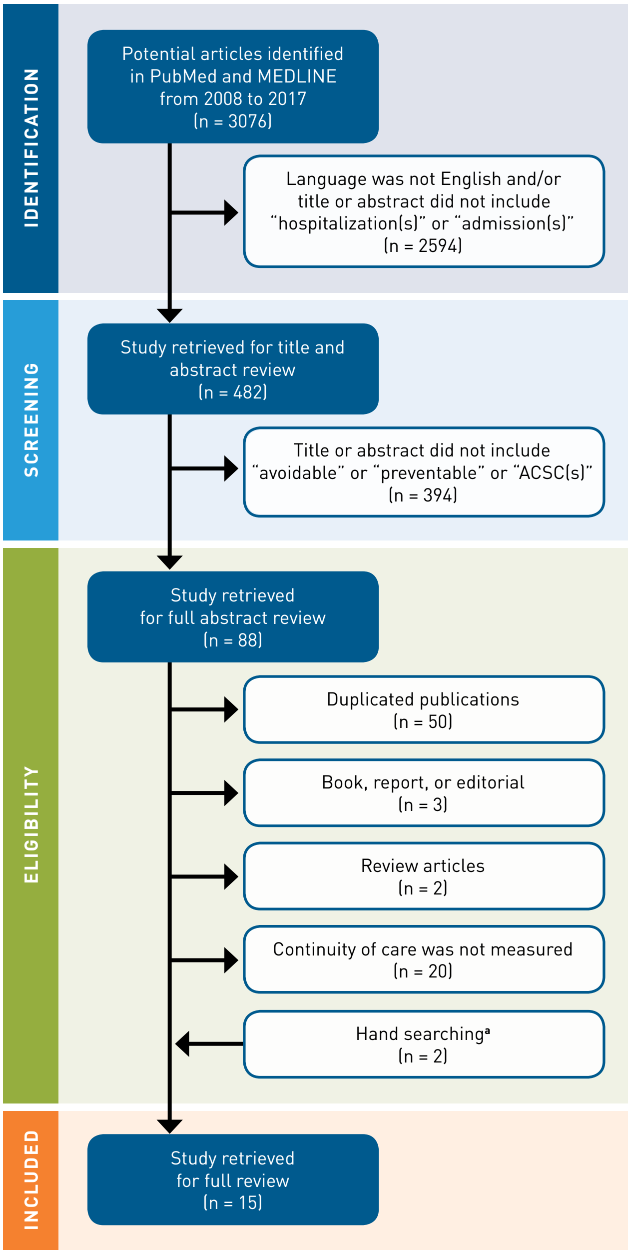
RESULTS

There were 13 studies in which a retrospective study design was conducted to investigate the association between COC and ACSC hospitalizations.[25-34,36-38] The other 2 studies used a cross-sectional design.[24,35] Regarding the study population, 6 studies analyzed adults 20 years or older[27,30-33,36]; 5 studies targeted elderly adults[24,27,29,34,35]; 3 studies focused on infants,[38] children aged 3.5 years and younger,[37] and children aged 12 years and younger,[28] respectively; and 1 study analyzed subjects of all ages.[26] Subjects who had a chronic disease such as diabetes,[27,32] asthma,[28,29] COPD,[30,31] hypertension,[33] or heart failure[36] were considered in 8 studies. The remaining 7 studies were not limited by subjects' diseases. Regarding the primary outcome measurement, ACSC hospitalization was used as the primary outcome in 7 studies.[24-26,34,35,37,38] The remaining studies focused on diabetes,[27,32] asthma,[28,29] COPD,[30,31] hypertension,[33] and heart failure.[36] Studies were conducted in 5 countries: United States,[25,34,35,37,38] United Kingdom,[24] Korea,[27,28,33] Taiwan,[26,29-32] and Germany.[36] They adopted claims data from 7 care systems—Medicare,[25,34,35] Children's Hospital of Philadelphia's greater Philadelphia primary care network,[38] Hawaii's largest single health insurer,[37] the UK National Health Service,[24] Korean National Health Insurance,[27,28,33] Taiwan's National Health Insurance,[26,29-32] and Germany's biggest statutory health insurance company[36]—to investigate the association between COC and ACSC hospitalizations.

Association Between COC and ACSC Hospitalizations

Most of the studies showed a significant link between COC and hospitalization for either all ACSCs or a specific ACSC (**Figure 2**).

FIGURE 1. Article Search and Screening Process for the Association Between Continuity of Care and Hospitalization for ACSCs



ACSC indicates ambulatory care–sensitive condition.

[a]Identifying further relevant studies by searching the reference lists of included studies and using the Web of Science Core Collection to explore all potentially relevant research that cited the included studies.

Compared with patients in the high COC group, patients in the low COC group tended to have a significantly higher likelihood of ACSC hospitalization in 9 studies (odds ratios [ORs] ranged from 1.34 to 8.69).[27-33,37,38] Three studies showed that an increased COC might be associated with fewer hospitalizations for ACSCs (coefficient, −0.32%; 95% CI, −0.39% to −0.25%[24]; ORs ranged from 0.75 to 0.98[34,36]). However, the association between COC and all ACSC hospitalizations was inconsistent in the 3 studies using low COC as a referent. In the study by Bentler et al, patient-reported affective continuity showed that better COC was associated with fewer ACSC hospitalizations, but the positive association was not observed when using Medicare claims.[25] Cheng et al found that patients with high or medium COC were less likely to have ACSC hospitalizations than those with low COC in different age groups (ORs ranged from 0.39 to 0.73).[26] Romaire et al explored the associations between COC and healthcare use among beneficiaries with primary care physicians (PCPs) or specialists as their predominant provider. Positive relationships between COC and ACSC hospitalization were found if a specialist physician was the principal provider; this association was not found when beneficiaries sought PCPs as their predominant provider.[35]

COC Measurement

The Bice-Boxerman Continuity of Care Index (COCI) and Usual Provider Continuity (UPC) index were the most common objective measures of continuity. Of the 15 included studies, the COCI was adopted as the primary assessment in 11 studies to measure care continuity[25-27,29-31,33-37]; the remaining 3 studies used the UPC index as the primary assessment.[24,28,32,38] Other indicators, such as the Sequential Continuity Index (SECON), the Modified Continuity Index, and the Modified Modified Continuity Index, were also mentioned in 2 studies.[25,36] In addition, Bentler et al measured COC from claims data and patient-reported questionnaires to measure longitudinal continuity and interpersonal continuity, respectively.[25] Twelve studies included patients who had at least 3 outpatient visits to calculate COC.[26-37] Seven of these studies analyzed study subjects with at least 4 outpatient visits to assess COC.[27-29,32-34,37] In terms of COC measurement units, 3 studies determined COC at the institute level because of data limitations[27,28,33]; the remaining studies assessed COC at the physician level.[24-26,29-32,34-38]

COC Scores and Cutoff Points

Studies that focused on subjects with a specific chronic disease had mean COC scores between 0.61 and 0.86.[27-33,36,38] Studies that considered subjects without limiting to any specific diseases had fairly low mean COC scores between 0.27 and 0.43.[24-26,34,35,37] Regarding the cutoff point of COC, 8 studies divided COC scores into 3 levels of low, medium, and high by tertiles[24-26,30-32,35] or first and third quartiles.[29] Three studies split COC scores into low and high groups by means[28,33] or quartiles.[38] Two studies considered COC as a continuous variable.[34,36] The other studies[27,37] divided COC scores into several groups by a fixed score, such as 0.20 or 0.25, respectively.

Temporal Issue for COC and Outcome Measurement

A total of 13 studies applied a longitudinal design to avoid cross-sectional design limitations and present stronger evidence of an association between COC and ACSC hospitalizations.[25-34,36-38] In these studies, 11 papers measured COC before determining

TABLE. Literature for Association Between COC and ASCS Hospitalization[24-38]

Reference (year)	Nation	Study design	Sample	Data Resources (year range of data collected)	COC Measures/Unit
Barker et al (2017)[24]	UK	CS	230,472 patients aged 62-82 years	Clinical Practice Research Datalink in England (2011- 2013)	UPC (≥2 visits)[a]/ physician
Bentler et al (2014)[25]	US	RC	1219 Medicare beneficiaries	National Health and Health Services Use Questionnaire and Medicare fee-for-service claims data (2002-2009)	Patient-reported/ claims-based COC[b]/ physician
Cheng et al (2010)[26]	Taiwan	RC	30,830 patients separated into 3 age groups (≤18, 19-64, and ≥65 years)	NHIRD (2000-2006)	COCI (≥3 visits)/ physician
Cho et al (2016)[27]	Korea	RC	5163 patients aged ≥20 years with newly diagnosed type 2 diabetes	KNHI (2002-2010)	COCI (≥4 visits)/ institution
Cho et al (2016)[28]	Korea	RC	9997 patients aged ≤12 years with asthma	KNHI (2009-2013)	UPC (≥4 visits)/ institution
Enlow et al (2017)[38]	US	RC	17,773 infants birth through 3 years	30 clinics in the Children's Hospital of Phildelphia's greater Philadelphia primary care network (2007-2008)	UPC (≥2 visits)/ physician
Kao and Wu (2016)[29]	Taiwan	RC	3356 patients aged ≥65 years with asthma	NHIRD (2004-2013)	COCI (≥4 visits)/ physician
Lin and Wu (2017)[30]	Taiwan	RC	2199 patients aged ≥40 years with newly diagnosed COPD	NHIRD (2005-2009)	COCI (≥3 visits)/ physician
Lin et al (2015)[31]	Taiwan	RC	3015 patients aged ≥40 years with newly diagnosed COPD	NHIRD (2005-2009)	COCI (≥3 visits)/ physician
Lin et al (2010)[32]	Taiwan	RC	6476 patients with newly diagnosed diabetes (mean age, 58.8 years)	NHIRD (1997-2002)	UPC (≥4 visits)/ physician
Nam et al (2016)[33]	Korea	RC	34,607 patients aged ≥20 years with hypertension	KNHI (2011-2013)	COCI (≥4 visits)/ institution
Nyweide et al (2013)[34]	US	RC	3,276,635 Medicare beneficiaries	Medicare fee-for-service claims data (2007-2010)	COCI and UPC (≥4 visits)/physician
Romaire et al (2014)[35]	US	CS	613,471 Medicare beneficiaries	Medicare fee-for-service claims data (2007-2009)	COCI and UPC (≥3 visits)/physician
Tom et al (2010)[37]	US	RC	36,944 children aged ≤3.5 years	Hawaii's largest single health insurer (1999-2006)	COCI (≥4 visits)/ physician
Vogt et al (2016)[36]	Germany	RC	382,118 patients aged ≥35 years with heart failure	Germany's biggest statutory health insurance company (Allgemeine Ortskrankenkassen) (2009-2011)	COCI, UPC, and SECON (≥3 visits)/ physician

ACSC indicates ambulatory care–sensitive condition; CCI, Charlson Comorbidity Index; COC, continuity of care; COCI, Bice-Boxerman COC Index; COPD, chronic obstructive pulmonary disease; CS, cross-sectional; HCC, hierarchical condition categories; KNHI, Korean National Health Insurance; MCI, Modified Continuity Index; MMCI, Modified Modified Continuity Index; MPR, medication possession ratio; NHIRD, National Health Insurance Research Database; PCP, primary care provider; RC, retrospective cohort; SECON, sequential continuity index; UPC, Usual Provider of Care Index.

[a]Sensitivity analysis: COCI (≥3 visits).

[b]Patient-reported affective continuity. Claims-based: Herfindahl index, current provider of care, MMCI, Ejlertsson's K Index, and MCI.

TABLE. *(Continued)* Literature for Association Between COC and ASCS Hospitalization[24-38]

Reference (year)	COC Mean (cutoff point)	Design of Temporal	Main Outcome (Hospitalization)	Main Findings Summary
Barker et al (2017)[24]	UPC, 0.61 (low, 0-0.4; medium, 0.4-0.7; high, 0.7-1.0)	COC and outcome measures in the same period	ACSC	Higher COC was associated with fewer ACSC hospitalizations.
Bentler et al (2014)[25]	CPC, 0.46; UPC, 0.5; MMCI, 0.59; COCI, 0.27; MCI, 0.46 (3 tertiles: lowest, middle, highest)	COC before outcome measures	ACSC	Patient-reported COC was associated with fewer ACSC hospitalizations. Claims-based COC was not associated with reduced ACSC hospitalizations.
Cheng et al (2010)[26]	Aged ≤18 years: COCI, 0.31-0.36; aged 19-64 years: COCI, 0.28-0.29; aged ≥65 years: COCI, 0.32-0.33: (3 equal tertiles: low, 0-0.16; medium, 0.17-0.33; high, 0.34-1.0)	COC and outcome measures in the same period	ACSC	Better COC was associated with fewer ACSC hospitalizations.
Cho et al (2016)[27]	COC mean was not shown (COCI categories: 0.00-0.19, 0.20-0.39, 0.40-0.59, 0.60-0.79, 0.80-0.99, 1)	COC before outcome measures	Diabetes	Greater COC was associated with fewer preventable hospitalizations for diabetes.
Cho et al (2016)[28]	UPC, 0.82-0.86 (mean is a cutoff point)	COC and outcome measures in the same period	Asthma	Lower COC was associated with a higher risk of admission for asthma.
Enlow et al (2017)[38]	UPC, 0.29-0.66 (cutoff point was not shown)	COC before outcome measures	Pediatric ACSC	Lower COC was associated with more pediatric ACSC hospitalizations.
Kao and Wu (2016)[29]	COCI, 0.73 (3 groups by first and third quartiles: low, <0.5; medium, 0.5-0.99; high, 1)	COC before outcome measures	Asthma	Low COC was associated with a higher risk of avoidable hospitalizations for asthma.
Lin and Wu (2017)[30]	COC mean was not shown (3 equal tertiles: low, <0.5; medium, 0.5-0.99; high, 1)	COC before outcome measures	COPD	Long-term high COCI was associated with a lower risk of avoidable hospitalizations for COPD.
Lin et al (2015)[31]	COCI, 0.65 (3 equal tertiles: low, <0.44; medium, 0.45-0.99; high, 1)	COC before outcome measures	COPD	Higher COC was associated with a lower likelihood of avoidable hospitalizations for COPD.
Lin et al (2010)[32]	UPC, 0.61 (low, <0.47; medium, 0.48-0.74; high, 0.75-1)	COC before outcome measures	Diabetes	Higher COC was associated with a lower risk of hospitalization for diabetes.
Nam et al (2016)[33]	COCI, 0.75 (low, <0.75; high, 0.75-1)	COC before outcome measures	Hypertension	Higher COC was associated with a decreased risk of hospital admission for hypertension.
Nyweide et al (2013)[34]	COCI, 0.306-0.358 UPC, 0.471-0.578 (continuous; no cutoff points)	COC before outcome measures	ACSC	Higher COC was associated with a lower rate of ACSC hospitalizations.
Romaire et al (2014)[35]	COCI, 0.473 (COCI by tertiles: low, 0-0.286; medium, 0.287-0.533; high, 0.534-1.0) UPC, 0.550 (UPC by tertiles: low, 0-0.417; medium, 0.418-0.615; high, 0.616-1.0)	COC before outcome measures	ACSC	Higher COC was associated with fewer ACSC hospitalizations.
Tom et al (2010)[37]	COC mean was not shown (COCI categories, 0-0.25, 0.26-0.50, 0.51-0.74, 0.75-1.00)	COC before outcome measures	Pediatric ACSC	ACSC hospitalizations increased as COCI decreased in all children (healthy and ≥1 chronic disease).
Vogt et al (2016)[36]	COCI, 0.77; UPC, 0.86; SECON, 0.78 (continuous; no cutoff points)	COC before outcome measures	Heart failure	High continuity of specialist and generalist ambulatory care was significantly associated with a reduced likelihood of hospitalization.

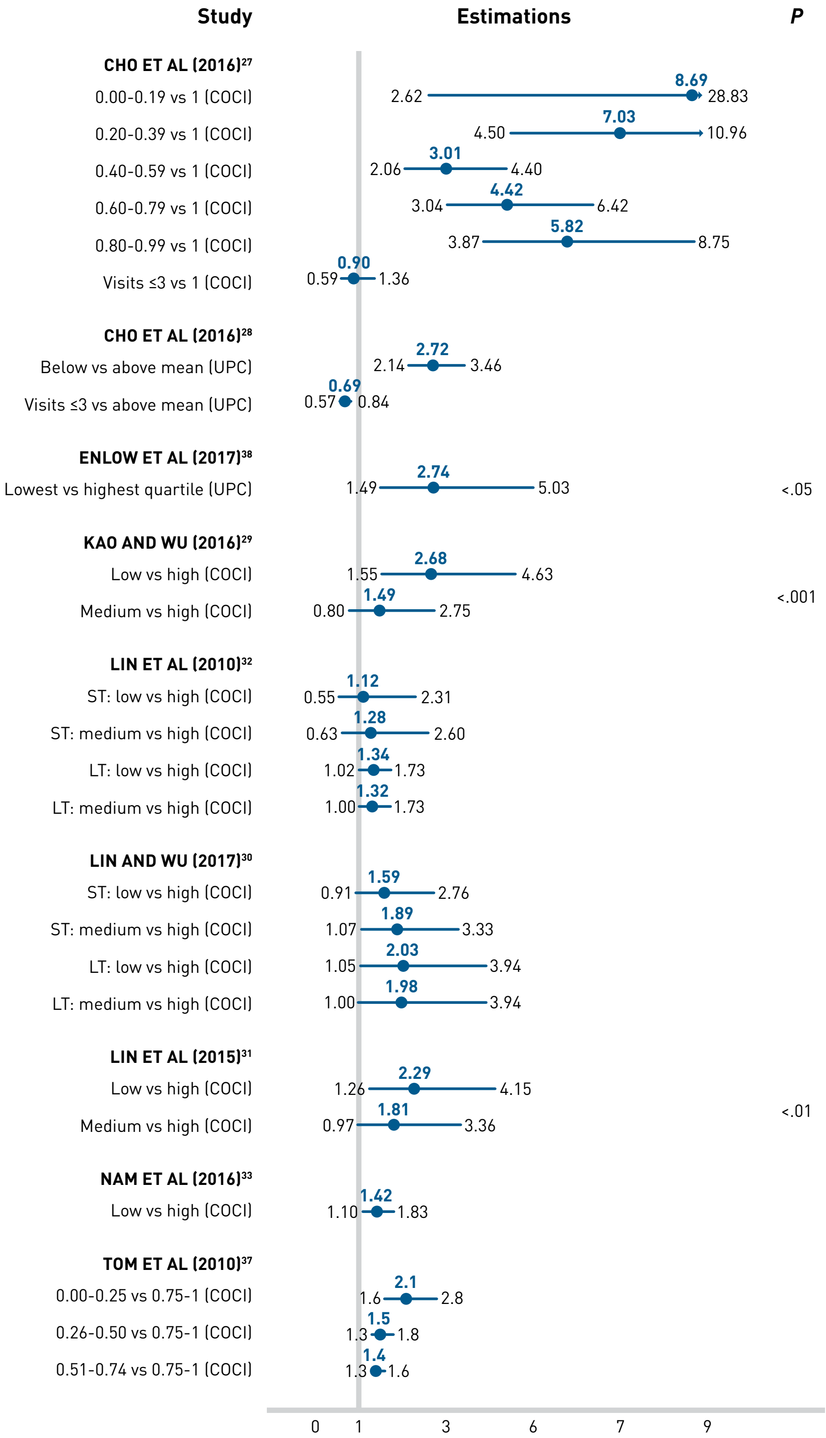
ACSC indicates ambulatory care–sensitive condition; CCI, Charlson Comorbidity Index; COC, continuity of care; COCI, Bice-Boxerman COC Index; COPD, chronic obstructive pulmonary disease; CS, cross-sectional; HCC, hierarchical condition categories; KNHI, Korean National Health Insurance; MCI, Modified Continuity Index; MMCI, Modified Modified Continuity Index; MPR, medication possession ratio; NHIRD, National Health Insurance Research Database; PCP, primary care provider; RC, retrospective cohort; SECON, sequential continuity index; UPC, Usual Provider of Care Index.

[a]Sensitivity analysis: COCI (≥3 visits).

[b]Patient-reported affective continuity. Claims-based: Herfindahl index, current provider of care, MMCI, Ejlertsson's K Index, and MCI.

FIGURE 2. Association Between COC and Hospitalization for ACSCs[a]

A. Referent Is High COC



ACSC indicates ambulatory care–sensitive condition; COC, continuity of care; COCI, Bice-Boxerman COC Index; cont, continuous; CPC, current provider of care; GP, general practitioner; LT, long-term; MCI, Modified Continuity Index; MMCI, Modified Modified Continuity Index; SECON, Sequential Continuity Index; ST, short-term; UPC, Usual Provider of Care index.

[a]Dependent variable (ACSC hospitalization) was treated as a dichotomous variable in Figure parts A, B, and C and as a continuous variable in Part D.

hospitalization for ACSCs to strengthen the evidence of association between COC and ACSC hospitalizations.[25,27,29-34,36-38] Two studies indicated COC as a time-dependent variable and applied random intercept models to adjust for the temporal problem because COC and ACSC hospitalizations were measured simultaneously.[26,28] In the remaining studies, 1 assessed COC before determining ACSC hospitalizations, although it applied a cross-sectional analysis,[35] and the other study considered COC over the whole study period, at the end of which outcomes were measured.[24]

Consideration of Confounders

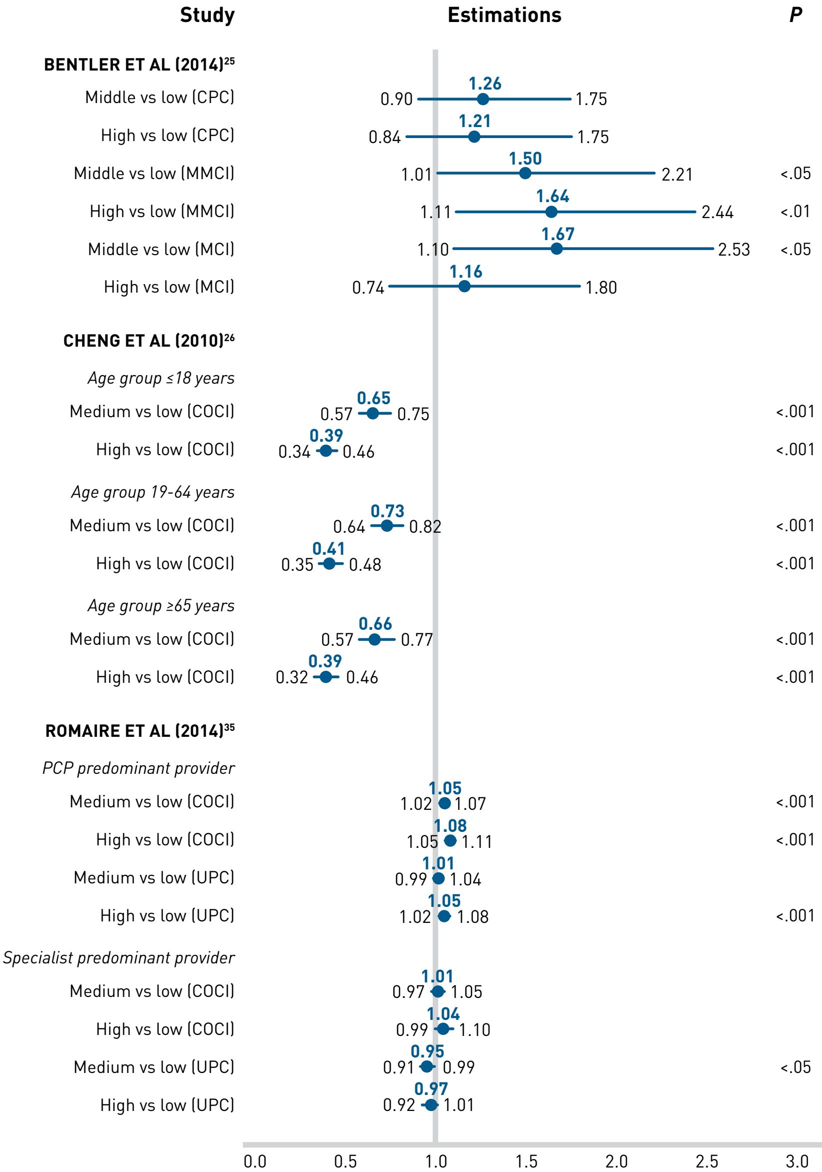
Several confounders were considered across the 15 studies. Demographic factors included patient's age, gender, race, marital status, deprivation score, level of education, income-level quintile, low-income status, health insurance type, level of insurance premium, and residential area. Patients' clinical characteristics, such as Charlson Comorbidity Index score, medication possession ratio, and healthcare utilization history (eg, number of outpatient visits, hospital admissions, and ED visits), were also considered.

DISCUSSION

This systematic review shows that higher COC is associated with lower risk of ACSC hospitalizations. All studies in this review clearly defined the measure of COC and used claims data to estimate the association between COC and ACSC hospitalizations. The results of these studies have validated the notion that increased COC is associated with a reduced risk of ACSC hospitalizations, and the relationship has been shown in any age group with a specific chronic disease or multiple diseases. In addition, the average COC score is higher in patients with a single specific chronic disease than in those without any specific diseases; hence, it is more sensitive in identifying the association between COC and hospitalizations for ACSC with a specific disease. This finding suggests that patients with a single specific chronic disease might benefit from developing an abiding relationship with the same physician. Furthermore, the robust association between COC and hospitalizations for ACSC was observed

FIGURE 2. *(Continued)* Association Between COC and Hospitalization for ACSCs[a]

B. Referent Is Low COC



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[a]Dependent variable (ACSC hospitalization) was treated as a dichotomous variable in Figure parts A, B, and C and as a continuous variable in Part D.

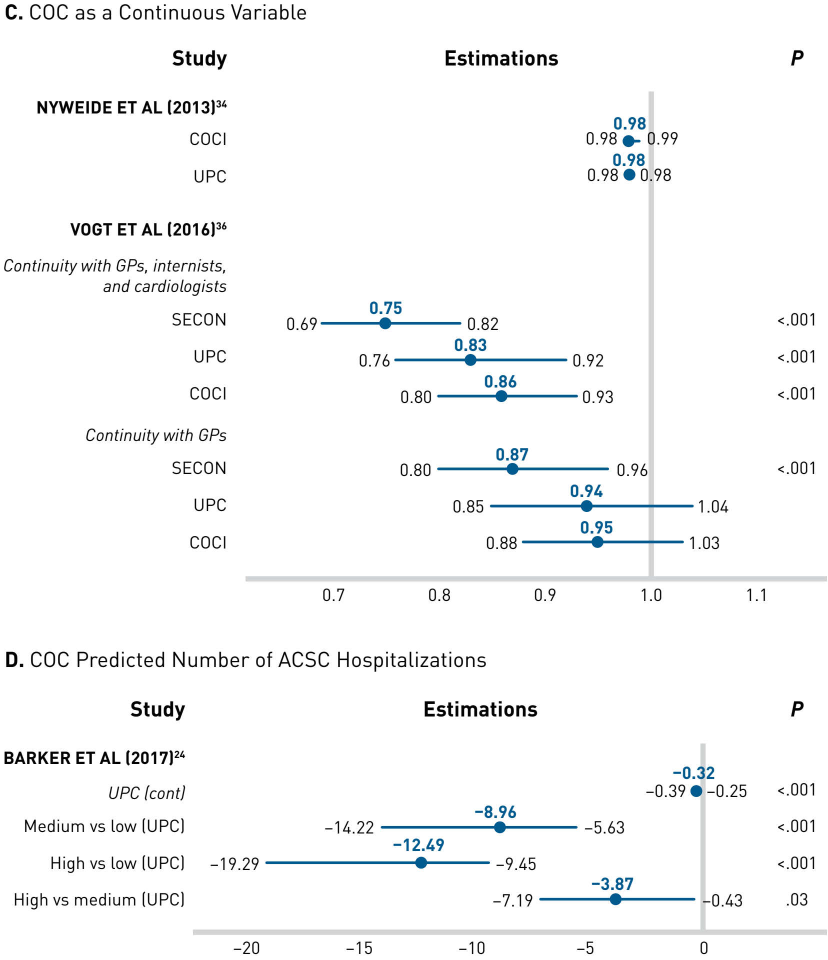
in both referral healthcare systems[24,25,34,35,37,38] and nonreferral healthcare systems.[26-28,29-33,36]

COC is a hierarchical relationship that includes informational continuity, longitudinal continuity, and interpersonal continuity.[16] Informational continuity represents the precise information exchanged from one healthcare provider to another. Longitudinal continuity is based on providers having enough information and creates a stable care pattern for patients in a familiar place of care over time. Interpersonal continuity incorporates longitudinal continuity and relates to a strong ongoing physician–patient relationship that is developed over time and incorporates trust in one another. When studies used claims data, longitudinal continuity was usually used to exhibit interpersonal continuity because repeated contacts between a patient and care provider were recorded, representing a reliant and stable relationship.[22]

Many indices, such as the COCI, UPC index, and SECON, were developed to evaluate COC in claims data.[39] Each index has advantages and disadvantages, and there are no conclusions as to which is necessarily better.[15] The COCI reflects the dispersion of contact between patients and physicians[40] and identifies visit concentration of a patient with each physician. The UPC index, a density measure, focuses on the number of visits with the most frequently visited physicians, which cannot recognize whether patients reduce their visits or change healthcare providers frequently. SECON determines the sequences of change in the healthcare process, but it was limited to the detection of nonsequential issues. In this review, the COCI is the most common index adopted as the main measure for COC. A possible reason is that the COCI is less sensitive to the number of physician visits and more suitable for a higher number of outpatient visits.[40] This feature was considered and adopted by studies that used claims databases to analyze COC. Thus, according to this review, we recommend that future research can consider the COCI as the preferred COC measure if claims data are available.

All but 3 studies in our review examined medical institution continuity.[27,28,33] A previous study published in 1998, not included within this review, found that physician continuity is more important than medical site continuity in decreasing patients' likelihood of hospitalization.[19] In addition, COC is measured at the physician level, which may provide superior information about the association between COC and avoidable hospitalization than that obtained from measurements at the level of healthcare institutions.[41] Three studies mentioned that they measured COC at the medical institution level because of data limitations and recommended that further studies try to measure COC at the physician level.[27,28,33]

FIGURE 2. *(Continued)* Association Between COC and Hospitalization for ACSCs[a]



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[a]Dependent variable (ACSC hospitalization) was treated as a dichotomous variable in Figure parts A, B, and C and as a continuous variable in Part D.

With this in mind, this review suggests that future studies could calculate COC at the physician level if data are available.

Our review found that the temporal relationship between COC and outcome measures is an essential issue for study design. Most studies assessed COC before measuring ACSC hospitalizations. This design may reduce the time bias to interpret the association between COC and healthcare outcomes. However, the problem of temporal ambiguity between COC and hospitalization for ACSCs might not be completely avoided. Hence, this issue should be further investigated in future studies. In addition, 2 studies considered that biased conclusions would also occur if continuity is measured concurrently with outcomes.[26,28] Therefore, these studies adopted a longitudinal design with random intercept models to assess the relationship between COC and ACSC hospitalization. We recommend that the methodological limitations in temporal design between COC and hospitalization for ACSCs should be considered in future studies that measure the association between COC and outcomes.

Most studies calculated COC in subjects with more than 3 or 4 ambulatory care visits. In addition, 2 articles added a sensitivity analysis to compare avoidable hospitalizations between patients with 3 or fewer outpatient visits and those who were in the high COC group. The results showed that patients with 3 or fewer outpatient visits might have a lower risk of hospitalization for ACSCs. Therefore, future studies could consider conducting the analyses for patients with fewer than 3 or 4 visits in the model and provide comparison results.

There are many factors, such as patient age, gender, socioeconomic status, insurance type, comorbidities, and severity of illness, that could serve as critical confounders in exploring the association between COC and ACSC hospitalizations in this review. Each of these factors might be associated with not only ACSC hospitalizations, but also COC. Hence, future studies investigating the association of COC and ACSC hospitalizations will need to consider the influence of such confounders when conducting multivariate analyses.

Limitations and Strengths

Some limitations of this review should be noted. First, some pertinent studies may have been missed because several synonymous terms could represent COC and ACSCs. Second, ACSCs include chronic diseases that could be analyzed independently, which may exclude them from our search strategy. In addition, using meta-analytic methods to compare and summarize results might be limited by the heterogeneity of study designs and methods used to measure COC. Despite this limit, higher COC scores represent better continuity with care providers. Therefore, we showed the range of COC scores across studies. Lastly, this review was limited to studies that calculated objective COC rather than subjective COC. Studies using qualitative methods are not discussed here.

Nevertheless, this systematic review has several strengths. First, our study shows that higher COC is associated with a lower risk of hospitalization in the cases of all ACSCs and a specific ACSC. Second, this review observes COCI as a mainstream indicator to measure COC in the studies using claims data sets in the past 10 years. Third, this review reveals that measuring COC before healthcare outcomes is a better method to reduce time bias and demonstrate a strong association. Fourth, the affirmative association between COC and ACSC hospitalizations is found in different healthcare systems, such as the US healthcare system, the UK National Health Service, and a single-payer national health insurance system. Finally, this review suggests that future studies should consider controlling for critical confounders with multivariate analytical models when measuring the association between COC and hospitalization for ACSC.

CONCLUSIONS

Most findings from this review support the notion that higher COC is associated with fewer ACSC hospitalizations. The COCI is often used to measure COC in studies using claims data sets. Additionally, most studies measured COC before the period of outcome measurement. Continuous patient–physician relationships should be encouraged. Also, increasing COC is favorable for patients who are managing a specific ACSC. ■

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REFERENCES

1. Billings J, Anderson GM, Newman LS. Recent findings on preventable hospitalizations. *Health Aff (Millwood)*. 1996;15(3):239-249. doi: 10.1377/hlthaff.15.3.239.
2. Bindman AB, Grumbach K, Osmond D, et al. Preventable hospitalizations and access to health care. *JAMA*. 1995;274(4):305-311. doi: 10.1001/jama.1995.03530040033037.
3. Caminal J, Starfield B, Sánchez E, Casanova C, Morales M. The role of primary care in preventing ambulatory care sensitive conditions. *Eur J Public Health*. 2004;14(3):246-251.
4. Magán P, Alberquilla Á, Otero Á, Ribera JM. Hospitalizations for ambulatory care sensitive conditions and quality of primary care: their relation with socioeconomic and health care variables in the Madrid regional health service (Spain). *Med Care*. 2011;49(1):17-23. doi: 10.1097/MLR.0b013e3181ef9d13.
5. Billings J, Parikh N, Mijanovich T. Emergency department use in New York City: a substitute for primary care? *Issue Brief (Commonw Fund)*. 2000;(433):1-5.
6. Rosano A, Loha CA, Falvo R, et al. The relationship between avoidable hospitalization and accessibility to primary care: a systematic review. *Eur J Public Health*. 2013;23(3):356-360. doi: 10.1093/eurpub/cks053.
7. *Guide to Prevention Quality Indicators: Hospital Admission for Ambulatory Care Sensitive Conditions*. Rockville, MD: Agency for Healthcare Research and Quality; 2001. ahrq.gov/downloads/pub/ahrqqi/pqiguide.pdf. Accessed April 5, 2018.
8. *National Healthcare Quality and Disparities Report: Chartbook on Rural Health Care*. Rockville, MD: Agency for Healthcare Research and Quality; 2017. ahrq.gov/sites/default/files/wysiwyg/research/findings/nhqrdr/chartbooks/qdr-ruralhealthchartbook-update.pdf. Accessed October 5, 2018.
9. Mkanta WN, Chumbler NR, Yang K, Saigal R, Abdollahi M. Cost and predictors of hospitalizations for ambulatory care–sensitive conditions among Medicaid enrollees in comprehensive managed care plans. *Health Serv Res Manag Epidemiol*. 2016;3:2333392816670301. doi: 10.1177/2333392816670301.
10. Galarraga JE, Mutter R, Pines JM. Costs associated with ambulatory care sensitive conditions across hospital-based settings. *Acad Emerg Med*. 2015;22(2):172-181. doi: 10.1111/acem.12579.
11. Page A, Ambrose S, Glover J, Hetzel D. *Atlas of Avoidable Hospitalisations in Australia: Ambulatory Care–Sensitive Conditions*. Adelaide, Australia: Public Health Information Development Unit, The University of Adelaide; 2007. aihw.gov.au/getmedia/c4d175cd-f22f-4834-a96b-546a0595613f/10459.pdf. Accessed April 10, 2018.
12. Sanmartin C, Khan S. Hospitalizations for ambulatory care sensitive conditions (ACSC): the factors that matter. Statistics Canada website. www150.statcan.gc.ca/n1/en/catalogue/82-622-X2011007#formatdisp. Published June 30, 2011. Accessed April 19, 2018.
13. Vuik SI, Fontana G, Mayer E, Darzi A. Do hospitalisations for ambulatory care sensitive conditions reflect low access to primary care? an observational cohort study of primary care usage prior to hospitalisation. *BMJ Open*. 2017;7(8):e015704. doi: 10.1136/bmjopen-2016-015704.
14. Haggerty JL, Reid RJ, Freeman GK, Starfield BH, Adair CE, McKendry R. Continuity of care: a multidisciplinary review. *BMJ*. 2003;327(7425):1219-1221. doi: 10.1136/bmj.327.7425.1219.
15. Jee SH, Cabana MD. Indices for continuity of care: a systematic review of the literature. *Med Care Res Rev*. 2006;63(2):158-188. doi: 10.1177/1077558705285294.
16. Saultz JW. Defining and measuring interpersonal continuity of care. *Ann Fam Med*. 2003;1(3):134-143. doi: 10.1370/afm.23.
17. Christakis DA, Mell L, Koepsell TD, Zimmerman FJ, Connell FA. Association of lower continuity of care with greater risk of emergency department use and hospitalization in children. *Pediatrics*. 2001;107(3):524-529. doi: 10.1542/peds.107.3.524.
18. Gill JM, Mainous AG 3rd. The role of provider continuity in preventing hospitalizations. *Arch Fam Med*. 1998;7(4):352-357.
19. Mainous AG 3rd, Gill JM. The importance of continuity of care in the likelihood of future hospitalization: is site of care equivalent to a primary clinician? *Am J Public Health*. 1998;88(10):1539-1541.
20. Rosenblatt RA, Wright GE, Baldwin LM, et al. The effect of the doctor-patient relationship on emergency department use among the elderly. *Am J Public Health*. 2000;90(1):97-102.
21. Saultz JW, Albedaiwi W. Interpersonal continuity of care and patient satisfaction: a critical review. *Ann Fam Med*. 2004;2(5):445-451. doi: 10.1370/afm.91
22. Cabana MD, Jee SH. Does continuity of care improve patient outcomes? *J Fam Pract*. 2004;53(12):974-980.
23. Moher D, Liberati A, Tetzlaff J, Altman DG; PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med*. 2009;6(7):e1000097. doi: 10.1371/journal.pmed1000097.
24. Barker I, Steventon A, Deeny SR. Association between continuity of care in general practice and hospital admissions for ambulatory care sensitive conditions: cross sectional study of routinely collected, person level data. *BMJ*. 2017;356:j84. doi: 10.1136/bmj.j84.
25. Bentler SE, Morgan RO, Virnig BA, Wolinsky FD. The association of longitudinal and interpersonal continuity of care with emergency department use, hospitalization, and mortality among Medicare beneficiaries. *PloS One*. 2014;9(12):e115088. doi: 10.1371/journal.pone.0115088.
26. Cheng SH, Chen CC, Hou YF. A longitudinal examination of continuity of care and avoidable hospitalization: evidence from a universal coverage health care system. *Arch Intern Med*. 2010;170(18):1671-1677. doi: 10.1001/archinternmed.2010.340.
27. Cho KH, Nam CM, Choi Y, Choi JW, Lee SH, Park EC. Impact of continuity of care on preventable hospitalization of patients with type 2 diabetes: a nationwide Korean cohort study, 2002-10. *Int J Qual Health Care*. 2016;28(4):478-485. doi: 10.1093/intqhc/mzw050.
28. Cho KH, Park EC, Nam YS, Lee SH, Nam CM, Lee SG. Impact of market competition on continuity of care and hospital admissions for asthmatic children: a longitudinal analysis of nationwide health insurance data 2009-2013. *PloS One*. 2016;11(3):e0150926. doi: 10.1371/journal.pone.0150926.
29. Kao YH, Wu SC. STROBE-compliant article: is continuity of care associated with avoidable hospitalization among older asthmatic patients? *Medicine (Baltimore)*. 2016;95(38):e4948. doi: 10.1097/MD.0000000000004948.
30. Lin IP, Wu SC. Effects of long-term high continuity of care on avoidable hospitalizations of chronic obstructive pulmonary disease patients. *Health Policy*. 2017;121(9):1001-1007. doi: 10.1016/j.healthpol.2017.06.010.
31. Lin IP, Wu SC, Huang ST. Continuity of care and avoidable hospitalizations for chronic obstructive pulmonary disease (COPD). *J Am Board Fam Med*. 2015;28(2):222-230. doi: 10.3122/jabfm.2015.02.140141.
32. Lin W, Huang IC, Wang SL, Yang MC, Yaung CL. Continuity of diabetes care is associated with avoidable hospitalizations: evidence from Taiwan's National Health Insurance scheme. *Int J Qual Health Care*. 2010;22(1):3-8. doi: 10.1093/intqhc/mzp059.
33. Nam YS, Cho KH, Kang HC, Lee KS, Park EC. Greater continuity of care reduces hospital admissions in patients with hypertension: an analysis of nationwide health insurance data in Korea, 2011-2013. *Health Policy*. 2016;120(6):604-611. doi: 10.1016/j.healthpol.2016.04.012.
34. Nyweide DJ, Anthony DL, Bynum JP, et al. Continuity of care and the risk of preventable hospitalization in older adults. *JAMA Intern Med*. 2013;173(20):1879-1885. doi: 10.1001/jamainternmed.2013.10059.
35. Romaire MA, Haber SG, Wensky SG, McCall N. Primary care and specialty providers: an assessment of continuity of care, utilization, and expenditures. *Med Care*. 2014;52(12):1042-1049. doi: 10.1097/MLR.0000000000000246.
36. Vogt V, Koller D, Sundmacher L. Continuity of care in the ambulatory sector and hospital admissions among patients with heart failure in Germany. *Eur J Public Health*. 2016;26(4):555-561. doi: 10.1093/eurpub/ckw018.
37. Tom JO, Tseng CW, Davis J, Solomon C, Zhou C, Mangione-Smith R. Missed well-child care visits, low continuity of care, and risk of ambulatory care–sensitive hospitalizations in young children. *Arch Pediatr Adolesc Med*. 2010;164(11):1052-1058. doi: 10.1001/archpediatrics.2010.201.
38. Enlow E, Passarella M, Lorch SA. Continuity of care in infancy and early childhood health outcomes. *Pediatrics*. 2017;140(1):e20170339. doi: 10.1542/peds.2017-0339.
39. Saultz JW, Lochner J. Interpersonal continuity of care and care outcomes: a critical review. *Ann Fam Med*. 2005;3(2):159-166. doi: 10.1370/afm.285.
40. Bice TW, Boxerman SB. A quantitative measure of continuity of care. *Med Care*. 1977;15(4):347-349.
41. Chan CL, You HJ, Huang HT, Ting HW. Using an integrated COC index and multilevel measurements to verify the care outcome of patients with multiple chronic conditions. *BMC Health Serv Res*. 2012;12:405. doi: 10.1186/1472-6963-12-405.

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eAppendix. Literature for Association Between COC and ASCS Hospitalization[24-38]

Reference (Year)	Nation	Study design	Sample	Data Resources (year range of data collected)	COC Measures/ Unit	COC Mean (cutoff point)	Design of Temporal	Covariables	Main Outcome (Hospitalization)	Main Findings Summary
Barker et al[24] (2017)	UK	CS	230,472 patients aged 62-82 years	Clinical Practice Research Datalink in England (2011- 2013)	UPC (≥2 visits)[a] / Physician	UPC, 0.61 (low, 0-0.4; medium, 0.4-0.7; high, 0.7-1.0)	COC and outcome measures in the same period	Age, sex, socioeconomic deprivation score, number of contacts with a GP, number of active previous long-term health conditions, number of previous referrals to specialist care, and number of preexisting long-term conditions	ACSC	Higher COC was associated with fewer ACSC hospitalizations.
Bentler et al[25] (2014)	US	RC	1,219 Medicare beneficiaries	National Health and Health Services Use Questionnaire and Medicare fee-for-service claims data (2002-2009)	Patient-reported/ claims-based COC[b] / Physician	CPC, 0.46; UPC, 0.5; MMCI, 0.59; COCI, 0.27; MCI, 0.46 (3 tertiles: lowest, middle, highest)	COC before outcome measures	Age, sex, race, marital status, education, supplemental insurance, population density, a median split of income, smoking status, health-related quality of life, history of selected serious medical conditions, and comorbidity	ACSC	Patient-reported COC was associated with fewer ACSC hospitalization. Claims-based COC was not associated with reduced ACSC hospitalization.
Cheng et al[26] (2010)	Taiwan	RC	30,830 patients separated into 3 age groups (≤18, 19-64, and ≥65 years)	NHIRD (2000-2006)	COCI (≥3 visits)/ Physician / Physician	Aged ≤18 years: COCI, 0.31-0.36; Aged 19-64 years: COCI, 0.28-0.29; aged ≥65 years: COCI, 0.32-0.33: (3 equal tertiles: low, 0-0.16; medium, 0.17-0.33; high, 0.34-1.0)	COC and outcome measures in the same period	Age, sex, low-income status, the number of physician visits in the previous year, the likelihood of hospitalization, CCI, and time dummy variables	ACSC	Better COC is associated with fewer ACSC hospitalizations.
Cho et al[27] (2016)	Korea	RC	5,163 patients aged ≥ 20 years with newly diagnosed type 2 diabetes	KNHI (2002-2010)	COCI (≥4 visits) / Institution	COC mean was not shown (COCI categories: 0.00-0.19, 0.20-0.39, 0.40-0.59, 0.60-0.79, 0.80-0.99, 1)	COC before outcome measures	Age, sex, health insurance type, income-level quintile, residential area, body mass index, fasting blood glucose level, CCI score, number of hypoglycemic agents, diabetic complications, smoking status, frequency of alcohol use, physical activity per week, MPR, and primary type of medical institution visited	Diabetes	Greater COC was associated with fewer preventable hospitalizations for diabetes.

Cho et al[28] (2016)	Korea	RC	9,997 patients aged ≤12 years with asthma	KNHI (2009-2013)	UPC (≥4 visits)\/ Institution / Institution	UPC, 0.82-0.86 (mean is a cutoff point)	COC and outcome measures in the same period	Age, sex, insurance type, CCI, type of main visiting medical institution, total ambulatory care visits, use of inhaled corticosteroid, and presence of respiratory distress	Asthma	Lower COC had a higher risk of admission for asthma.
Enlow et al[38] (2017)	US	RC	17,773 infants birth through 3 years	30 clinics in the Children's Hospital of Philadelphia's greater Philadelphia primary care network (2007-2008)	UPC (≥2 visits) / Physician	UPC, 0.29-0.66 (Cutoff point was not shown)	COC before outcome measures	Gestational age, sex, race/ethnicity, high school graduation rate, percentage below poverty, median income, insurance, clinic site, and number of sick visits in first year of life	Pediatric ACSC	Lower COC was associated with more pediatric ACSC hospitalizations.
Kao et al[29] (2016)	Taiwan	RC	3,356 patients aged ≥65 years with asthma	NHIRD (2004-2013)	COCI (≥4 visits) / Physician	COCI, 0.73 (3 groups by 1st and 3rd quartile: low, <0.5; medium, 0.5-0.99; high, 1)	COC before outcome measures	Age, sex, insurance premium, COPD, pulmonary-related diseases, diabetes, CCI, and number of asthma-related ED visits	Asthma	Low COC had a higher risk of avoidable hospitalization for asthma.
Lin et al[30] (2017)	Taiwan	RC	2,199 patients aged ≥40 years with newly diagnosed COPD	NHIRD (2005-2009)	COCI (≥3 visits) / Physician	COC mean was not shown (3 equal tertiles: low, <0.5; medium, 0.5-0.99; high, 1)	COC before outcome measures	Age, sex, low-income status, number of COPD-related ED visits, and CCI	COPD	Long-term high COCI had a lower risk of avoidable hospitalizations for COPD.
Lin et al[31] (2015)	Taiwan	RC	3,015 patients aged ≥40 years with newly diagnosed COPD	NHIRD (2005-2009)	COCI (≥3 visits) / Physician	COCI, 0.65 (3 equal tertiles: low, <0.44; medium, 0.45-0.99; high, 1)]	COC before outcome measures	Age, sex, low-income status, number of COPD-related ED visits, and CCI	COPD	Higher COC had a lower likelihood of avoidable hospitalization for COPD.
Lin et al[32] (2010)	Taiwan	RC	6,476 patients with newly diagnosed diabetes (mean age, 58.8 years)	NHIRD (1997-2002)	UPC (≥4 visits) / Physician	UPC, 0.61 (low, <0.47; medium, 0.48-0.74; high, 0.75-1)	COC before outcome measures	Age, sex, number of complications or comorbidities, total number of visits for diabetes treatment, and type of practice setting	Diabetes	Higher COC was associated with lower risk of hospitalization for diabetes.
Nam et al[33] (2016)	Korea	RC	34,607 patients aged ≥20 years with hypertension	KNHI (2011-2013)	COCI (≥4 visits) / Institution	COCI, 0.75 (low, <0.75; high, 0.75-1)	COC before outcome measures	Age, sex, insurance type, CCI, number of antihypertensive agents, primary visit medical institution, and MPR	Hypertension	Higher COC was associated with a decreased risk of hospital admission for hypertension.
Nyweide et al[34] (2013)	US	RC	3,276,635 Medicare beneficiaries	Medicare fee-for-service claims data (2007-2010)	COCI and UPC (≥4 visits) / Physician	COCI, 0.306-0.358 UPC, 0.471-0.578 (continuous; no cutoff points)	COC before outcome measures	Age, sex, race, Medicaid dual-eligible status, residential zip code, HCC score, total visits, and total preventable hospitalizations	ACSC	Higher COC was associated with a lower rate of ACSC hospitalizations.
Romaire et al[35] (2014)	US	CS	613,471 Medicare beneficiaries	Medicare fee-for-service claims data (2007-2009)	COCI and UPC (≥3 visits) / Physician	COCI, 0.473; (COCI by tertiles: low, 0-0.286; medium, 0.287-	COC before outcome measures	Age, sex, race, enrollment in Medicaid, original reason for Medicare eligibility, CCI, HCC risk	ACSC	Higher COC was associated with fewer ACSC hospitalizations.

						0.533; high, 0.534-1.0) UPC, 0.550; (UPC by tertiles: low, 0-0.417; medium, 0.418-0.615; high, 0.616-1.0)		score, residence in an urban area, state of residence, PCPs/100,000 residents, specialists/100,000 residents, per capita income in county of residence, percent of residents aged ≥25 years with a high school diploma, and death during the follow-up period		
Tom et al[37] (2010)	US	RC	36,944 children aged ≤3.5 years	Hawaii's largest single health insurer (1999-2006)	COCI (≥4 visits) / Physician	COC mean was not shown (COCI categories, 0-0.25, 0.26-0.50, 0.51-0.74, 0.75-1.00)	COC before outcome measures	Age, sex, regularly scheduled well-child care visit adherence, geographical location, and chronic disease	Pediatric ACSC	ACSC hospitalizations increased as COCI decreased in all children (healthy and ≥1 chronic disease).
Vogt et al[36] (2016)	Germany	RC	382,118 patients aged ≥35 years with heart failure	Germany's biggest statutory health insurance company (Allgemeine Ortskrankenkassen) (2009 – 2011)	COCI, UPC, and SECON (≥3 visits) / Physician	COCI, 0.77; UPC, 0.86; SECON, 0.78 (continuous; no cutoff points)	COC before outcome measures	Age; sex; number of ambulatory care visits to GPs, internists, and cardiologists; number of prescribed medications with different active agents; previous heart failure admission and length of hospital stay; and CCI	Heart failure	High continuity of specialist and generalist ambulatory care was significantly associated with a reduced likelihood of hospitalization.

ACSC indicates ambulatory care–sensitive condition; CCI, Charlson Comorbidity Index; COC, continuity of care; COCI, Bice-Boxerman COC Index; COPD, chronic obstructive pulmonary disease; CS, cross-sectional; ED, emergency department; GP, general practitioner; HCC, hierarchical condition categories; KNHI, Korean National Health Insurance; MCI, Modified Continuity Index; MMCI, Modified Modified Continuity Index; MPR, medication possession ratio; NHIRD, National Health Insurance Research Database; PCP, primary care provider; RC, retrospective cohort; SECON, sequential continuity index; UPC, Usual Provider of Care Index.

[a]Sensitivity analysis: COCI (≥3 visits).

[b]Patient-reported affective continuity. Claims-based: Herfindahl index, current provider of care, MMCI, Ejlertsson's K Index, and MCI.