CONTINUITY OF CARE

Bibliography

THE CENTER FOR
PROFESSIONALISM & VALUE
IN HEALTH CARE

CONTINUITY OF CARE

ANNOTATED BIBLIOGRAPHY

By

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Contents

ACSC: Ambulatory Care Sensitive Condition
ED: Emergency Department
GP: General Practitioner
FP: Family Practice
PCP: Primary Care Provider

Note: *Many papers analyzed the relationship of continuity to more than one outcome. The papers are sorted based on the outcome of each paper that the authors of this bibliography deemed to be the primary outcome. See table 1.*

Why Continuity?

What exactly is continuity of care, and why is it important? From their own individual experiences, most people would likely agree on the importance of developing close relationships. Close personal relationships improve our understanding of one another and assist our ability to properly support each other. It is not surprising, then, that relationships with our physicians have the same feature.

Interpersonal continuity of care has been defined as an ongoing relationship between the physician and the patient. The exact ways of measuring continuity vary, but continuity is generally thought to improve over time and with more consistent visits to a physician, and in the case of this bibliography, a primary care physician specifically. Achieving continuity improves the physician's understanding of a patient's specific needs so that they can tailor their care towards that patient. It prevents patients from slipping through the cracks of health systems, makes physicians better advocates of their patients, and improves the trust between the physician and the patient(Goold and Lipkin 1999)[1]. Regarding trust, continuity has been shown to improve trust in African-Americans(Horn 2012)[2], low-income women(Sheppard 2004)[3], and the elderly(Butterworth 2014)[4]. This makes continuity especially pertinent to today, as increasing trust in physicians will likely increase the amount of people in these populations that get the COVID-19 vaccine.

Past studies and reviews have indicated that continuity's impact may exceed simply improving the relationship and trust between a patient and physician, with demonstrated improvements in clinical outcomes as well. Specifically, hospitalizations and other healthcare utilization, as well as healthcare costs, have been shown to decrease as continuity increases. However, studies and reviews have reached conflicting conclusions, and our understanding of continuity's impact is yet to reach a consensus. If the evidence accumulated in this bibliography indicates the clear benefits of continuity that might be expected from the explanation above, policymakers and healthcare providers should place a renewed emphasis on continuity.

Continuity of care is not achieved passively. Care fragmentation and specialization, along with an expected shortage of primary care providers, will hinder healthcare providers ability to support continuity of care in the coming years. Further, the impact that telemedicine will have on continuity is still unknown. Therefore, it is essential that our comprehension about the importance and benefits, along with any potential drawbacks, of continuity is properly researched and understood. Patient and physician advocacy should focus on improving continuity without sacrificing elements of quality of care. In this bibliography, we aim to update and summarize what is known about continuity and its effect on outcomes important to clinical and policy stakeholders.

1 Goold SD, Lipkin M. The Doctor–Patient Relationship. *J Gen Intern Med*. 1999;14(Suppl 1):S26-S33. doi:10.1046/j.1525-1497.1999.00267.x

2 Horn IB, Mitchell SJ, Wang J, Joseph JG, Wissow LS. African American Parents' Trust in their Child's Primary Care Provider. *Acad Pediatr*. 2012;12(5):399-404. doi:10.1016/j.acap.2012.06.003

3 Sheppard VB, Zambrana RE, O'Malley AS. Providing health care to low-income women: a matter of trust. *Family Practice*. 2004;21(5):484-491. doi:10.1093/fampra/cmh503

4 Butterworth JE, Campbell JL. Older patients and their GPs: shared decision making in enhancing trust. *Br J Gen Pract*. 2014;64(628):e709-e718. doi:10.3399/bjgp14X682297

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Methods

Led by a trained research librarian, we searched the online PubMed database for all papers from 2002 through the present (Feb 28th, 2021). Papers with the medical subject heading "continuity of patient care" and all possible subheadings, combined with the outcome categories of cost of care, cost of healthcare, total cost of care, "health care costs" and subheadings, utilization, ambulatory care sensitive condition(ACSC) hospitalizations, or ambulatory care sensitive condition(ACSC) were generated. The search was further narrowed to primary care using the keywords primary care, primary health care, family medicine, family practice, pediatrics, or internal medicine. This search yielded 228 results.

The titles and abstracts of the papers were scanned to eliminate irrelevant papers, such as papers that focused on care coordination or transition rather than care continuity. The references of each relevant article were also scanned to identify papers that may have been missed in the search. Any papers that examined continuity of care and its impact on one of the outcomes included in the search were selected. Though our search was limited to ACSC hospitalization, studies that examined all cause and other types of hospitalization that were present in the search were also included. The articles were then more carefully read and categorized based on outcomes measured.

Executive Summary

Continuity of care is considered a crucial aspect of family medicine, which makes it an important variable to investigate in order to assess its impact. Interpersonal continuity of care can be defined as the ongoing relationship between the physician and the patient.

We identified 66 studies since 2002 that examine continuity and a policy outcome, analyzing either healthcare costs or some form of healthcare utilization. A wide variety of study types and sample sizes have been used to measure this concept. Continuity itself is measured using both pre-existing developed measures, such as the Bice-Boxerman, UPC, SECON, and others, as well as study specific measures using survey responses. The pre-existing scales tend to examine either the density, dispersion, or sequence of physician visits. In general, more visits to a single primary care physician will result in a higher continuity score.

Existing research on primary care continuity's impact on healthcare policy outcomes can be grouped into two categories: cost and utilization. As it pertains to cost, the vast majority of studies found that improved primary care continuity reduces a variety of healthcare costs. This includes total costs, ED costs, inpatient costs, primary care costs, and costs for specific conditions or treatments. Drug and pharmaceutical costs were the only form of costs that didn't uniformly decrease as continuity increased across each study that examined it.

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> Many different forms of healthcare utilization were assessed, but most commonly hospitalizations or emergency department(ED) utilization were analyzed. For hospitalizations, Ambulatory Care Sensitive Conditions(ACSC) hospitalizations, diabetes-related hospitalizations, and all-cause hospitalizations were most frequently analyzed. Most studies that measured it found that continuity decreased the likelihood or rate of hospitalizations. ED visits showed a similar pattern, with continuity reducing ED utilization. There was some variation in these studies' outcomes, with one study finding that continuity had a greater impact on urban populations, and others analyzing the likelihood of using the ED as compared to other healthcare services, such as primary care.

Many studies did not limit their utilization to hospitalizations and ED visits. Several studies analyzed the impact of continuity on the likelihood of receiving desirable utilization, such as utilization for a variety of cancer screenings, testing for other diseases, and immunizations, among others. Continuity appeared to be less related to this form of utilization, with only approximately half of the 12 studies that examined it finding that continuity increased desirable utilization. However, this could possibly be due to a lack of volume of studies analyzing it, as ED utilization and hospitalizations were examined in a significantly greater number of studies. Similarly, other forms of undesirable utilization were also analyzed by several studies. This type of utilization includes measurements of overuse of medical procedures, over-prescribing medications, and total inpatient and outpatient days, among others. These also revealed conflicting results, with studies finding that continuity reduced utilization of some forms of undesirable utilization, but had no effect on some, and even increased utilization for a few procedures. Lastly, 11 studies analyzed some form of primary care utilization. These measures included, but were not limited to, using primary care resources during scheduled or out-of-hours times, the frequency of primary care visits, and the likelihood of using primary care over other healthcare services. Overall, about half of the studies found that better continuity led to improved primary care utilization.

In summary, the majority of the evidence indicates that continuity of care will improve policy outcomes, though the association may differ for different types of outcomes. Continuity has been heavily researched throughout the past 2 decades. The findings of such studies overwhelmingly indicate that primary care continuity should be promoted. More research should continue to be conducted to improve our understanding of primary care continuity, specifically in the areas of utilization where less research has been conducted(desirable utilization and primary care utilization). However, the existing evidence has proven to be sufficient to indicate that future policy should promote primary care continuity and build on the efforts of prior healthcare policy.

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Table 1

Outcomes examined by each study and location of study in bibliography

X = included in study

Study	Form of Utilization						
	Hospitalization	ED utilization	Desirable utilization	Primary care utilization	Other	Cost	Section found in
Lei et al, 2020						X	Cost
Hollander & Kadlec, 2015						X	Cost
De Maeseneer et al, 2003						X	Cost
Jacobs et al, 2020 chapter 7						X	Cost
Lin et al, 2010	X						Hospitalization
Enlow et al, 2017	X	X	X	X			Primary care utilization
Reddy et al, 2018	X	X					Multiple outcomes
Menec et al, 2006	X			X	X		Multiple outcomes
Huang et al, 2016		X					ED utilization
Johnston & Hockenberry, 2016	X	X	X		X		Other undesirable and desirable utilization
Fenton et al, 2008			X				Other undesirable and desirable utilization
Reid et al, 2005			X				Other undesirable and desirable utilization
McDermott et al, 2020				X			Primary care utilization
Meyers et al, 2019			X				Other undesirable and desirable utilization
Irigoyen et al, 2004			X				Other undesirable and desirable utilization
Warren et al, 2015			X				Other undesirable and desirable utilization
Bradford et al, 2004			X				Other undesirable and desirable utilization
Flores et al, 2008			X				Other undesirable and desirable utilization
Mendoza-Sassi & Béria, 2003			X				Other undesirable and desirable utilization
Skarshaug et al, 2021	X			X			Primary care utilization
Van Loenen et al, 2016	X						Hospitalization

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Study	Form of Utilization						
	Hospitalization	ED utilization	Desirable utilization	Primary care utilization	Other	Cost	Section found in
Brousseau et al, 2004		X					ED utilization
Ionescu-Ittu et al, 2007		X					ED utilization
Burge et al, 2003		X					ED utilization
Arthur et al, 2018		X					ED utilization
Holderness et al, 2019		X					ED utilization
Chaiyachati et al, 2014		X					ED utilization
Nyweide & Bynum, 2017		X					ED utilization
Jacobs et al, 2020 chapter 4	X	X					Multiple outcomes
Cree et al, 2006	X	X					Multiple outcomes
Ride et al, 2019	X	X					Multiple outcomes
Bentler et al, 2014	X	X					Multiple outcomes
Cheng et al, 2010	X						Hospitalization
Knight et al, 2009	X						Hospitalization
Wang et al, 2020	X	X		X			Primary care utilization
Gudzune et al, 2013	X	X					Multiple outcomes
Katz et al, 2015	X	X					Multiple outcomes
Bayliss et al, 2015	X	X					Multiple outcomes
Chen et al, 2019	X	X			X		Other undesirable and desirable utilization
Barker et al, 2017	X						Hospitalization
Nyweide et al, 2013	X						Hospitalization
Solomon et al, 2015	X	X		X			Multiple outcomes
Cheng & Chen, 2014					X		Other undesirable and desirable utilization
Romano et al, 2015					X		Other undesirable and desirable utilization

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Study	Form of Utilization						
	Hospitalization	ED utilization	Desirable utilization	Primary care utilization	Other	Cost	Section found in
Barrera et al, 2019					X		Other undesirable and desirable utilization
Coleman et al, 2010		X		X			Primary care utilization
Koopman et al, 2003			X				Other undesirable and desirable utilization
Liao et al, 2015	X						Hospitalization
Stein et al, 2002		X					ED utilization
Thanh & Rapoport, 2017				X	X		Primary care utilization
Tsai et al, 2010				X			Primary care utilization
Pourat et al, 2015	X	X					Multiple outcomes
Langton et al, 2020				X		X	Cost and Utilization
Romaire et al, 2014	X	X				X	Cost and Utilization
Robles & Anderson, 2011			X			X	Cost and Utilization
Jung et al, 2018	X					X	Cost and Utilization
Hong & Kang, 2013	X					X	Cost and Utilization
Amjad, 2016	X	X			X	X	Cost and Utilization
Hussey et al, 2020	X	X				X	Cost and Utilization
Shin et al, 2014					X	X	Cost and Utilization
Bazemore et al, 2018	X					X	Cost and Utilization
Dreiher et al, 2012	X	X		X		X	Cost and Utilization
McBurney et al, 2004		X				X	Cost and Utilization
Anderson et al, 2012		X				X	Cost and Utilization
Chen & Cheng, 2011	X	X				X	Cost and Utilization
Chen et al, 2020		X			X	X	Cost and Utilization

Cost Only

The literature demonstrates that improved continuity of care reduces healthcare costs. Studies that analyzed various types of cost in various populations generally remained consistent in their findings of this association. Different patient groups included patients with dementia, diabetes, congestive heart failure, chronic obstructive pulmonary disease, serious mental illness, hypercholesterolemia, hypertension, knee osteoarthritis, and the general population, among others. Among these various groups, total costs, ED costs, inpatient costs, primary care costs, and other types of costs tended to decline. However, this association was not uniform, with several studies finding continuity to not improve some or all types of costs. One study found that drug costs increased with better continuity.

Lei L, Intrator O, Conwell Y, Fortinsky RH, Cai S. Continuity of care and health care cost among community-dwelling older adult veterans living with dementia. *Health Serv Res*. 2021;56(3):378-388. doi:10.1111/1475-6773.13541

Using the Bice-Boxerman COC index, the relationship between continuity of care and healthcare costs was measured for 102,073 community-dwelling veterans with dementia aged 66 and older. A 0.1 higher COC value resulted in $4045 lower total cost overall, $1597 lower acute inpatient cost, $119 lower emergency department cost, $4368 lower long-stay nursing home cost, $402 higher noninstitutional medical long term care cost, and $764 higher noninstitutional social long term care cost, but no impact of short-stay nursing home cost. Limiting the sample to primary care continuity revealed results consistent with these principal findings.

Hollander MJ, Kadlec H. Financial implications of the continuity of primary care. *Perm J*. 2015;19(1):4-10. doi:10.7812/TPP/14-107

This study analyzed the financial impact of relational continuity by operationalizing it as a patient's attachment to their primary practice, measured by the percent of overall services a patient has that are performed by their primary practice. 222,279 patients in Canada with diabetes, congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), hypertension, angina, chronic kidney disease, osteoarthritis, or stroke were included. Controlling for other cost-related predictors, the authors found that a stronger patient attachment was correlated with lower total, annual, per-patient, government-related health care cost. This association was stronger than any of the 9 other predictor variables studied, including age and sex of patient, median after-tax household income of patient, and sex and length of time in family practice for physicians, among others. The authors estimated that a 5% increase in every Canadiens attachment to their practice would result in saving $142 million Canadian dollars in total healthcare costs.

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De Maeseneer JM, De Prins L, Gosset C, Heyerick J. Provider continuity in family medicine: does it make a difference for total health care costs? *Ann Fam Med*. 2003;1(3):144-148. doi:10.1370/afm.75

The authors surveyed 4,800 adults over the age of 45 in Belgium and found that patients with only one family physician over the 2 year study period had lower healthcare costs compared to patients with more than one family physician. Other patient characteristics and determinants of utilization, such as age, sex, morbidity, and others, accounted for 27.6% of the cost difference, so there was still a significant difference in costs between the two continuity groups after controlling for these variables.

Jacobs R, Aylott L, Dare C, et al. The association between primary care quality and multisector costs. *NIHR Journals Library*; 2020. Accessed March 15, 2021. https://www.ncbi.nlm.nih.gov/books/NBK558182/

In this study, the impact of continuity of care on various healthcare costs was studied using Primary and Secondary care administrative records for 16,486 patients with serious mental illness(SMI) in the United Kingdom. The Bice-Boxerman COC, UPC, and SECON indices were used. The authors found that higher general practitioner continuity was associated with lower primary care costs(consultations, drugs prescribed, and diagnostic tests), but not with total costs or costs for any other services.

Utilization Only

The literature demonstrates that improved continuity of care reduces most healthcare utilization. Studies measured utilization by using a variety of outcomes, including ED utilization, various types of hospitalizations, primary care utilization, over-utilization of some healthcare procedures and utilization of desirable procedures. Most studies found that improved continuity decreased undesirable healthcare utilization, largely in the form of a lower likelihood of hospitalization or ED visits. However, continuity's influence on desirable utilization was less evident, with only about half of the studies that analyzed it finding a positive association. Lastly, studies that analyzed primary care utilization found contradicting results, with some showing that increased continuity improved primary care utilization, while others found it had no effect or worsened utilization.

Hospitalization

Several studies examined the impact of continuity on different types of hospitalization. Ambulatory Care Sensitive Conditions hospitalizations, diabetes-related hospitalizations, and all-cause hospitalizations were most frequently analyzed. Outcomes focused on both the likelihood of ever being hospitalized and the rate and length of hospitalizations. Most studies found that better continuity reduced the different forms of hospitalization previously mentioned.

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Lin W, Huang I-C, Wang S-L, Yang M-C, Yaung C-L. Continuity of diabetes care is associated with avoidable hospitalizations: evidence from Taiwan's National Health Insurance scheme. *International Journal for Quality in Health Care*. 2010;22(1):3-8. doi:10.1093/intqhc/mzp059

The authors used caims data from Taiwan's National Health Insurance system for 6,476 diabetic patients and used the UPC index to examine the relationship between continuity and hospitalizations. Compared to patients with high continuity of care, patients with medium or low level continuity had a higher likelihood of long-term hospitalization. The relationship between continuity and short-term hospitalization was not statistically significant, likely due to the small sample size of short-term admissions.

Van Loenen T, Faber MJ, Westert GP, Van den Berg MJ. The impact of primary care organization on avoidable hospital admissions for diabetes in 23 countries. *Scand J Prim Health Care*. 2016;34(1):5-12. doi:10.3109/02813432.2015.1132883

The authors used data from the OECD Healthcare Quality Indicators Project and Quality and Costs of Primary Care in Europe(QUALPIOC) study for primary care systems in 23 different countries to analyze the relationship between continuity and diabetes-related hospitalizations. After controlling for differences between diabetes prevalence in different countries, countries with better continuity were found to have less hospitalizations for diabetes.

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

In this paper, the authors used the Bice-Boxerman COC index and claims data from a universal health insurance program for 30,830 patients in Taiwan. They found that patients with a high or medium COC had a lower likelihood of avoidable hospitalizations and hospital admissions than patients with low COC. Sensitivity analyses were performed that confirmed these observations.

Knight JC, Dowden JJ, Worrall GJ, Gadag VG, Murphy MM. Does higher continuity of family physician care reduce hospitalizations in elderly people with diabetes? *Population Health Management*. 2009;12(2):81-86. doi:10.1089/pop.2008.0020

The authors used the National Diabetes Surveillance System(NDSS) in Newfoundland and Labrador, Canada for 1,143 patients aged 65 or older with diabetes to analyze the effect of continuity of care on hospitalizations. Using the UPC, Bice-Boxerman COC, and SECON indices, they found that patients with high continuity, defined as having a continuity of care score above 0.75, had 18-25% less hospitalizations and a higher likelihood of having 0 hospitalizations compared to patients without high continuity.

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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

In this paper, the authors used the UPC index and Primary and Secondary care records for 230,472 patients aged 62-82 in 200 general practices in England to assess the relationship between continuity and ACSC hospitalizations. After controlling for covariates, they found that a 0.2 increase in the UPC correlated with a 6.22% decrease in ACSC admissions. This association existed for all patients, but was strongest for patients with high general practitioner utilization.

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

This study used claims and enrollment data for 3,276,635 fee-for-service Medicare beneficiaries over age 65 to analyze the effect of continuity, measured with the HI and UPC indices, on preventable hospitalization. Preventable hospitalization was classified as a hospitalization for angina without procedure, asthma, bacterial pneumonia, congestive heart failure(CHF), chronic obstructive pulmonary disease (COPD), dehydration, short- or long-term complications from diabetes mellitus, uncontrolled diabetes mellitus, diabetes mellitus–related lower extremity amputation, hypertension, perforated appendix, or urinary infection. The study revealed that a 0.1 increase in the COC score for either measurement was associated with a 2% reduction in preventable hospitalizations. Further, patients with any preventable hospitalizations had worse continuity than patients without a preventable hospitalization.

Liao PJ, Lin ZY, Huang JC, Hsu KH. The relationship between type 2 diabetic patients' early medical care-seeking consistency to the same clinician and health care system and their clinical outcomes. *Medicine (Baltimore)*. 2015;94(7):e554. doi:10.1097/MD.0000000000000554

The authors used the National Health Insurance database of Taiwan for 89,428 patients newly diagnosed with type 2 diabetes in the past year to analyze whether consistency of patient to provider and medical setting had a relationship with diabetes-related hospitalizations. Consistency was classified as high consistency if 100% of a patient's outpatient visits to a single provider and low consistency if less than 70% were to a single provider. The authors found that the likelihood of hospitalization was found to decrease with increasing consistency.

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Emergency Department Utilization

The majority of findings showed that improved continuity reduced ED utilization for a number of different conditions. Patients with asthma, cancer, and other conditions, as well as children with medical complexities, healthy children, and adults were studied. Continuity reduced both the likelihood and rate of ED utilization and these findings were largely consistent across the studies included. One study found that continuity decreased ED utilization more in urban areas. Another study found that being established with a PCP reduced the likelihood of a patient presenting to the ED as their first visit when they have a problem, and another study found that patients with a PCP were less likely to go to the ED inappropriately, meaning for elective cases.

Huang ST, Wu SC, Hung YN, Lin IP. Effects of continuity of care on emergency department utilization in children with asthma. *Am J Manag Care*. 2016;22(1):e31-e37. Published 2016 Jan 1.

> In this study, the Bice-Boxerman COC index and data from the Taiwan National Health Insurance Dataset for 29,277 patients with asthma aged 0 to 17 years old was used to analyze the effect of continuity of care on asthma-related ED visits. The risk of an ED visit was 1.21 times greater for patients with medium level continuity compared to the high level, and 1.38 times greater for the low level. However, the number of ED visits for patients with at least 1 visit did not show any statistically significant relationship with continuity.

Brousseau DC, Meurer JR, Isenberg ML, Kuhn EM, Gorelick MH. Association between infant continuity of care and pediatric emergency department utilization. *Pediatrics*. 2004;113(4):738-741. doi:10.1542/peds.113.4.738

> In this study 181 children were followed from the 8th through 19 months of life using UnitedHealthcare of Wisconsin claims data for 30 pediatricians at 11 Children's Medical Group clinic sites. Children were then followed up 6 months after the initial study completed. The goal of the study was to assess continuity of care, using the Bice-Boxerman's index, and its relation to ED utilization. The authors found that there was a significant negative correlation between COC and ED utilization and the 18th month follow-up showed an even stronger correlation, indicating that better COC reduces ED visits.

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Ionescu-Ittu R, McCusker J, Ciampi A, et al. Continuity of primary care and emergency department utilization among elderly people. *CMAJ*. 2007;177(11):1362-1368. doi:10.1503/cmaj.061615

The authors used the UPC index and a database of 95,173 patients aged 65 years or older in Quebec, Canada to analyze continuity of care's association with ED utilization. They found that lack of any primary care physician was associated with more ED use, and this relationship was stronger in rural areas. Further, low and medium levels of continuity of care were also associated with an increased rate of ED use compared to the high level of continuity, and this relationship was stronger in urban areas.

Burge F, Lawson B, Johnston G. Family physician continuity of care and emergency department use in end-of-life cancer care. *Med Care*. 2003;41(8):992-1001. doi:10.1097/00005650-200308000-00012.

In this study, the authors used data from 4 administrative health databases in Canada for 8,702 patients who made at least 3 visits to a family physician during their last 6 months of life before dying of cancer in order to assess the relationship between continuity of care, measured with MMCI, and ED utilization. Cancer patients with low or medium family physician continuity of care were found to make 3.9 and 2 more ED visits, respectively, and had a 8 and 3.9 times greater odds of having any ED visits, respectively, than patients with high continuity of care.

Arthur KC, Mangione-Smith R, Burkhart Q, et al. Quality of care for children with medical complexity: An analysis of continuity of care as a potential quality indicator. *Academic Pediatrics*. 2018;18(6):669-676. doi:10.1016/j.acap.2018.04.009

The authors assessed the relationship between continuity of care, using the Bice-Boxerman COC index, and ED utilization by analyzing administrative data from Minnesota and Washington state Medicaid agencies for 1,477 children with medical complexities(CMC). They found that a 0.1 improvement in COC score was associated with 4% decrease in odds of having at least 1 ED visit.

Holderness H, Angier H, Huguet N, et al. Where do Oregon Medicaid enrollees seek outpatient care post-Affordable Care Act Medicaid expansion? *Med Care*. 2019;57(10):788-794. doi:10.1097/MLR.0000000000001189

In this study, the authors used Oregon Medicaid enrollment and administrative claims for 212,541 patients aged 19-64 to assess the relationship between being established with a primary care provider, defined as having 2 visits to a provider and Evaluation Management(EM) codes from that provider, and ED utilization. Following Medicaid expansion, the authors found that patients without an established primary care provider were more likely to have the ED be their first medical visit. Further, ED visit rates were lowest for patients established at one primary care provider(PCP) and highest when patients were unestablished and seeing multiple PCPs.

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Chaiyachati KH, Gordon K, Long T, et al. Continuity in a VA patient-centered medical home reduces emergency department visits. *PLoS One*. 2014;9(5). doi:10.1371/journal.pone.0096356

This paper uses electronic medical health records of 13,495 patients at the West Haven Veteran Affairs(VA) primary care clinic in West Haven, CT. Using the UPC index, the authors found that continuity of care was found to reduce ED utilization by 46%. The rate of ED visits was lower for patients with any continuity than patients without. Further, within the patients with any continuity, patients with high and medium continuity were 41% and 31% less likely to go to the ED than patients with low continuity, respectively.

Nyweide DJ, Bynum JPW. Relationship between continuity of ambulatory care and risk of emergency department episodes among older adults. *Ann Emerg Med*. 2017;69(4):407-415.e3. doi:10.1016/j.annemergmed.2016.06.027

The authors conducted a study using Medicare data for 3,200,158 patients over 65 years of age and found that a 0.1 increase in the continuity score was associated with a 1%-2% decrease in ED visit rate, depending on the index used. Both the Bice-Boxerman COC index and UPC index were used in the study.

Stein A, Harzheim E, Costa M, Busnello E, Rodrigues L. The relevance of continuity of care: a solution for the chaos in the emergency services. *Family Practice*. 2002;19(2):207-210. doi:10.1093/fampra/19.2.207

In this study, the authors interviewed 438 patients of the emergency service of the Conceição Hospital in Brazil to assess the impact of having or not having a primary care physician, defined as seeing the same physician when you have a problem, on ED utilization. ED visits were classified as appropriate(emergency and urgent cases) and inappropriate(elective cases). Patients with a primary care physician were more likely to present to the ED appropriately.

Other Undesirable and Desirable Utilization

While hospitalization and ED utilization was most regularly analyzed, several studies examined different forms of healthcare utilization's relation to continuity. This included, among others, cancer testing for various cancers, chlamydia screening, medication adherence to a variety of drugs, immunizations, lead, anemia, and tuberculosis screening, receiving medical advice, recognition of disease, overprescribing antibiotics and other drugs, overuse of some medical procedures, and post-cancer follow up procedures. Overall, the association with continuity for these forms of utilization was weaker than hospitalization or ED visits. Several studies found that improved continuity led to more desirable utilization, but others found no association and even others found a negative association. Additionally, within individual studies, continuity was found to improve desirable utilization of some procedures and outcomes, but not others.

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Fenton JJ, Franks P, Reid RJ, Elmore JG, Baldwin L-M. Continuity of care and cancer screening among health plan enrollees. *Medical Care*. 2008;46(1):58-62. doi:10.1097/MLR.0b013e318148493a

In this study, the authors used automated health and pharmacy data for 67,633 patients aged 50-78 years old enrolled in a Washington State health plan to assess the impact of continuity of care, measured with UPC, on the use of various desirable utilization procedures. They found that better continuity of care was associated with a higher likelihood of receiving colorectal cancer testing, though that occurred through a higher likelihood of fecal occult blood testing but a lower likelihood of lower endoscopy. Better continuity was also associated with more prostate-specific antigen(PSA) testing for men but no relationship to mammography for women.

Reid RJ, Scholes D, Grothaus L, et al. Is provider continuity associated with chlamydia screening for adolescent and young adult women? *Preventive Medicine*. 2005;41(5):865-872. doi:10.1016/j.ypmed.2005.08.005

The authors used administrative data for 4,117 sexually active women at a large US HMO to assess the relationship between continuity and the likelihood of chlamydia screening. Higher UPC and Bice-Boxerman COC quartiles were found to be associated with a statistically significant lower likelihood of chlamydia testing. Women in the lowest UPC quartile had a 41% higher chance of being tested compared to women in the highest quartile.

Meyers DJ, Cole MB, Rahman M, et al. The association of provider and practice factors with HIV ART adherence. *AIDS*. 2019;33(13):2081-2089. doi:10.1097/QAD.0000000000002316

In this study, the authors used Medicaid Analytic Extract claims for 60,496 patients aged 18-64 with HIV in the 14 US states with the highest HIV prevalence to assess the relationship between continuity and HIV Anti-Retroviral Therapy(ART) adherence. Measuring continuity by the number of years a patient saw the same provider, the authors found that each additional year a patient saw the same provider was associated with a 6% increase in percent of year of ART adherence, defined as the percent of the calendar year that an individual used ART.

Irigoyen M, Findley SE, Chen S, et al. Early continuity of care and immunization coverage. *Ambulatory Pediatrics*. 2004;4(3):199-203. doi:10.1367/A03-138R1.1

In this study, the authors tracked 641 randomly selected children under pediatric care from their first visit pre-3 months of age until 18 months of age and found that children who remained in their initial source of care were 17.5 times more likely to be up to date in their immunizations at 18 months(UTD18) than children in care for less time. However, that increase in likelihood stayed constant for any length of care beyond 12-14 months, indicating that the effect of continuity on immunizations may only be present up to 12-14 months.

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Warren JR, Falster MO, Tran B, Jorm L. Association of continuity of primary care and statin adherence. *PLoS One*. 2015;10(10). doi:10.1371/journal.pone.0140008

The authors used data of 36,144 patients with statin dispensed from the cohort 45 and Up study which includes 260,000 people aged 45 and older in New South Wales, Australia in order to assess continuity's relation to medication and statin adherence. Medication adherence was positively associated with continuity of care, with the upper tertile UPC associated with a 5% increase in Medication Possession Ratio(MPR) for statin adherence compared to the lowest tertile, and a UPC greater than 75% was also correlated to increased adherence. Further, the Bice-Boxerman COC index was highly correlated to the UPC and thus the same trends were observed for both measures.

Bradford WD, Kaste LM, Nietert PJ. Continuity of medical care, health insurance, and nonmedical advice in the first 3 years of life. *Medical Care*. 2004;42(1):91-98. doi:10.1097/01.mlr.0000102368.39193.5a

The authors used survey responses for 8,285 Caucasian and African-American mothers surveyed in the National Maternal and Infant Health Survey, 1988 (NMIHS) and the 1991 Longitudinal Follow-up to analyze the association between continuity of care and the likelihood of receiving medical advice. A child was considered to have continuity of care if "over 50% of the ambulatory medical visits the child received were with 1 provider, the child received at least 1 visit with that provider per year, and the provider type was a private office or clinic." The authors found that mothers with children with continuity of care were more likely to receive advice/counseling on all 3 aspects of their child's health(nutrition, development, dental care) than mothers with children without continuity of care. However, only child nutrition and development showed a significant association, while dental advice did not.

Flores AI, Bilker WB, Alessandrini EA. Effects of continuity of care in infancy on receipt of lead, anemia, and tuberculosis Screening. *Pediatrics*. 2008;121(3):e399-e406. doi:10.1542/peds.2007-1497

The authors conducted a prospective birth cohort study with hospital chart reviews and maternal interviews for 1,564 Medicaid-enrolled infants in Philadelphia, PA to examine the relationship between continuity of care and utilization of various desirable health screenings. Different COC measures(UPC, Bice-Boxerman COC, and SECON) showed varying strengths of relationships, but for all measures, better continuity of care was significantly associated with a greater likelihood of receiving lead, anemia, and tuberculosis screening.

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Mendoza-Sassi R, Béria JU. Prevalence of having a regular doctor, associated factors, and the effect on health services utilization: a population-based study in Southern Brazil. *Cadernos de Saúde Pública*. 2003;19(5):1257-1266. doi:10.1590/S0102-311X2003000500004

The authors conducted interviews of 1,260 people over 15 years of age in Brazil in 540 households to assess the relationship between having a regular doctor and utilization of various medical screenings. Continuity of care, defined as having a regular doctor, was associated with a 51% greater chance of clinical breast examination and 62% greater chance of cervical cancer screening for women over 40, a 98% greater chance of prostate cancer screening for men over 40, and a 23% greater chance in visiting a doctor over the past year for all patients over 15. A non-significant association was observed for breast-self examination and mammography.

Koopman RJ, Mainous III AG, Baker R, Gill JM, Gilbert GE. Continuity of care and recognition of diabetes, hypertension, and hypercholesterolemia. *Arch Intern Med*. 2003;163(11):1357. doi:10.1001/archinte.163.11.1357

In this study, the authors used data from the National Health and Nutrition Examination survey for 18,162 adult patients in the United States to analyze the relationship between continuity and recognition of diabetes, hypertension, or hypercholesterolemia. Continuity was assessed using the usual source of care proxy, and was scored on a 3 point scale that scored patients from no usual source of care, usual place but no usual provider, to usual place and provider. Unadjusted analysis showed that greater level of continuity was associated with a lower likelihood of having unrecognized diabetes and hypertension, but not hypercholesterolemia. Logistic regression showed no difference between a usual site of care without a usual provider of care and not having either a usual site or provider. Further, regression analysis contrasted with the unadjusted analysis and found that continuity was not associated with recognition of hypertension.

Cheng S-H, Chen C-C. Effects of continuity of care on medication duplication among the elderly. *Medical Care*. 2014;52(2):149-156. doi:10.1097/MLR.0000000000000042

In this study, the authors analyzed the impact of continuity by examining duplicated medication, defined as being prescribed drugs in the same pharmacotherapeutic subgroups by separate physicians with overlapping prescription days, for 55,573 elderly patients 65 years of age and older with multiple chronic conditions from the Taiwan National Health Insurance Dataset. Patients with higher physician or site level continuity of care were less likely to have duplicate medications regardless of the number of chronic conditions they had, and that relationship was stronger for physician level continuity.

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Romano MJ, Segal JB, Pollack CE. The association between continuity of care and the overuse of medical procedures. *JAMA Intern Med*. 2015;175(7):1148-1154. doi:10.1001/jamainternmed.2015.1340

The authors used Medicare fee-for-service claims for 1,208,250 patients aged 65 and older and the Bice-Boxerman COC index to examine the relationship between continuity of care and the overuse of 19 different medical procedures. They found that patients who had an overused procedure had lower continuity of care than patients who did not for 15 of the 19 procedures. Regression models found that higher continuity was associated with lower odds of 9 procedures, higher odds of 3 procedures, and no association for 7 procedures.

Barrera SC, Cancino RS, Barreto TW. The impact of continuity of care on antibiotic prescribing in acute otitis media. *International Journal of Pediatric Otorhinolaryngology*. 2019;126:109616. doi:10.1016/j.ijporl.2019.109616

In this paper, the authors utilized outpatient primary care records for 277 patients under that age of 25 in the United States and found that patients who were seen by their primary care provider were less likely to receive an antibiotic prescription than patients who weren't seen.

Johnston KJ, Hockenberry JM. Are two heads better than one or do too many cooks spoil the broth? The trade-off between physician division of labor and patient continuity of care for older adults with complex chronic conditions. *Health Serv Res*. 2016;51(6):2176-2205. doi:10.1111/1475-6773.12600

The authors used the Bice-Boxerman COC index and panel data from the Medicare Current Beneficiary Survey(MCBS) for Medicare patients with type 2 diabetes or heart failure and found that a 0.1 increase in the COC index was associated with higher guideline-concordant care for hemoglobin a1c (HbA1c) biannual screening and follow ups within 30 days of inpatient stay, but no significant relationship with influenza and pneumonia vaccination, HbA1c annual screening, low-density level cholesterol annual screening, annual nephropathy screening, serum creatine annual screening, or annual left ventricular function for patients with heart failure. Further, as it pertains to the overuse of cardiac imaging, a 0.1 increase in COC was associated with less cardiac stress tests, but had no relationship to echocardiograms or chest X-rays. Continuity was not found to have any impact on acute care utilization, measured as ACSC hospitalizations, all diabetes-related inpatient stays for those with diabetes, all heart failure–related inpatient stays for those with heart failure, all inpatient stays, ACSC ED visits, diabetes-related ED visits for those with diabetes, heart failure–related ED visits for those with heart failure, and all ED visits.

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Chen Y-Y, Hsieh C-I, Chung K-P. Continuity of care, follow-up care, and outcomes among breast cancer survivors. *Int J Environ Res Public Health*. 2019;16(17):3050. doi:10.3390/ijerph16173050

The authors used data from the Taiwan Cancer Registry, which has a nationally representative sample of patients diagnosed with cancer, for 18,031 patients over the age of 20 who have survived at least 2 years after a stage I-III breast cancer diagnosis. They found that higher primary care continuity, measured with the Bice-Boxerman COC index, was associated with a lower likelihood of hospitalization or ED use, but had no association with the use of the various follow-up testing services for this patient group.

Primary care Utilization

Several studies analyzed whether primary care continuity had an impact on primary care utilization itself. This was done in a variety of ways. Family physicians, internal medicine physicians, general practitioners, and pediatricians were all included as primary care. Researchers analyzed primary care utilization through the frequency of primary care attendance, the likelihood of utilizing primary care over other healthcare services, the number and type of visits to PCPs, and scheduled and out-of-hours PCP consultations. In summary, about half of the studies found that increased continuity improved primary care utilization. Improved primary care utilization was defined as anything that increased primary care utilization during scheduled office hours or improved the appropriateness of primary care utilization, such as utilizing primary care over other healthcare services or utilizing monthly PCP consultations. The rest of the studies found primary care utilization either worsened or had no effect from increased continuity.

McDermott A, Sanderson E, Metcalfe C, et al. Continuity of care as a predictor of ongoing frequent attendance in primary care: a retrospective cohort study. *BJGP Open*. 2020;4(5). doi:10.3399/bjgpopen20X101083

In this study, the authors used practice record data for 35,296 patients over 18 years of age in Bristol, England and utilized the UPC index to assess continuity's relationship to primary care utilization. The authors found no relationship between a patient's continuity and the likelihood that they would be a frequent attender of primary care, defined as 9-16 consultations over 6 months.

Tsai J, Shi L, Yu W-L, Lebrun LA. Usual source of care and the quality of medical care experiences: a cross-sectional survey of patients from a Taiwanese community. *Medical Care*. 2010;48(7):628-634. doi:10.1097/MLR.0b013e3181dbdf76

The authors surveyed approximately 750 randomly sampled patients in Taichung County, Taiwan to determine the influence of a usual source of care, assessed with 3 survey questions, on primary care utilization. They found that patients with a usual source of care reported higher quality utilization than patients without a usual source of care; meaning that patients with a usual source of care are more likely to utilize their primary care provider first rather than other health services.

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Enlow E, Passarella M, Lorch SA. Continuity of care in infancy and early childhood health outcomes. *Pediatrics*. 2017;140(1). doi:10.1542/peds.2017-0339

In this study, the authors used electronic health records for 17,773 infants at Children's Hospital of Philadelphia clinics who had at least 5 primary care visits during the first year of life and at least one visit before and after the age of 3 following the 1st year to determine the relationship between continuity and healthcare utilization. Using the UPC and Bice-Boxerman COC indices, the authors found that lower continuity was associated with more ACSC hospitalization, ED visits, and sick visits to their primary care but less well visits to their primary care. Further, lower continuity was associated with a lower likelihood of being up to date on immunizations and receiving anemia and lead screening.

Skarshaug LJ, Kaspersen SL, Bjørngaard JH, Pape K. How does general practitioner discontinuity affect healthcare utilisation? An observational cohort study of 2.4 million Norwegians 2007-2017. *BMJ Open*. 2021;11(2):e042391. Published 2021 Feb 16. doi:10.1136/bmjopen-2020-042391

In this study, the authors used National registrars data from 2,560 general practitioner(GP) patient lists for 2,409,409 Norwegian patients in order to assess the impact of a discontinuity of care, defined as a patient who experienced a sudden discontinuity that lasted for over 2 months after having 12 months of stable continuity. Compared to the 12 months before the discontinuity, patients had 3%-5% lower odds of monthly GP consultations but 2%-6% higher odds of monthly out-of-hours consultation in the 12 months after the discontinuity. Further, ACSC hospitalizations only showed a significant relationship with continuity for patients aged 65-79, with 7%-11% higher odds of ACSC hospitalizations after discontinuity for that age group. However, there was no observed change in acute hospital admissions.

Wang C, Kuo H-C, Cheng S-F, Hung J-L, Xiong J-H, Tang P-L. Continuity of care and multiple chronic conditions impact frequent use of outpatient services. *Health Informatics J*. 2020;26(1):318-327. doi:10.1177/1460458218824720

In this study, data of 333,294 internal medicine patients from the National Health Insurance Research Database in Taiwan was used to analyze the impact of continuity, measured with the Bice-Boxerman COC index, on various measures of healthcare utilization. The authors found that higher levels of COC were associated with less hospitalization and ED visits. Further, after adjusting for covariates, high continuity of care was associated with lower medical utilization, defined as the number of outpatient internal medicine visits, than moderate or low levels of continuity of care.

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Coleman K, Reid RJ, Johnson E, et al. Implications of reassigning patients for the medical home: a case study. *Ann Fam Med*. 2010;8(6):493-498. doi:10.1370/afm.1190

The authors used data of 8,005 patients part of the Group Health Cooperative healthcare system in the United States that implemented a medical home redesign initiative. The initiative resulted in 1,817 patients being reassigned to a new physician, which disrupted continuity of care. The authors found that after controlling for patient characteristics, reassigned patients had less primary care visits than non-reassigned patients, but had no significant difference in ED visits.

Thanh NX, Rapoport J. Health services utilization of people having and not having a regular doctor in Canada. *The International Journal of Health Planning and Management*. 2017;32(2):180-188. doi:https://doi.org/10.1002/hpm.2338

In this study, the authors used data from the Canadian Community Health Surveys for 62,909 patients over age 12 from the 2010 survey and 131,061 patients from 2007/2008. They found that having a regular doctor was associated with more utilization for all forms of health service utilization: hospitalization, specialist services, and GP services.

Multiple Outcomes

The authors of this bibliography attempted to sort studies that included multiple forms of utilization into the category they deemed to be the primary outcome of the study. However, some studies were unable to be prioritized. Most of these were studies that assessed both hospitalization and ED utilization, but several other studies were also unable to be prioritized. These studies are summarized below.

Reddy A, Wong E, Canamucio A, et al. Association between continuity and team-based care and health care utilization: an observational study of medicare-eligible veterans in VA patient aligned care team. *Health Serv Res*. 2018;53(Suppl Suppl 3):5201-5218. doi:10.1111/1475-6773.13042

Data of ACSC hospitalizations and ED visits from the Veterans Affairs Health Care System(VA) and Medicare claims data for 1,160,365 patients was utilized to assess its relation to continuity of care using the UPC index. A 10% increase in the COC score was associated with 3.2 fewer ACSC hospitalizations but 2.6 more ED visits. Team-based care was not successful in reducing the impact of continuity of care on these figures.

Menec VH, Sirski M, Attawar D, Katz A. Does continuity of care with a family physician reduce hospitalizations among older adults? *Journal of Health Services Research & Policy*. 2006;11(4):196-201. doi:10.1258/135581906778476562

The authors surveyed 1,863 adults over the age of 67 in Manitoba, Canada to examine continuity's relationship to healthcare utilization. Continuity was defined using the majority-of-care definition, which classifies seeing the same family physician for more than 75% of family practice visits as high continuity of care, and anything below defined as low. Patients with low continuity of care were found to make significantly more visits to all physicians but the same amount of visits to family physicians. Further, high continuity was associated with a lower risk of ACSC hospitalizations, although this trend was not observed for hospitalizations for all conditions.

Jacobs R, Aylott L, Dare C, et al. The association between primary care quality and hospital care utilisation. *NIHR Journals Library; 2020*. Accessed March 4, 2021. https://www.ncbi.nlm.nih.gov/books/NBK558195/

In this study, the authors used Primary and Secondary care administrative records for 19,324 patients with serious mental illness(SMI) in the United Kingdom and various continuity measures(Bice-Boxerman COC, UPC, and SECON) in order to assess the association between continuity of care and healthcare utilization. The authors found that higher continuity was associated with a lower likelihood of ED visits and ACSC hospitalization for patients with moderate visit frequency, but was only associated with less ACSC hospitalizations for frequent attenders of primary care. SMI hospitalizations were not associated with continuity for either group.

Cree M, Bell N r., Johnson D, Carriere K c. Increased continuity of care associated with decreased hospital care and emergency department visits for patients with asthma. *Disease Management*. 2006;9(1):63-71. doi:10.1089/dis.2006.9.63

The authors used the UPC index along with administrative health datasets for 2,774 patients with asthma in Alberta, Canada and found that high continuity of care, defined as a continuity score over 0.69, was associated with less hospitalizations and a half as long length of stay in hospitalizations than low continuity of care. However, no association between continuity and the likelihood of ever being hospitalized was found. Further, high continuity of care was associated with a lower chance of an ED visit, and a lower total number of ED visits among patients with at least one visit.

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Ride J, Kasteridis P, Gutacker N, et al. Impact of family practice continuity of care on unplanned hospital use for people with serious mental illness. *Health Serv Res*. 2019;54(6):1316-1325. doi:10.1111/1475-6773.13211

In this paper, family practice data from the Clinical Practice Research Datalink database and hospital administrative data from the Hospital Episode Statistics(HES) dataset for 19,324 patients with serious mental illness(SMI) in England was used to examine continuity of care's relationship with healthcare utilization. Using the Bice-Boxerman COC, UPC, and SECON indices, the authors found that higher continuity was associated with lower ED visits, but had borderline statistical significance. Further, better continuity was associated with a 23% and 27% lower risk of ACSC hospitalizations for patients with moderate and frequent visit frequency, respectively. However, SMI hospitalizations were not associated with continuity.

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). doi:10.1371/journal.pone.0115088

The authors used the National Health and Health Services Use Questionnaire for 1,219 Medicare beneficiaries to analyze the impact of continuity on healthcare utilization. A variety of continuity measures were used and results varied for different measures. Less ED visits were associated with better COC scores for both interpersonal and longitudinal patient-reported continuity and 3 continuity indices. However, total hospitalizations were not associated with the patient-reported COC measures. Further, less hospitalizations were associated with higher continuity for 2 different continuity indices, but more hospitalizations were associated with higher continuity for 4 different indices. Lastly, more ACSC hospitalizations were associated with higher patient-reported continuity but lower continuity for 4 indices.

Gudzune KA, Bleich SN, Richards TM, Weiner JP, Hodges K, Clark JM. Doctor shopping by overweight and obese patients is associated with increased healthcare utilization. *Obesity (Silver Spring)*. 2013;21(7):1328-1334. doi:10.1002/oby.20189

In this study, the authors examined the impact of "doctor shopping," defined as seeing 5 or more primary care physicians during the 24 month study period, on hospitalizations and ED utilization for 20,726 non-underweight(BMI<18.5) patients who completed the health risk assessments(HRA) in the United States. They found that doctor shoppers were associated with statistically significant higher rates of ED visits than non-shoppers for all weight groups included in the study. Shoppers also had higher hospitalization rates, but this was not statistically significant.

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Katz DA, McCoy KD, Vaughan-Sarrazin MS. Does greater continuity of Veterans Administration primary care reduce emergency department visits and hospitalization in older veterans? *J Am Geriatr Soc*. 2015;63(12):2510-2518. doi:10.1111/jgs.13841

Using Veteran Affairs(VA) administrative data of 243,881 Medicare-eligible veterans aged 65 and older and the UPC index, the authors of this study found that having a UPC score above 0.9 was found to be associated with less ED visits and hospitalizations. Similar results were observed when limiting the outcomes to ACSC related hospitalizations and ED visits.

Bayliss EA, Ellis JL, Shoup JA, Zeng C, McQuillan DB, Steiner JF. Effect of continuity of care on hospital utilization for seniors with multiple medical conditions in an integrated health care system. *Ann Fam Med*. 2015;13(2):123-129. doi:10.1370/afm.1739

In this paper, the authors studied 12,200 adult patients of Kaiser Permanente Colorado with at least 3 chronic conditions pertaining to hypertension, congestive heart failure, hyperlipidemia, diabetes, coronary artery disease, chronic obstructive pulmonary disease, osteoarthritis, osteoporosis, depression, or obesity. Using the Bice-Boxerman COC index, they found that higher primary care continuity was associated with a lower risk of hospitalizations and less ED visits. In a subgroup analysis of patients with 3 or more primary care visits and 3 or more specialty care visits in the last 2-3 years, higher primary care continuity was associated with less ED visits but not with hospitalizations.

Solomon SR, Gooding HC, Reyes Nieva H, Linder JA. Acute care utilization by patients after graduation of their resident primary care physicians. *J Gen Intern Med*. 2015;30(11):1611-1617. doi:10.1007/s11606-015-3305-7

The authors used billing and electronic health record data for 4,018 patients of 90 internal medicine junior and senior residents at a practice at Brigham and Women's Hospital in Boston, MA. Patients transitioning to a different resident, a disruption in continuity, were found to be at no increased risk of clinic visits, hospitalizations for ambulatory care sensitive conditions, or ED visits.

Pourat N, Davis AC, Chen X, Vrungos S, Kominski GF. In California, primary care continuity was associated with reduced emergency department use and fewer hospitalizations. *Health Aff (Millwood)*. 2015;34(7):1113-1120. doi:10.1377/hlthaff.2014.1165

In this study, the authors used enrollment and claims data for 8,162 patients aged 21-64 enrolled in the Health Care Coverage Initiative in Orange County, California, which is a program that assigned patients to a usual source of primary care, in order to determine if adherence to a primary care provider impacted healthcare service utilization. They found that patients who were adherent to their primary care provider

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had their rate of ED visits drop from 4.11% to 3.13% and hospitalizations drop from 1.37% to 1.17%. Further, compared to patients who were never adherent, patients who were always adherent had a 2.0% and 1.7% higher chance of having no ED visits and hospitalizations, respectively. Thus, the program was effective at increasing provider continuity and in turn reduced hospitalizations and ED visits.

Cost and Utilization

A number of studies assessed the impact that continuity had on both healthcare costs and some form of utilization. The findings for the individual outcomes within these studies are summarized in this bibliography under the section for which the outcome pertains to, but more detailed summaries of each study are included below.

Dreiher J, Comaneshter DS, Rosenbluth Y, Battat E, Bitterman H, Cohen AD. The association between continuity of care in the community and health outcomes: a population-based study. *Isr J Health Policy Res*. 2012;1:21. doi:10.1186/2045-4015-1-21

The authors compared the continuity of care of 1,713 patients in Israel using the continuity measurements UPC, MMCI, Bice-Boxerman COC, and SECON with healthcare costs and utilization. A statistically significant association was found between higher values of UPC, COC, and SECON and a decrease in the number and cost of ED visits, but higher MMCI values were associated with a greater number and higher costs of medical consultation visits. Further, multivariate analysis showed no relationship between continuity and hospitalizations or its costs, outpatient clinic visits, or medication purchases.

Hussey PS, Schneider EC, Rudin RS, Fox DS, Lai J, Pollack CE. Continuity and the costs of care for chronic disease. *JAMA Intern Med*. 2014;174(5):742-748. doi:10.1001/jamainternmed.2014.245

In this study, the authors analyzed the relationship between continuity of care and cost of care and hospitalizations for 53,488 congestive heart failure patients(CHF), 76,520 chronic obstructive pulmonary disease patients(COPD), and 166,654 diabetes mellitus patients(DM). The authors found that a 0.1 increase in the Bice-Boxerman COC index was associated with a lower cost of care of 4.7% for CHF, 6.3% for COPD, and 5.1% for DM. Further, higher continuity of care was associated with lower odds of inpatient hospitalization and emergency department visits for all three conditions.

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Chen CC, Chen SH. Better continuity of care reduces costs for diabetic patients. *Am J Manag Care*. 2011;17(6):420-427

This study used claims data of diabetes mellitus patients from the Taiwanese universal health insurance system to examine the relationship between continuity of care and healthcare utilization and costs. From the Bice-Boxerman COC index, the authors found that patients with better continuity of care had a lower likelihood of hospitalization or an ED visit and lower pharmaceutical and total healthcare expenses for diabetes-related conditions. Further, diabetic patients with high continuity of care saved $4,155 in pharmaceutical expenses and $24,314 in total expenses compared to patients with low continuity.

Langton JM, Wong ST, Burge F, et al. Population segments as a tool for health care performance reporting: an exploratory study in the Canadian province of British Columbia. *BMC Fam Pract*. 2020;21:98. doi:10.1186/s12875-020-01141-w

In this study, the authors used patient data from Canada to classify 3,441,393 patients into four groups classified as low need, multiple morbidities, medically complex, or frail and analyzed different characteristics of those groups. One of their measures was continuity of care using the UPC index. The authors found no difference in the frequency of utilization of family physicians outside of regular office hours due to different levels in continuity of care. However, the authors found that better continuity of care was associated with lower costs for the frail population segments only, but not for the other three groups. However, seeing fewer than 5 family physicians in a given year was associated with lower costs in all segments.

Romaire MA, Haber SG, Wensky SG, McCall N. Primary care and specialty providers: an assessment of continuity of care, utilization, and expenditures. *Medical Care*. 2014;52(12):1042-1049. doi:10.1097/MLR.0000000000000246

In this study, the authors used medicare enrollment data for 613,471 community-residing beneficiaries to assess the relationship between continuity and healthcare costs and utilization. Using both the Bice-Boxerman and UPC indices, they found improved continuity of care was associated with a lower rate of hospitalizations, ACSC ED visits, and all ED visits. Further, higher continuity was associated with lower costs for hospitalizations, ED utilization, and total expenses. However, higher continuity was associated with higher rates of ACSC hospitalizations.

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Jung B, Cho KH, Lee DH, Kim S. The effects of continuity of care on hospital utilization in patients with knee osteoarthritis: analysis of Nationwide insurance data. BMC *Health Serv Res*. 2018;18:152. doi:10.1186/s12913-018-2951-y

In this study, the effect of continuity on costs and hospitalizations was analyzed using claims data from the Korean National Health Insurance system for 121,566 patients with knee osteoarthritis. The Bice-Boxerman COC, Most Frequent Provider Continuity (MFPC), and Modified Modified Continuity (MMCI) indices were used to measure continuity. The authors determined that higher continuity of care was significantly associated with less hospitalization. Further, cost was also associated with continuity, with patients with a 0.76-1.00 COC index score having significantly lower medical expenses than patients with a 0.00-0.25 COC index score.

Hong J-S, Kang H-C. Continuity of ambulatory care and health outcomes in adult patients with type 2 diabetes in Korea. *Health Policy*. 2013;109(2):158-165. doi:10.1016/j.healthpol.2012.09.009

The authors used Korean National Health Insurance claims data over 4 years for 68,469 patients 20 years of age or older diagnosed with type 2 diabetes the year the study began to assess continuity of care's impact on healthcare costs and hospitalizations. Using the Bice-Boxerman COC index, they found that after adjusting for a number of control variables, better continuity of care was found to decrease the risk of hospitalization in the final year of the study. Further, costs were also inversely correlated with continuity of care. Total, hospitalization, and ambulatory care costs all reduced as continuity of care increased.

Amjad H, Carmichael D, Austin AM, Chang C-H, Bynum JP. Continuity of care and healthcare utilization in older adults with dementia in fee-for-service Medicare. *JAMA Intern Med*. 2016;176(9):1371-1378. doi:10.1001/jamainternmed.2016.3553

In this study, the authors utilized the Bice-Boxerman COC index as well as claims data for 1,416,369 Medicare beneficiaries aged 65 and older with dementia. After inverse probability weighting, the authors found that compared to the lowest continuity group, the highest continuity group had a 5.8% lower rate of hospitalizations, 15.4% less ED visits, less CT and urinalysis, and lower inpatient and outpatient costs. However, no significant association was found for ACSC hospitalizations or chest x-rays. The authors then explored whether the patient's predominant provider was from primary or specialist care affected these outcomes and found the difference between the two to be significant. It appears that the correlation between continuity and the various outcomes was stronger for primary care providers for hospitalizations, ED visits, CT head, chest x-rays, urinalysis, and costs, and similar for the other outcomes.

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Bazemore A, Petterson S, Peterson LE, Bruno R, Chung Y, Phillips RL. Higher primary care physician continuity is associated with lower costs and hospitalizations. *Ann Fam Med*. 2018;16(6):492-497. doi:10.1370/afm.2308

The authors used Medicare claims data for 1,448,952 beneficiaries from 6,551 primary care physicians to assess the relationship between continuity of care and healthcare costs and hospitalizations. Using the Bice-Boxerman continuity index, they found that spending of beneficiaries was 14.1% lower for patients cared for by physicians in the highest continuity quintile compared to the lowest quintile, and the odds of hospitalization for any condition were 16.1% lower for the highest quintile. Correlation between these results and 3 other continuity measures (UPC, MMCI, and HI) was strong and yielded similar results.

McBurney PG, Simpson KN, Darden PM. Potential cost savings of decreased emergency department visits through increased continuity in a pediatric medical home. *Ambulatory Pediatrics*. 2004;4(3):204-208. doi:10.1367/A03-069R.1

Using past literature and the Bice-Boxerman COC index, the authors conducted an economic modeling study to estimate the cost of emergency department visits for 2 hypothetical pediatric medical homes in the United States with a 10% difference in their continuity of care. They found that increasing continuity of the practice by 10% resulted in 72 less ED visits per practice per year and consequently $19,905 less ED charges per 2000 pediatric patients. These results are sensitive to the average number of ED visits inputted into the model and the level of service provided, but the trend remains regardless.

Anderson LH, Flottemesch TJ, Fontaine P, Solberg LI, Asche SE. Patient medical group continuity and healthcare utilization. *Am J Manag Care*. 2012;18(8):450-457.

In this study, the authors used administrative data over 5 years for 121,780 patients in a Minnesota health plan to determine the impact of continuity to a specific medical group on costs and ED utilization. Continuity was considered high if a patient was always attributed to the same medical group over 5 years, medium if the patient made 1 move between medical groups, and low continuity if the patient made more than 1 move. The authors found that high continuity patients had predicted annual costs 17% lower than low continuity patients and 8% lower than medium continuity patients. Higher continuity was also associated with a lower likelihood of ED utilization.

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Chen AY, Chen B, Kuo CC. Better continuity of care improves the quality of end-of-life care among elderly patients with end-stage renal disease. *Sci Rep*. 2020;10(1):19716. Published 2020 Nov 12. doi:10.1038/s41598-020-76707-w

The authors used data from the National Health Research Database in Taiwan for 29,095 elderly patients with end-stage renal disease(ESRD) who died from 2005-2013 to examine the relationship between continuity of care and healthcare costs and utilization. A 1% increase in the Bice-Boxerman COC index was associated with a 6-8% decrease in total health costs in the last 3-6 months of life. These savings were mostly contributed to inpatient services and ED visit savings. Further, patients with high continuity of care had a lower likelihood of intensive care unit utilization, ED utilization, and utilization of mechanical ventilation, continuous renal replacement therapy, nasogastric intubation, and surgical intervention.

Shin DW, Cho J, Yang HK, et al. Impact of continuity of care on mortality and health care costs: a nationwide cohort study in Korea. *Ann Fam Med*. 2014;12(6):534-541. doi:10.1370/afm.1685

In this study, the authors analyzed the relationship between continuity of care and healthcare costs and utilization over 5 years for 47,433 patients recently diagnosed with hypertension, diabetes, or hypercholesterolemia. The continuity of care indices MFPC, MMCI, and Bice-Boxerman COC were used. Lower continuity of care was found to be associated with increased inpatient and outpatient days and consequently higher inpatient and outpatient costs across all three indices. The association was stronger for inpatient costs, indicating that continuity of care was likely most successful at reducing emergency department visits and hospitalizations.

Robles S, Anderson GF. Continuity of care and its effect on prescription drug use among Medicare beneficiaries with hypertension. *Medical Care*. 2011;49(5):516-521. doi:10.1097/MLR.0b013e31820fb10c

In this study, Medicare data for 5,590 patients aged 67 and older with hypertension was used along with the Bice-Boxerman COC index to examine continuity and its relation to healthcare costs and utilization. After classifying the patients into 3 COC groups, the authors found that the higher level of COC groups purchased more classes of drugs than the correspondingly lower groups, resulting in higher costs. Further, COC showed no association with adherence to antihypertensive drug.

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