Continuity of care in older adults with multiple chronic conditions

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Abstract

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Nearly three out of four people over 65 years of age in the United States (U.S.), or greater than 35 million older adults, have two or more chronic conditions. People with multiple chronic conditions (MCCs) pose a significant challenge to the health care system because they are at greater risk for morbidity and mortality, utilize more health care services, and are vulnerable to poor quality care. Despite their considerable needs, this patient population is often excluded from clinical and health services research. Thus, the evidence base for best practices of care for this population is lacking, which contributes to poor outcomes of care.

Continuity of care (COC) is an important process of care that prior studies have shown is associated with greater patient satisfaction, fewer emergency department (ED) visits and hospitalizations, a reduced risk of mortality, and lower costs of care in older adults. Studies specifically examining patients with MCCs have also demonstrated associations between higher

COC and fewer duplicated medications, fewer ED visits and hospitalizations, and a lower risk of death. Thus, COC is a recommended component of high quality care for patients with MCCs.

There are, however, a number of limitations to the current COC literature for older adults with MCCs. Although patients with MCCs would seem to be particularly vulnerable to care fragmentation, the association between morbidity burden and COC has not been explored. Also missing from the literature are studies exploring the relationships between COC and patient-reported measures of health status. Another shortcoming is the limited exploration of provider type in COC studies. Finally, differences in benefits conferred by continuity with an individual provider as compared with a medical practice are unclear. In this dissertation, I aim to fill the gaps in the COC literature by testing: 1) whether there is an association between morbidity burden and COC at the provider and practice-level among older adults who primarily saw a PCP and older adults who primarily saw a specialist for their medical care; 2) whether there is an association between provider and practice-level COC and functional status in a population of older adults with MCCs, and whether any observed associations were moderated by the type of provider the patient primarily saw for their health care visits; and 3) whether there is an association between provider and practice-level COC and health care expenditures in a population of older adults with MCCs, and whether any observed associations were moderated by the type of provider the patient primarily saw for their health care visits.

In the first study of this dissertation, I found that multimorbidity is an independent risk factor for lower COC. The magnitude of the association was such that people with high levels of morbidity burden would be expected to experience a decrease in continuity that was clinically meaningful, and could impact their clinical outcomes. In the second study, I found that neither provider nor practice-level continuity was significantly associated with functional status decline.

However, in subgroup analyses, I observed that specialty care continuity was significantly associated with a lower odds of functional status decline among patients seeing primarily a specialty care provider. Finally, in the third study, I found a significant association between higher continuity and lower expenditures that was irrespective of provider type and provider or practice levels. Results also suggested the lower costs may have arisen from lower rates of emergency department visits and hospitalizations among those with higher COC.

Our findings lend further support for the value of COC, a process of care that should be encouraged, particularly among high morbidity patients who are at risk of greater care fragmentation. They also provide insight into the possible effects of delivery system reform efforts that emphasize COC. Our results suggest that COC may provide benefits in terms of costs and utilization, though not necessarily patient-reported health outcomes. They also suggest that emphases on different levels of continuity might not produce appreciable differences in terms of lowered costs, but differences may arise for patient-reported health outcomes. Finally, they indicate the importance of provider type considerations when thinking about care continuity.

TABLE OF CONTENTS

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Chapter 1. INTRODUCTION

1.1 BACKGROUND

Nearly three out of four people over 65 years of age in the United States (U.S.), or greater than 35 million older adults, have two or more chronic conditions.[1] People with multiple chronic conditions (MCCs) experience greater functional impairment, sharper declines in health status, and a higher risk of mortality as compared to those without MCCs.[2,3] They also consume a disproportionate share of health care resources because they have more health care visits, an increased number of emergency department (ED) visits and hospitalizations, and a greater risk of readmission after hospital discharge.[2,4,5] Consequently, total costs of care for patients with MCCs are higher than for those without. In 2010, for instance, the 14 percent of Medicare beneficiaries with six or more chronic conditions accounted for 46 percent of total Medicare spending.[2] Many have also expressed concern that people with MCCs are vulnerable to poor quality of care as a result of their medical complexity. For example, the necessity of seeing multiple providers creates difficulties with adequate coordination of care.[3] Complex medication regimens also contribute to a higher risk of adverse drug events in patients with MCCs.[3] Considering the significant challenges that patients with MCCs pose to the health care system, multiple national organizations have identified patients with MCCs as a priority population requiring further study to improve the quality and outcomes of their care.

Continuity of care, a process of care that is valued by both patients and providers, is a defining element of primary care and a significant component of current delivery system reform efforts.[6-10] In a synthesis of the expansive literature on COC, Saultz (2003) defined continuity as a hierarchical concept consisting of three levels: informational, longitudinal, and interpersonal.[11]

At the most basic level, informational continuity consists of the ready availability of relevant information to any provider involved with the patient's care. Longitudinal continuity is defined as a regular place of care that is responsible for the coordinated delivery of services through a team of providers. The final level, interpersonal continuity, captures the ongoing relationship between the patient and a personal physician that is characterized by mutual trust and the physician's sense of responsibility for the care and well-being of the patient.[11] Notably, delivery system reform efforts that promote care continuity, such as patient-centered medical homes and accountable care organizations, differ in the emphases they place on informational and longitudinal continuity as opposed to interpersonal continuity.

Continuity of care is thought to improve health care quality and outcomes and increase efficiency of care through several mechanisms. Informational continuity increases knowledge of the patient, including knowledge of their medical history, status of current medical issues and management plans, and values and preferences regarding medical care. This increased knowledge aids in the diagnosis of new conditions and in the management of ongoing conditions, prevents medical errors, reduces the likelihood of duplication of services, and improves coordination of care.[10,12-15] Longitudinal continuity promotes access to care when needed and may benefit patients by exposing them to protocols or management plans that have been institutionalized to ensure care consistent with best practices.[11,16] The sustained relationship with a personal physician that defines interpersonal continuity increases a patient's trust in their provider. This trust, in turn, increases the likelihood that the patient will reveal information relevant to their medical care and improve patient adherence to recommended medications, self-management behaviors, and preventive care.[10,12,17-20] It is also thought that there is additional

information transferred during interactions between a patient and personal physician that is not captured within a medical record.[21]

In studies of older adults, higher COC has been associated with greater patient satisfaction, fewer emergency department (ED) visits and hospitalizations, a reduced risk of mortality, and lower costs of care.[22-27] Studies specifically examining patients with MCCs have also demonstrated associations between higher COC and fewer duplicated medications, fewer ED visits and hospitalizations, and a lower risk of death.[13,28,29] Thus, COC is a recommended component of high quality care for patients with MCCs.

There are, however, a number of limitations to the current COC literature for older adults with MCCs. Although patients with MCCs would seem to be particularly vulnerable to care fragmentation, the association between morbidity burden and COC has not been explored. Also missing from the literature are studies exploring the relationships between COC and patient-reported measures of health status.

Another shortcoming is the limited exploration of provider type in COC studies. Specialists play a significant role in the diagnosis and ongoing management of chronic conditions. For a substantial number of patients, specialists will even function as a primary care provider (PCP).[30,31] Yet, studies of COC have either ignored provider type within their continuity calculations or have focused exclusively on relationships with PCPs.

Finally, differences in benefits conferred by continuity with an individual provider as compared with a medical practice are unclear. Practice-level continuity encompasses the first two levels within the hierarchical definition of continuity, ensuring that information pertinent to the care of the patient is available to all of the patient's providers and ensuring that a patient has a familiar place to go that is responsible for the coordinated delivery of their care. Provider-level

continuity encompasses all three levels of continuity, adding the relationship with a trusted personal provider. Whether provider-level continuity provides superior benefits to that of practice-level continuity has not been established.

1.2 OBJECTIVES

The objective of this dissertation is to undertake several studies that address the limitations of the COC literature, with a focus on patients with MCCs. Conduct of these studies should generate evidence to aid in the development of clinical care practices to improve outcomes for people with MCCs and to provide guidance for policy decisions that relate to care continuity.

The specific aims of this dissertation are:

Aim 1: To examine the relationships between morbidity burden and COC at the provider and practice-level among older adults who primarily saw a PCP and patients who primarily saw a specialist for their medical care.

Aim 2: To examine the association between provider and practice-level COC and functional status in a population of older adults with MCCs. Also, to examine whether any observed associations were moderated by the type of provider, PCP or specialist, the patient primarily saw for their health care visits.

Aim 3: To examine the association between provider and practice-level COC and health care expenditures in a population of older adults with MCCs. Also, to examine whether any observed associations were moderated by the type of provider, PCP or specialist, the patient primarily saw for their health care visits.

Aims 1-3 will be performed with survey data from the Health and Retirement Study (HRS) and linked Medicare claims data. The HRS is a longitudinal study of aging that gathers

information on the physical and mental health, health services utilization, and financial resources of older Americans. The HRS interviews a sample of 20,000 adults over the age of 50 every 2 years, providing data that is nationally representative when sampling weights are used. For each analysis, we linked HRS survey responses to Medicare part A and B claims for the subset of HRS participants who provided their Medicare number and had fee-for-service (FFS) coverage. Chapters 2-4 will address Aims 1-3, respectively.

1.3 CONCEPTUAL MODEL

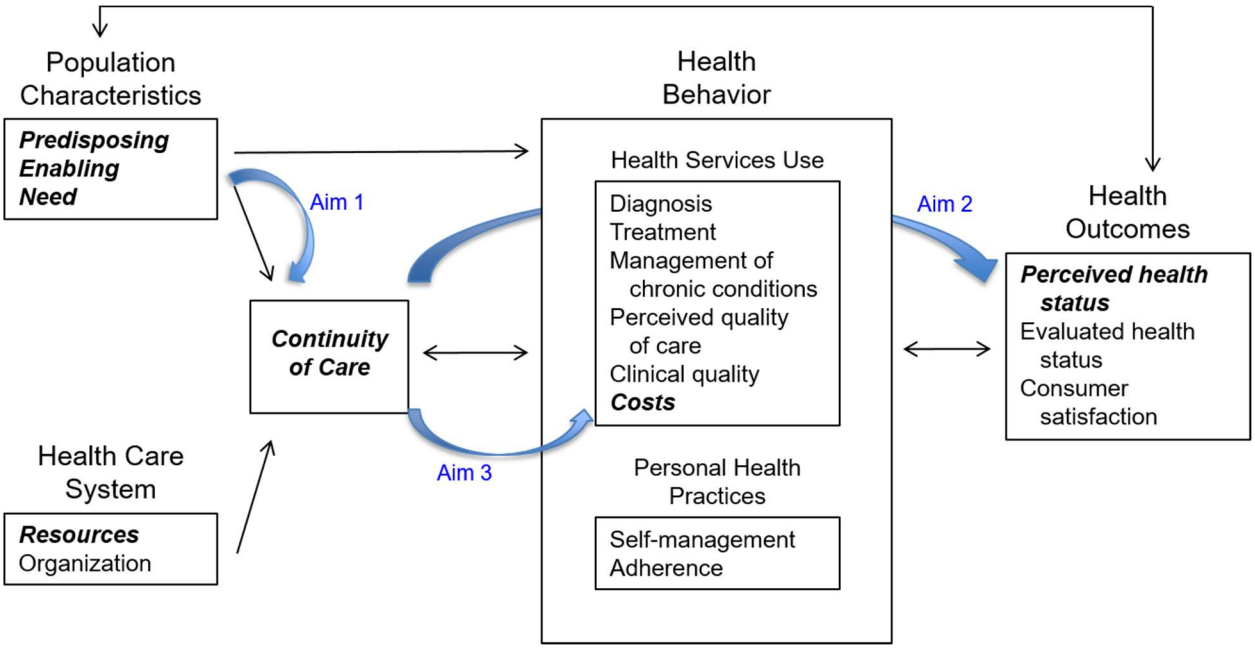

Figure 1. Conceptual model

Figure 1 illustrates the conceptual model guiding the proposed research. The model is based on Andersen's Behavioral Model of Health Services Use, but adapted to incorporate the construct of COC.[32] At the center of the model lies COC, which is influenced by characteristics

of the patient and the health care system. Patient characteristics include predisposing (e.g. age, gender, race, education, health beliefs), enabling (e.g. income, health insurance), and need (e.g. self-assessed health status, provider-assessed health status) factors, while health care system characteristics refer to the availability of medical resources and the way in which the care delivery system is organized. Consistent with this model are results from studies demonstrating associations between patient characteristics such as age, health status, and education and COC.[33-35] Similarly, associations between COC and health plan type, size of medical practice that serves as usual source of care, and availability of weekend hours at the usual source of care have also been shown.[34,36,37]

The model then illustrates the influence of COC on health behaviors, including both the health services received by patients and the personal health practices of patients. Notably, these relationships are thought to be bi-directional with health behaviors also influencing COC. Health services in the model encompass the processes of diagnosis, treatment of illness, and ongoing management of chronic conditions. Perceived quality of care, clinical quality of care, and costs of care are also included in health services as they are a function of the processes of care received. Perceived quality refers to the patient's perspective on the quality of the care they received, while clinical quality is measured using objective clinical indicators. Consistent with this portion of the model are studies that have shown associations between COC and the recognition of disease, medications prescribed for treatment, recommended processes of care for diabetics, patient-provider communication, and health care costs.[13,22,23,38-45] Personal health practices in this model include self-management behaviors and adherence to treatment or preventive service recommendations given by providers. This part of the model is supported by

prior studies demonstrating associations between COC and dietary changes, substance use, adherence to diabetes medications, and receipt of preventive services.[15,17,18,46-48]

The final portion of this model is comprised of health outcomes, including perceived and evaluated health status and consumer satisfaction. Perceived health status refers to a patient's own perspective on the state of their health. In contrast, evaluated health status pertains to the provider's judgment regarding a patient's physical and mental well-being. A number of studies have demonstrated findings congruent with this part of the model, including associations between COC and health outcomes such as glucose control and mortality, and between COC and patient satisfaction.[26,27,48-52]

In this model, health outcomes influence subsequent population characteristics and health behaviors. Consequently, COC has both a direct effect on health behaviors as well as a downstream effect. For example, a number of studies have found associations between COC and fewer ED visits and hospitalizations.[15,21,22,24,52-57] Knowledge of the patient's medical history may influence the provider's decision to hospitalize the patient versus closely monitor the patient at home or, the trusting relationship between provider and patient may alter the patient's decision to seek treatment at an ED during an illness. In these ways, COC directly changes the use of health services. However, continuity also influences perceived and evaluated health statuses. This, in turn, alters the patient's subsequent need for and utilization of ED and hospital services.

Constructs that will be measured and included in our proposed studies are bolded in the figure. Aim 1 will address the first portion of the conceptual model, evaluating the relationship between a population need characteristic, burden of chronic conditions, and COC. Aim 2 examines the association between COC and functional status, a measure of perceived health status. By evaluating the relationship between COC and health care costs, Aim 3 addresses the

model in its entirety, because costs will capture both the direct and downstream effects of COC on health services use.

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Chapter 2. MORBIDITY BURDEN AND CONTINUITY OF CARE IN OLDER ADULTS

2.1 ABSTRACT

Objectives

Continuity of care (COC) is a recommended component of high quality care for patients with multiple chronic conditions, yet little is known about the relationship between morbidity burden and COC. This study tested associations between morbidity burden and COC among subjects who primarily saw a primary care provider (PCP) and subjects who primarily saw a specialist for their medical care.

Methods

The study was a retrospective, cohort study of older adults using data from the 2008 Health and Retirement Study linked with 2007-2009 Medicare claims data.

Results

Subjects who primarily saw a PCP had higher provider and practice-level COC than did subjects who primarily saw a specialist. Irrespective of predominant provider type, increasing morbidity was significantly associated with lower provider-level COC, calculated using all visits or only specialty care visits, and with lower practice-level COC. Morbidity burden was not associated with provider-level continuity for primary care visits among subjects with a primary care predominant provider. However, among subjects with a specialty care predominant provider, those with the lowest and highest levels of morbidity had significantly lower primary care continuity.

Discussion

Increasing morbidity burden places patients at risk of reduced COC, particularly for patients with a specialty care predominant provider.

2.2 BACKGROUND

Nearly 70 percent of Medicare beneficiaries have two or more chronic conditions and more than one-third suffer from four or more conditions (Centers for Medicare and Medicaid Services, 2012). People with multiple chronic conditions (MCCs) pose a significant challenge to the health care system because they experience greater functional impairment, sharper declines in health status, and a higher risk of mortality as compared to those without MCCs (Centers for Medicare and Medicaid Services, 2012; Vogeli et al., 2007). They also consume a disproportionate share of health care resources because they have more frequent health care visits and are at greater risk for emergency department (ED) visits and hospitalizations (Pham, Schrag, O'Malley, Wu, & Bach, 2007; Starfield, Lemke, Herbert, Pavlovich, & Anderson, 2005; Wolff, Starfield, & Anderson, 2002).

Continuity of care (COC) is a recommended component of high quality care for patients with MCCs. These patients, in particular, benefit from an ongoing relationship with a trusted provider familiar with the complexities of their health status and values and preferences regarding medical care. In studies of older adults, higher COC has been associated with greater patient satisfaction, fewer emergency department (ED) visits and hospitalizations, a reduced risk of mortality, and lower costs of care (Chu, Chen, & Cheng, 2012; Hussey et al., 2014; Nyweide et al., 2013; Romaire, Haber, Wensky, & McCall, 2014; Saultz & Albedaiwi, 2004; Wolinsky et al., 2010). Studies specifically examining patients with MCCs have also demonstrated associations between higher COC and fewer duplicated medications, fewer ED visits and hospitalizations, and a lower risk of death (Bayliss et al., 2015; Cheng & Chen, 2014; Weir, McAlister, Majumdar, & Eurich, 2016). In the hopes of improving outcomes of care and

reducing costs, particularly for chronically ill patients, recent health care delivery reform efforts have placed a renewed emphasis on care continuity.

Due to their medical complexity, patients with MCCs would seem to be particularly vulnerable to care fragmentation, but the relationship between morbidity burden and COC has not been studied. Patients with MCCs often require the expertise of multiple providers to address their complex health care needs, placing them at risk of experiencing lower continuity. However, studies suggest that patients in poor health and those with chronic conditions place more value on COC than do healthier patients without chronic conditions (Cheraghi-Sohi et al., 2008; Nutting, Goodwin, Flocke, Zyzanski, & Stange, 2003; Pandhi & Saultz, 2006; Schers et al., 2002). Consequently, patients with chronic conditions will proactively seek out care from their usual providers and are willing to travel further and wait longer for appointments to do so (Bayliss, Edwards, Steiner, & Main, 2008; Cowie, Morgan, White, & Gulliford, 2009; Rubin, Bate, George, Shackley, & Hall, 2006). It is possible, then, that patients with MCCs may experience levels of continuity comparable to those without MCCs.

Studies of Medicare beneficiary care patterns indicate that a majority of beneficiaries will receive care from both primary care providers (PCPs) and specialists, but some will receive care from only one type of provider or the other (Pham et al., 2007; Rosenblatt, Hart, Baldwin, Chan, & Schneeweiss, 1998). A sizable proportion of beneficiaries will have a predominant provider in specialty care (Pham et al., 2007; Rosenblatt et al., 1998). For these beneficiaries, specialists may act in the role of a PCP, providing services outside the scope of their specialty to address the varied health care needs of their patient (Rosenblatt et al., 1998). Primary care providers and specialists differ, however, in the scope of care provided, care coordination efforts, and referral practices in ways that are likely to influence COC (A. H. Chen & Rittenhouse, 2012; Rosenblatt

et al., 1998). Thus, it is also necessary to clarify the separate associations between morbidity burden and continuity with PCPs and specialists, while accounting for the type of provider that serves as the predominant provider.

In this study, we used data from a large, nationally-representative survey, linked with Medicare claims data, to examine the relationships between morbidity burden and COC at the provider and practice-level among patients who primarily saw a PCP and patients who primarily saw a specialist for their medical care. We hypothesized that, among both groups of patients, COC with all providers and practices would decrease with increasing morbidity burden. Furthermore, continuity with specialty care providers would decrease with increasing morbidity burden, but continuity with PCPs was hypothesized to stay the same or increase.

2.3 METHODS

Study design, data and study population

We conducted a retrospective, cohort study of older adults using data from the Health and Retirement Study (HRS) linked with Medicare Part A and B claims data. The HRS is a longitudinal study of aging that provides details on the physical and mental health, retirement plans, economic circumstances and social support systems of older Americans. Sponsored by the National Institute on Aging and conducted by the University of Michigan, the HRS interviews a nationally representative sample of 20,000 adults over the age of 50 every two years. For our analysis, we linked HRS survey responses to Medicare claims for the subjects who provided their Medicare number during the HRS interview (more than 80% of Medicare beneficiaries). Study procedures were approved by the Institutional Review Board at the University of Washington, the HRS Restricted Data Applications Processing Center, and the Centers for Medicare and Medicaid Services Privacy Board.

Figure 1 provides a detailed study population flow chart. The study population included all community-dwelling adults, age 65 or older as of January 1, 2007, who participated in the HRS in 2008 and who were continuously enrolled in a Medicare FFS plan from January 1, 2007 through December 31, 2009. We defined community-dwelling as a subject having no single stay in an inpatient facility, either skilled nursing facility (SNF) or hospital, of greater than 29 days and having an annual total of days in an inpatient facility of less than 60 days during the study period (n=343 excluded). Because a stable and meaningful measurement of continuity cannot be calculated for those with fewer than three visits in one year, we excluded subjects with less than three outpatient visits during the year in which COC was calculated (n=755 excluded) (Cheng & Chen, 2014; Gill & Mainous, 1998). The final study population included 4,369 subjects.

We used Medicare claims data from 2007 through 2008 to determine each subject's morbidity burden, while claims data from 2009 were used to calculate COC. Survey responses from the 2008 interview wave provided additional covariates for the analyses.

Dependent variable: COC – Continuity of care index and Usual provider continuity index

We selected the Continuity of Care Index (COCI) by Bice and Boxerman (1977) as the primary measure of COC. This measure quantified the extent to which visits were dispersed across providers, identified using the National Provider Identifier (NPI), or practices, identified using the taxpayer identification number in the carrier file and the organization-level NPI in the institutional outpatient file. It was calculated using the following formulas:

(1) $$\text{Provider-level continuity}_{COCI} = \frac{\sum_{j=1}^{s} n_j^2 - N}{N(N-1)}$$

where N was the total number of provider visits during the study period, n_j was the number of visits to provider j, and s was the total number of providers seen during the study period; and

(2) $$\text{Practice-level continuity}_{COCI} = \frac{\sum_{i=1}^{q} n_i^2 - N}{N(N-1)}$$

where N was the total number of provider visits during the study period, n_i was the number of visits to practice i, and q was the total number of practices visited during the study period. The COCI ranges from zero to one, with higher values indicating higher COC. We chose this measure because it captures continuity across multiple providers and practices, is best for comparing populations that may differ in levels of health care utilization, and is used frequently in the published literature allowing for a comparison of results with prior studies (Bice & Boxerman, 1977; Jee & Cabana, 2006; Saultz, 2003; Smedby, Eklund, Eriksson, & Smedby, 1986).

We conducted sensitivity analyses using the Usual Provider Continuity (UPC) Index, another frequently used measure that captured the proportion of all visits that were made to the subject's predominant provider (described in detail below) or practice in a given period of time (Breslau & Reeb, 1975). The UPC was calculated according to the following formulas:

(3) $$\text{Provider-level continuity}_{UPC} = n/N$$

where N was the total number of provider visits during the study period and n was the number of visits to the predominant provider during the same period; and

(4) $$\text{Practice-level continuity}_{UPC} = q/N$$

where N was the total number of provider visits during the study period and q was the number of visits to the practice most frequently attended during the same period. The UPC also varies from zero to one, with increasing values signifying higher continuity.

We defined a provider visit as a face-to-face evaluation and management visit in the outpatient setting. The location of a service was determined through a combination of the

Current Procedural Terminology (CPT) code and the Medicare place of service indicator in the carrier file and through the revenue center code for the outpatient file. We included visits that occurred in an office, hospital outpatient department, home, or assisted living facility; nursing home, custodial care, and ED visits were excluded. The CPT and revenue center codes used to identify face-to-face evaluation and management visits are listed in the Appendix. The codes include those in the CPT evaluation and management code category as well as selected codes from the Berenson-Eggers Type of Service (BETOS) evaluation and management code category. This latter group of codes were included because they represented general visits to mental health providers and ophthalmologists, providers that may play important roles in the delivery of care to high-morbidity patients. We linked the National Provider Identifier (NPI) for each provider to the National Plan and Provider Enumeration System (NPPES) downloadable file to determine each provider's primary specialty. Eligible providers included all physicians as well as the following non-physician providers: nurse practitioner, physician's assistant, clinical nurse specialist, mental health provider, chiropractor, optometrist, and podiatrist. Visits to pathologists, dentists, registered nurses, and medical technicians were excluded. The list of taxonomy codes that were classified as primary care and specialists are presented in the Appendix.

We defined the predominant provider as the provider that saw the subject for the plurality of their outpatient evaluation and management visits (Pham et al., 2007; Romaire et al., 2014). If ties occurred between a PCP and a specialist, the PCP was selected. However, if ties occurred between PCPs or between specialists, we selected the provider that claimed the greatest total charges for the subject (Pham et al., 2007; Romaire et al., 2014).

Independent variable: Morbidity burden – Number of chronic conditions and Charlson index - primary care costs adaptation

We operationalized morbidity burden in two ways: the number of chronic conditions a subject had and the Charlson comorbidity index. The Appendix provides a list of the 20 common chronic conditions considered for our condition count. We used the Medicare chronic condition warehouse indicators to determine the presence or absence of each condition for each subject (Centers for Medicare and Medicaid Services).

For the Charlson index, we employed a recent adaptation that was developed to predict total annual health care costs in a cohort of patients attending a primary care practice (Charlson et al., 2008; Charlson, Pompei, Ales, & MacKenzie, 1987). The primary care costs adaptation adds four conditions to the originally weighted index, including hypertension, depression, use of warfarin, and skin ulcers/cellulitis, resulting in a comorbidity score with a possible range of 0 to 38. The International Classification of Diseases – Ninth Revision (ICD-9) diagnosis codes and CPT codes used to identify each condition are provided in the Appendix (Quan et al., 2005).

Other covariates

We obtained sociodemographic characteristics for study subjects from the HRS survey. Additionally, geographic identifiers from the survey were linked to data from the Health Resources and Services Administration Data Warehouse, and we measured the number and rates of clinically active physicians at the primary care service area level for each study subject.

Statistical analysis

We characterized our study population using descriptive statistics. We then calculated means and quartiles to describe health care utilization and COC across varying levels of morbidity burden. As an initial exploration of an association between morbidity burden and

COC, we used unadjusted linear regression to assess a linear trend in mean COC across increasing categories of morbidity burden. Tobit regression with robust standard errors was used to test for an independent association between morbidity burden and COC. We selected the Tobit model because the values of the dependent variable, COC, were constrained by a minimum and maximum value. Under these circumstances, the ordinary least squares regression assumption of a normally distributed error term is sometimes violated, resulting in biased estimates (Long, 1997). We adjusted all regression models for subject sociodemographic and geographic characteristics. Analyses utilized the 2008 HRS sampling weights. All analyses were conducted in Stata 12 (StataCorp LP, College Station, TX).

2.4 RESULTS

Characteristics of the study subjects by predominant provider type

Characteristics of the study subjects are presented in Table 1. Just over two-thirds of subjects (67%) had a predominant provider in primary care and nearly one-third of subjects in specialty care (33%). Among this latter group, ophthalmology (17%) was the most common specialty reported, followed by cardiology (16%), surgery (9%), and hematology/oncology (8%). The mean age in both groups was 75 years. However, subjects with a predominant provider in specialty care were more likely to be male (45% vs 38%), a veteran (30% vs 24%), and have household assets greater than $500,000 (37% vs 30%) than subjects with a primary care predominant provider. Both groups had similar health characteristics with an average of five chronic conditions and a mean Charlson score of four. In terms of geographic characteristics, subjects with a specialist predominant provider were more likely to live in a metro area than subjects with a primary care predominant provider (75% vs 68%). The specialty care group also

lived in primary care service areas with a larger number of clinically active providers, both primary care and specialty care.

Health care utilization by predominant provider type and levels of morbidity burden

Health care utilization is described by predominant provider type and levels of morbidity burden in Table 2. Subjects with a predominant provider in specialty care had more provider visits and saw a greater number of providers and practices during the year than subjects with a predominant provider in primary care. However, similar patterns of health care utilization were exhibited by subjects in both provider type groups as levels of morbidity burden increased. Visits to both PCPs and specialists increased as the number of chronic conditions rose, though the increase was more marked in visits to specialists. There was also an increase in the median number of specialists and practices visited in those with six or more chronic conditions, however the median number of PCPs visited was one for all levels of morbidity burden.

Continuity of care by predominant provider type and levels of morbidity burden

Continuity of care by predominant provider type and levels of morbidity burden are shown in Table 3. When all visits were used in the calculations, subjects with a primary care predominant provider had higher provider and practice-level COC than did subjects with a specialty care predominant provider. Subjects with a primary care predominant provider also had higher continuity when only primary care visits were considered, while subjects with a predominant provider in specialty care had higher continuity in their specialty care visits. Among subjects with a primary care predominant provider, provider-level COC, calculated using all visits or specialty care visits alone, declined significantly as the number of chronic conditions increased. Practice-level COC also showed a significant decrease with increasing morbidity. Continuity calculated using only primary care visits was the same across all levels of morbidity

burden, however. Similarly, subjects with a specialty care predominant provider demonstrated significant declines in provider-level COC, calculated with all visits or specialty care visits, and practice-level COC with an increasing number of chronic conditions. As with subjects with a primary care predominant provider, continuity in the primary care visits was comparable across levels of morbidity burden for those in the specialty care predominant provider group.

Multivariate regression associations between morbidity burden and continuity of care

Table 4 provides the adjusted associations between number of chronic conditions and COC. To help with interpretation, the table also provides the expected values of COC, given the model results, at the mean number of chronic conditions for the study population and one standard deviation above and below. For subjects with a predominant provider in primary care, number of chronic conditions showed a significant inverse association with COC calculated using all visits; the expected COCI value is 0.33, 0.31 and 0.29 for subjects with 2.5, 4.9 and 7.3 chronic conditions, respectively. Each additional chronic condition was also associated with a significant decrease in provider-level continuity calculated with specialty visits and practice-level COC. Number of chronic conditions was not, however, independently associated with continuity in the primary care visits (p-value > 0.05 for both provider-level COCI and UPC). Evaluation of a non-linear association between number of chronic conditions and primary care continuity indicated no strong evidence of a non-linear association either.

A similar pattern of associations was demonstrated among subjects with a predominant provider in specialty care. Number of chronic conditions showed a significant inverse association with provider-level continuity calculated using all visits or specialty care visits and practice-level continuity (p-value < 0.001 for all associations). There was no significant linear association between number of chronic conditions and continuity calculated with primary care visits.

However, further evaluation indicated a significant non-linear association between number of chronic conditions and primary care continuity such that continuity initially increases with an increasing number of chronic conditions, but decreases again at higher levels of morbidity. Figure 2 shows the expected primary care COCI and UPC values for varying numbers of chronic conditions. Sensitivity analyses indicated that all study results were comparable when measuring morbidity burden with the Charlson index instead of the number of chronic conditions (results not shown).

2.5 DISCUSSION

Our study findings demonstrated a significant association between increasing morbidity burden and lower provider-level COC calculated using all visits or only specialty care visits. This finding applied to all subjects, regardless of the type of provider, PCP or specialist, which served as the predominant provider. A similar inverse association was also found for practice-level COC for all subjects. Morbidity burden was not, however, independently associated with provider-level primary care continuity among subjects with a primary care predominant provider. Among subjects with a specialty care predominant provider, however, morbidity burden was significantly associated with primary care continuity such that those with the lowest and highest levels of morbidity had lower continuity. These results are at odds with the only prior study of morbidity burden and COC, conducted in England. Salisbury, Johnson, Purdy, Valderas, and Montgomery (2011) found a small, but significant inverse association between morbidity burden and provider-level continuity for primary care visits. The study did not examine provider-level continuity for all visits or specialty care visits nor practice-level COC.

While many of the associations we found were statistically significant, an important question is whether the size of the associations are clinically meaningful. Several prior studies of

the effect of COC on clinical outcomes and costs of care have demonstrated significant reductions in hospitalizations, ED visits, chronic condition complications, overused medical procedures, and costs with even a 0.1-unit increase in COC (Bayliss et al., 2015; Hussey et al., 2014; Romano, Segal, & Pollack, 2015). Our findings were generally small, although somewhat larger for subjects with specialty care predominant providers. Overall, subjects with high levels of morbidity burden would be expected to experience a decrease in COC that was clinically meaningful.

The different associations we found between morbidity burden and continuity in the primary care visits and specialty care visits are notable. Almost all prior studies on the benefits of COC have combined visits with all types of providers or have examined solely primary care visits. A recent study by Bayliss et al. (2015), however, investigated the separate associations of primary care and specialty care continuity with outcomes of care and found independent associations with each. Our findings also showed important differences by type of predominant provider. In particular, subjects with a primary care predominant provider had higher COC and, among these subjects, morbidity burden exhibited no association with primary care continuity. Given the high levels of specialty care use within patients with multimorbidity and the important role specialists frequently play in the management of chronic conditions, it is necessary for future studies to consider the different types of providers with whom patients establish ongoing relationships.

Also notable is the similarity of the associations between morbidity burden and provider and practice-level continuity. Continuity of care has been defined as a hierarchical concept consisting of three levels: informational, longitudinal, and interpersonal (Saultz, 2003). At the most basic level, informational continuity consists of the ready availability of relevant

information to any provider involved with the patient's care. Longitudinal continuity is defined as a regular place of care that is responsible for the coordinated delivery of services through a team of providers. The final level, interpersonal continuity, captures the ongoing relationship between the patient and a personal provider. Some prior studies on COC have evaluated continuity at both the provider and practice level to determine whether informational and longitudinal continuity provided equivalent benefits to interpersonal continuity, with conflicting findings (Allen, Wieland, Griffin, & Gozalo, 2009; Chan, You, Huang, & Ting, 2012; Mainous & Gill, 1998; Mainous, Koopman, Gill, Baker, & Pearson, 2004; O'Malley, Mandelblatt, Gold, Cagney, & Kerner, 1997). Most studies found that continuity with a provider conferred superior benefits to that of continuity with a place of care alone. Some, however, found that high practice-level COC was as equally beneficial as high provider-level continuity. New models of health care delivery, including patient-centered medical homes and accountable care organizations, place different emphases on informational or longitudinal continuity as opposed to interpersonal continuity. Thus, studies incorporating both provider and practice-level continuity are informative to current policy discussions.

While COC is an important element of high quality care, it must be recognized that perfect continuity is neither achievable nor even appropriate for many patients, particularly those with MCCs. Additional providers can offer expertise to supplement the knowledge of a patient's predominant provider and can alter treatment plans that have stagnated as a result of clinical inertia or competing demands (L. M. Chen & Ayanian, 2014; Fiscella et al., 2010; Parchman, Pugh, Romero, & Bowers, 2007). However, there are also factors that contribute to unnecessary reductions in care continuity, including increased medical sub-specialization and the ability of patients with Medicare FFS plans to visit any covered provider without a referral (A. H. Chen &

Rittenhouse, 2012; L. M. Chen & Ayanian, 2014). It is hoped that new models of health care delivery can find an optimal balance between sufficient access to needed providers and unnecessary care fragmentation.

This study has several limitations. First, this was an observational study and our results cannot be interpreted as a causal relationship between morbidity burden and COC. Second, our study population was limited to Medicare beneficiaries with a FFS plan. Consequently, results may not be generalizable to younger patients or those with managed care insurance plans. Third, chronic conditions were identified using ICD-9 codes obtained from Medicare claims data. Since these codes are generated for the purposes of billing and not as a resource for clinical care or research, missing diagnoses are possible. A final limitation of our study is that only health care visits with an evaluation and management code were included in the calculations of COC. While this is consistent with methods from prior studies on COC, it should be acknowledged that patients may have many other encounters with the delivery system, including via telephone or email, which also may have a meaningful effect on care continuity.

Due to increasing life expectancy and the aging of the population, the number of older adults living in the U.S. with MCCs is growing rapidly. Our study results indicate that increasing morbidity burden places patients with Medicare FFS coverage at risk of reduced COC. This risk is more pronounced for patients with a predominant provider in specialty care. Since COC is associated with superior clinical outcomes, higher patient satisfaction, and lower costs of care, efforts are needed to support continuity in multimorbid older patients.

2.6 FIGURES

Figure 1. Study population flow chart

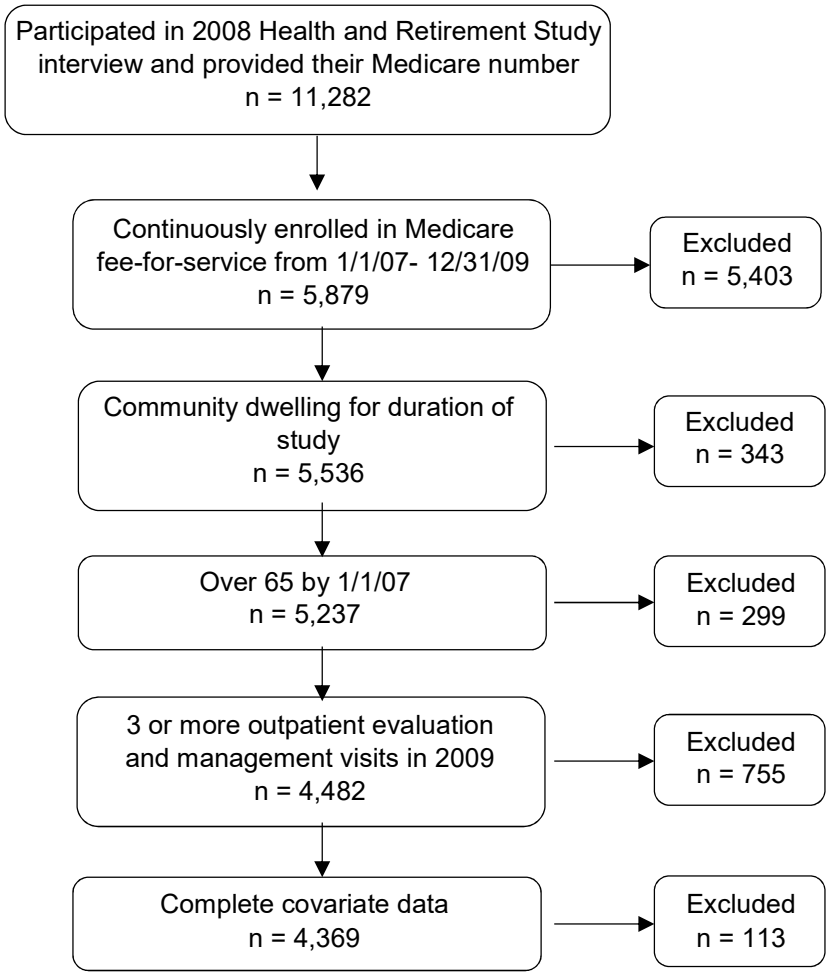
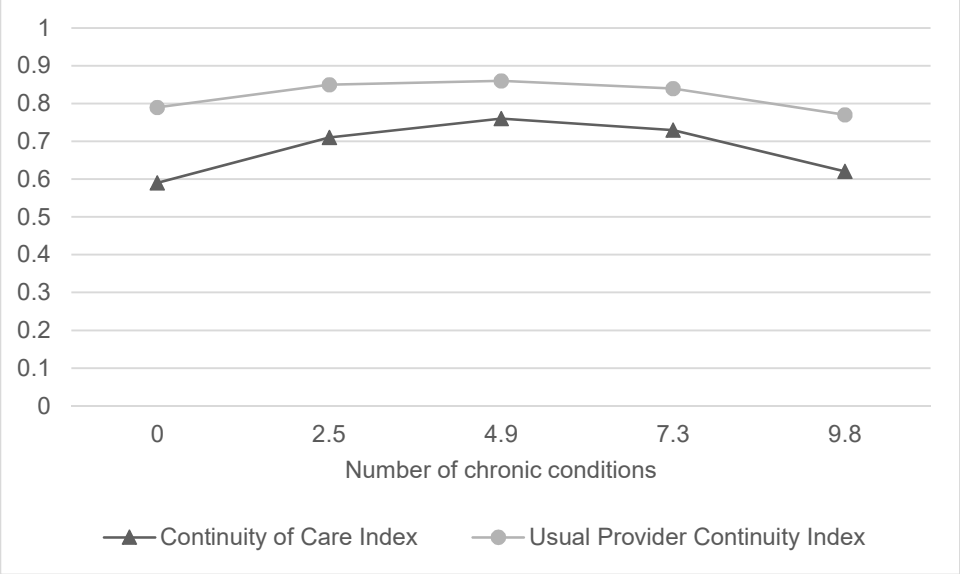


Figure 2. For subjects with a specialist predominant provider, the expected primary care continuity values at the mean number of chronic conditions for the study population and one and two standard deviations above and below the mean



2.7 TABLES

Table 1. Sociodemographic, health and geographic characteristics of the study subjects

	All subjects (n = 4,369)	Predominant provider type	
		Primary care (n = 2,946)	Specialty care (n = 1,423)
Sociodemographic characteristics			
Age in years, mean (sd)	75.2 (6.9)	75.3 (6.9)	75.0 (6.8)
Male, %	40.1	37.9	44.6
Race, %			
Non-hispanic white	83.3	82.7	84.4
Non-hispanic black	10.1	10.2	9.8
Hispanic	5.3	5.7	4.6
Non-hispanic other	1.4	1.5	1.2
Foreign born, %	7.5	7.7	6.9
Marital status, %			
Married	57.2	55.7	60.2
Separated/divorced	9.2	9.4	8.7
Widowed	31.1	32.3	28.5
Never married	2.5	2.5	2.5
Educational attainment, %			
No degree	21.1	22.9	17.3
High school graduate or GED	54.6	54.7	54.5
Associate's degree	3.3	3.4	2.9
Bachelor's degree	12.1	11.3	13.8
Graduate degree	9.0	7.7	11.6
Labor force status, %			
In labor force	16.6	16.6	16.7
Retired	73.9	73.1	75.8
Disabled	1.2	1.4	0.7
Not in labor force	8.3	9.0	6.8
Veteran, %	26.2	24.3	30.2
Household income below poverty threshold, %	7.7	8.3	6.6
Household assets in dollars, %			
< 49,999	19.9	21.0	17.6
50,000-174,999	20.2	21.9	16.7
175,000-499,999	27.9	27.6	28.6
500,000 +	32.0	29.5	37.1
Health characteristics			
Number of chronic conditions, mean (sd)	4.9 (2.4)	4.9 (2.4)	5.0 (2.5)
Charlson score, mean (sd)	3.9 (2.9)	3.8 (2.8)	4.2 (3.2)
Geographic characteristics			

Beale rural-urban continuum, %			
Metro area	70.4	68.1	75.2
Urban area	28.5	30.8	23.9
Rural area	1.1	1.2	0.9
PCSA with any population in primary Care HPSA, %	69.5	70.4	67.6
PCSA with any population in MUA, %	85.4	86.3	83.7
No. of clinically active PCPs in the PCSA, mean (sd)	132.1 (177.5)	125.5 (171.9)	145.7 (187.9)
No. of clinically active specialists in the PCSA, mean (sd)	259.2 (408.7)	242.5 (376.2)	293.9 (466.9)

GED – General education development
PCSA – Primary care service area
HPSA – Health professional shortage area
MUA – Medically underserved area
Predominant provider - The provider that saw the subject for the plurality of their outpatient evaluation and management visits

Table 2. Health care utilization by predominant provider type and levels of morbidity burden

	Primary care predominant provider						**Specialty care predominant provider**					
	All subjects	Number of chronic conditions					All subjects	Number of chronic conditions				
median	n= 2946	0-1 n= 189	2-3 n= 713	4-5 n= 955	6-8 n= 854	9+ n= 235	n= 1423	0-1 n= 104	2-3 n= 317	4-5 n= 461	6-8 n= 412	9+ n= 129
No. of visits	9	6	7	9	12	16	11	6	8	10	14	21
No. of visits to a PCP	5	4	4	5	6	7	2	1	1	2	2	3
No. of visits to a specialist	4	2	3	3	5	8	8	5	6	8	11	16
No. of providers	4	3	3	4	5	6	5	4	4	5	6	7
No. of PCPs	1	1	1	1	1	1	1	1	1	1	1	1
No. of specialists	2	2	2	2	3	4	4	3	3	3	4	6
No. of practices	3	3	3	3	4	5	4	3	3	4	5	5

IQR – Interquartile range
PCP – Primary care provider

Table 3. Continuity of care by predominant provider type and levels of morbidity burden

Primary care predominant provider

	All primary care subjects (n=2,946)	Number of chronic conditions					Test for trend p-value
		0-1 (n=189)	2-3 (n=713)	4-5 (n=955)	6-8 (n=854)	9+ (n=235)	
COCI, mean (sd)							
Provider-level COCI: all visits	0.32 (0.23)	0.34 (0.28)	0.33 (0.25)	0.33 (0.23)	0.30 (0.21)	0.27 (0.20)	p = 0.001
Provider-level COCI: primary care visits	0.77 (0.28)	0.74 (0.30)	0.76 (0.30)	0.78 (0.28)	0.78 (0.28)	0.78 (0.27)	p = 0.135
Provider-level COCI: specialty care visits	0.23 (0.21)	0.25 (0.23)	0.25 (0.23)	0.25 (0.22)	0.22 (0.19)	0.19 (0.14)	p = 0.002
Practice-level COCI: all visits	0.40 (0.26)	0.43 (0.30)	0.43 (0.28)	0.41 (0.26)	0.38 (0.25)	0.33 (0.22)	p < 0.001
UPC, mean (sd)							
Provider-level UPC: all visits	0.51 (0.21)	0.55 (0.22)	0.54 (0.21)	0.53 (0.21)	0.49 (0.20)	0.44 (0.20)	p < 0.001
Provider-level UPC: primary care visits	0.86 (0.18)	0.85 (0.19)	0.86 (0.19)	0.87 (0.18)	0.86 (0.18)	0.86 (0.19)	p = 0.490
Provider-level UPC: specialty care visits	0.46 (0.19)	0.50 (0.21)	0.50 (0.20)	0.48 (0.19)	0.44 (0.18)	0.39 (0.15)	p < 0.001
Practice-level UPC: all visits	0.58 (0.22)	0.62 (0.23)	0.62 (0.22)	0.59 (0.22)	0.56 (0.21)	0.50 (0.21)	p < 0.001

Specialty care predominant provider

	All specialty care subjects (n=1,423)	Number of chronic conditions					Test for trend p-value
		0-1 (n=104)	2-3 (n=317)	4-5 (n=461)	6-8 (n=412)	9+ (n=129)	
COCI, mean (sd)							
Provider-level COCI: all visits	0.25 (0.18)	0.30 (0.23)	0.27 (0.20)	0.26 (0.19)	0.23 (0.16)	0.21 (0.14)	p < 0.001
Provider-level COCI: primary care visits	0.60 (0.34)	0.49 (0.39)	0.60 (0.37)	0.61 (0.34)	0.61 (0.33)	0.58 (0.34)	p = 0.662
Provider-level COCI: specialty							

care visits	0.35 (0.24)	0.42 (0.28)	0.39 (0.26)	0.37 (0.24)	0.32 (0.23)	0.27 (0.20)	p < 0.001
Practice-level COCI: all visits	0.32 (0.23)	0.35 (0.26)	0.35 (0.24)	0.33 (0.23)	0.29 (0.20)	0.28 (0.19)	p = 0.001
UPC, mean (sd)							
Provider-level UPC: all visits	0.45 (0.18)	0.52 (0.19)	0.49 (0.18)	0.47 (0.17)	0.41 (0.17)	0.37 (0.17)	p < 0.001
Provider-level UPC: primary care visits	0.76 (0.22)	0.70 (0.25)	0.76 (0.24)	0.77 (0.22)	0.76 (0.22)	0.74 (0.22)	p = 0.464
Provider-level UPC: specialty care visits	0.55 (0.21)	0.62 (0.21)	0.59 (0.21)	0.57 (0.20)	0.51 (0.21)	0.44 (0.20)	p < 0.001
Practice-level UPC: all visits	0.51 (0.20)	0.57 (0.20)	0.55 (0.20)	0.52 (0.20)	0.47 (0.19)	0.44 (0.19)	p < 0.001

COCI – Continuity of care index

UPC – Usual provider continuity index

Note that continuity in the primary care visits and specialty care visits were only calculated among subjects with at least three visits to a primary care provider or specialty care provider. For patients with a primary care predominant provider, 2,593 were eligible for the primary care continuity calculations and 1,845 for the specialty care calculations. For patients with a specialty care predominant provider, 545 were eligible for the primary care continuity calculations and 1,385 for the specialty care calculations.

Table 4. Multivariate regression associations between morbidity burden and continuity of care

	Primary care predominant provider			
	No. of chronic conditions β (95% CI)	Expected COC at 2.5 chronic conditions (95% CI)	Expected COC at 4.9 chronic conditions (95% CI)	Expected COC at 7.3 chronic conditions (95% CI)
Provider-level COCI: all visits	-0.008 (-0.012, -0.004)***	0.33 (0.32, 0.34)	0.31 (0.30, 0.32)	0.29 (0.28, 0.30)
Provider-level COCI: primary care visits	-0.002 (-0.013, 0.009)	1.03 (0.99, 1.08)	1.03 (0.99, 1.06)	1.02 (0.98, 1.07)
Provider-level COCI: specialty care visits	-0.007 (-0.011, -0.003)**	0.24 (0.22, 0.26)	0.22 (0.21, 0.23)	0.21 (0.19, 0.22)
Practice-level COCI: all visits	-0.012 (-0.017, -0.007)***	0.43 (0.42, 0.45)	0.40 (0.39, 0.42)	0.38 (0.36, 0.39)
Provider-level UPC: all visits	-0.013 (-0.017, -0.010)***	0.54 (0.53, 0.56)	0.51 (0.51, 0.52)	0.48 (0.47, 0.49)
Provider-level UPC: primary care visits	-0.003 (-0.010, 0.004)	1.03 (1.01, 1.06)	1.03 (1.01, 1.05)	1.02 (0.99, 1.04)
Provider-level UPC: specialty care visits	-0.014 (-0.018, -0.011)***	0.50 (0.49, 0.52)	0.47 (0.46, 0.48)	0.43 (0.42, 0.45)
Practice-level UPC: all visits	-0.015 (-0.019, -0.011)***	0.63 (0.61, 0.64)	0.59 (0.58, 0.60)	0.55 (0.54, 0.57)

	Specialty care predominant provider			
	No. of chronic conditions β (95% CI)	Expected COC at 2.5 chronic conditions (95% CI)	Expected COC at 4.9 chronic conditions (95% CI)	Expected COC at 7.3 chronic conditions (95% CI)
Provider-level COCI: all visits	-0.011 (-0.015, -0.007)***	0.28 (0.26, 0.30)	0.25 (0.24, 0.26)	0.23 (0.21, 0.24)
Provider-level COCI: primary care visits	-0.009 (-0.031, 0.013)	0.74 (0.65, 0.84)	0.72 (0.66, 0.79)	0.70 (0.63, 0.77)
Provider-level COCI: specialty care visits	-0.019 (-0.025, -0.013)***	0.41 (0.38, 0.43)	0.36 (0.35, 0.38)	0.31 (0.30, 0.33)

Practice-level COCI: all visits	-0.012 (-0.018, -0.007)***	0.35 (0.33, 0.37)	0.32 (0.31, 0.34)	0.29 (0.28, 0.31)
Provider-level UPC: all visits	-0.018 (-0.022, -0.014)***	0.49 (0.48, 0.51)	0.45 (0.44, 0.46)	0.41 (0.39, 0.42)
Provider-level UPC: primary care visits	-0.009 (-0.022, 0.004)	0.86 (0.81, 0.92)	0.84 (0.80, 0.88)	0.82 (0.78, 0.86)
Provider-level UPC: specialty care visits	-0.023 (-0.028, -0.018)***	0.61 (0.59, 0.63)	0.56 (0.54, 0.57)	0.50 (0.48, 0.52)
Practice-level UPC: all visits	-0.017 (-0.022, -0.012)***	0.55 (0.53, 0.57)	0.51 (0.50, 0.52)	0.47 (0.45, 0.49)

COCI – Continuity of care index

UPC – Usual provider continuity index

* $p<0.05$, ** $p<0.01$, *** $p<0.001$

Note that the models involving continuity in the primary care visits and specialty care visits were only calculated among subjects with at least three visits to a primary care provider or specialty care provider. For patients with a primary care predominant provider, 2,593 were eligible for the primary care continuity calculations and 1,845 for the specialty care calculations. For patients with a specialty care predominant provider, 545 were eligible for the primary care continuity calculations and 1,385 for the specialty care calculations.

2.8 APPENDIX

CPT codes used to identify evaluation and management visits in the carrier file:

From the CPT evaluation and management code category:
99201, 99202, 99203, 99204, 99205, 99211, 99212, 99213, 99214, 99215, 99241, 99242, 99243, 99244, 99245, 99324, 99325, 99326, 99327, 99328, 99334, 99335, 99336, 99337, 99341, 99342, 99343, 99344, 99345, 99347, 99348, 99349, 99350, 99354, 99355, 99386, 99387, 99396, 99397, G0402, G0438, G0439, 99401, 99402, 99403, 99404, 99406, 99407, 99408, 99409, 99411, 99412, 99420, 99429

From the BETOS evaluation and management code category:
90801, 90802, 90804, 90805, 90806, 90807, 90808, 90809, 90810, 90811, 90812, 90813, 90814, 90815, 90845, 90847, 92002, 92004, 92012, 92014

Revenue center codes used to identify outpatient visits to federally qualified health centers and rural health centers in the outpatient file:
0521, 0522

Health care provider taxonomy codes classified as primary care:

- General practice: 208D00000X
- Family medicine (restricted to general family medicine, adult medicine, geriatric medicine): 207Q00000X, 207QA0505X, 207QG0300X
- Internal medicine (restricted to general internal medicine, geriatric medicine): 207R00000X, 207RG0300X
- Preventive medicine (restricted to public health and general preventive medicine): 2083P0901X
- Nurse practitioner (restricted to general NP, acute care, adult health, community health, family, gerontology, primary care, women's health): 363L00000X, 363LA2100X, 363LA2200X, 363LC1500X, 363LF0000X, 363LG0600X, 363LP2300X, 363LW0102X
- Clinical nurse specialist (restricted to general, adult health, community health, family health, gerontology, holistic, women's health, home health, acute care, chronic care): 364S00000X, 364SA2200X, 364SC1501X, 364SF0001X, 364SG0600X, 364SH1100X, 364SH0200X, 364SW0102X, 364SA2100X, 364SC2300X
- Physician assistant (restricted to general, medical): 363A00000X, 363AM0700X

Health care provider taxonomy codes classified as specialty care:

- Allergy and immunology: 207K******
- Anesthesiology: 207L******
- Colon and rectal surgery: 208C00000X
- Dermatology: 207N******
- Emergency medicine: 207P******

- Family medicine (excludes those codes listed above in primary care): 207Q******
- Hospitalist: 208M00000X
- Internal medicine (excludes those codes listed above in primary care): 207R******
- Clinical genetics: 207SG0201X
- Neurological surgery: 207T00000X
- Nuclear medicine: 207U******
- Neuromusculoskeletal medicine and OMM: 204D00000X
- Neuromusculoskeletal medicine, sports medicine: 204C00000X
- Obstetrics and gynecology: 207V******
- Ophthalmology: 207W******
- Oral and maxillofacial surgery: 204E00000X
- Orthopedic surgery: 207X******
- Otolaryngology: 207Y******
- Physical medicine and rehabilitation: 2081******
- Plastic surgery: 2082******
- Preventive medicine (excludes those codes listed above in primary care): 2083******
- Psychiatry and neurology: 2084******
- Pain medicine: 208VP*****
- Radiology: 2085******
- Surgery: 2086******
- Thoracic surgery: 208G00000X
- Transplant surgery: 204F00000X
- Urology: 2088******
- Clinical neuropsychologist: 103G******
- Counselor: 101Y******
- Psychologist: 103T******
- Social worker: 1041******
- Chiropractor: 111N******
- Optometrist: 152W******
- Clinical nurse specialist (excludes those codes listed above in primary care): 364S******
- Nurse practitioner (excludes those codes listed above in primary care): 363L******
- Physician assistant (excludes those codes listed above in primary care): 363A******
- Podiatrist: 213E******

List of chronic conditions used to count number of chronic conditions:
Acquired hypothyroidism
Alzheimer's disease and related disorders
Anemia
Asthma
Atrial fibrillation
Benign prostatic hyperplasia
Cancer (combines breast, colorectal, prostate, lung, and endometrial)
Chronic kidney disease
Chronic obstructive pulmonary disease

Congestive heart failure
Depression
Diabetes
Eye disorders (combines cataract and glaucoma)
Hip or pelvic fracture
Hyperlipidemia
Hypertension
Ishcemic heart disease (combines acute myocardial infarction and ischemic heart disease)
Osteoporosis
Rheumatoid arthritis and osteoarthritis
Stroke or transient ischemic attack

ICD-9 and CPT codes used to identify the presence of each condition in the adapted Charlson index:

- Myocardial infarction: 410.x, 412.x
- Congestive heart failure: 398.91, 402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 425.4-425.9, 428.x
- Peripheral vascular disease: 093.0, 437.3, 440.x, 441.x, 443.1-443.9, 447.1, 557.1, 557.9, V43.4
- Cerebrovascular disease: 362.34, 430.x-438.x
- Dementia: 290.x, 294.1, 331.2
- Chronic pulmonary disease: 416.8, 416.9, 490.x-505.x, 506.4, 508.1, 508.8
- Rheumatic disease: 446.5, 710.0-710.4, 714.0-714.2, 714.8, 725.x
- Peptic ulcer disease: 531.x-534.x
- Mild liver disease: 070.22, 070.23, 070.32, 070.33, 070.44, 070.54, 070.6, 070.9, 570.x, 571.x, 573.3, 573.4, 573.8, 573.9, V42.7
- Diabetes without chronic complication: 250.0-250.3, 250.8, 250.9
- Diabetes with chronic complication: 250.4-250.7
- Hemiplegia or paraplegia: 334.1, 342.x, 343.x, 344.0-344.6, 344.9
- Renal disease: 403.01, 403.11, 403.91, 404.02, 404.03, 404.12, 404.13, 404.92, 404.93, 582.x, 583.0-583.7, 585.x, 586.x, 588.0, V42.0, V45.1, V56.x
- Any malignancy, including lymphoma and leukemia, except malignant neoplasm of skin: 140.x-172.x, 174.x-195.8, 200.x-208.x, 238.6
- Moderate or severe liver disease: 456.0-456.2, 572.2-572.8
- Metastatic solid tumor: 196.x-199.x
- AIDS/HIV: 042.x-044.x
- Hypertension: 401.x, 402.x-405.x
- Depression: 296.2, 296.3, 296.5, 300.4, 309.x, 311
- Use of warfarin: 3 or more INR tests within the 1 year lookback period - INR test has CPT code 85610
- Skin ulcers/cellulitis: 707.x, 681.x, 682.x

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Chapter 3. CONTINUITY OF CARE AND FUNCTIONAL STATUS IN OLDER ADULTS WITH MULTIPLE CHRONIC CONDITIONS

3.1 ABSTRACT

Background

Little is known about the relationship between continuity of care (COC), a highly recommended process of care, and patient-reported health status.

Objectives

To examine the associations between provider and practice-level COC and functional status in a population of older adults with multiple chronic conditions (MCCs).

Research design and methods

We conducted a retrospective, cohort analysis of older adults with MCCs using data from the Health and Retirement Study (HRS) linked with Medicare claims. Functional status was measured during the HRS interview at baseline (2006) and follow-up (2008). Medicare claims (2006-2008) were used to calculate patient-level COC. Multivariate logistic regression models were used to assess the independent contribution of COC to functional status decline.

Subjects

Community-dwelling HRS participants interviewed in both 2006 and 2008, who had 2 or more chronic conditions, and were enrolled in a Medicare fee-for-service plan were studied.

Results

Overall, neither practice or provider-level COC was significantly associated with functional status decline. Amongst subjects who primarily saw a primary care provider for their visits, primary care continuity was also not associated with decline. However, amongst subjects who

primarily saw a specialty care provider, higher specialty care continuity was significantly associated with a lower odds of functional status decline such that subjects with mean-level specialty care continuity had a predicted probability of decline of 0.41, with subjects 1 standard deviation below and above the mean at 0.44 and 0.38, respectively.

Conclusions

Limiting the dispersion of patients' specialty care visits may reduce declines in functional status in Medicare populations.

3.2 BACKGROUND

More than two-thirds of Medicare beneficiaries have at least 2 chronic medical conditions; 37 percent have 4 or more.[1] People with multiple chronic conditions (MCCs) experience a heightened risk of morbidity and mortality, utilize a disproportionate share of health care resources, and are vulnerable to health care of poor quality.[2,3] In particular, their medical complexity may lead to care that is fragmented across multiple health care providers and practices. One study on Medicare care patterns found that beneficiaries with 0 to 2 chronic conditions visited a median of 3 providers across 2 practices in a single year compared with 11 providers across 7 practices for those with 7 or more conditions.[4]

This fragmentation of care is concerning because higher continuity of care (COC) is associated with fewer emergency department (ED) visits and hospitalizations, a lower risk of mortality, and lower costs of care in populations of older adults.[5-9] The few COC studies conducted in people with MCCs have indicated similar associations between higher COC and a reduced risk of ED visits, hospitalizations, and mortality.[10,11]

While the literature on COC and health care utilization is robust, there has been no research to date on the association between COC and patient-reported health status. Patient-reported outcome measures are increasingly recognized as valuable tools to guide decision-making in clinical care and to evaluate the quality of health care.[12,13] These measures have particular salience for people with MCCs because they aid in identifying priorities among competing health needs.[14] They also provide an alternative to traditional disease-specific quality measures, which are often inappropriate for people with MCCs.[14-17] Elucidating the relationship between COC and patient-reported health status for patients with MCCs would, thus, fill a significant gap in the COC literature.

Prior studies on COC have also either focused exclusively on continuity with primary care providers (PCPs) or have combined visits to all types of providers. Few have explicitly considered the type of provider, primary care or specialist, with whom the patient had continuity.[8,10] This is a significant limitation because older adults with MCCs are heavy users of specialty care. As morbidity increases the number of specialty care visits increases, without commensurate increases in visits to primary care.[18] Additionally, approximately one-third of Medicare beneficiaries see a specialist for the plurality of their health care visits.[4] Primary care providers and specialists differ, however, in scope of care and practice styles in important ways that would suggest continuity with one type of provider is not necessarily equivalent to continuity with another type.

Given these important limitations in the COC literature, we examined the association between provider and practice-level COC and functional status in a population of older adults with MCCs. Functional status was selected as the outcome because it is a frequently recommended patient-reported outcome measure that is important to older patients, is applicable to almost all conditions and condition combinations, and offers the benefit of measuring total treatment harm and benefit.[17,19] We also examined whether any observed associations were moderated by the type of provider, PCP or specialist, which served as the predominant provider. We hypothesized that higher provider and practice-level COC would be associated with a reduced odds of functional status decline in older adults with MCCs. Furthermore, we hypothesized that continuity with either type of provider would demonstrate this inverse association with functional status decline.

3.3 METHODS

Study design, data and population

We conducted a retrospective, cohort analysis of older adults with MCCs using data from the Health and Retirement Study (HRS) linked with Medicare claims. The HRS is a longitudinal study of aging that gathers information on the physical and mental health, health services utilization, and financial resources of older Americans. The HRS interviews a sample of 20,000 adults over the age of 50 every 2 years, providing data that is nationally representative when sampling weights are used. For our analysis, we linked HRS survey responses to Medicare part A and B claims for the subset of HRS participants who provided their Medicare number and had fee-for-service (FFS) coverage. Study procedures were approved by the Institutional Review Board at the University of Washington.

The study population included all community-dwelling HRS participants interviewed in both 2006 and 2008, age 65 and older, who had 2 or more of 20 common chronic conditions, and who were continuously enrolled in a Medicare FFS plan for the study period (n=3,906; see Table 1 for population flowchart). Chronic conditions were identified using the Medicare Chronic Condition Warehouse indicators in combination with the date on which clinical criteria for the conditions were met. (see Supplemental digital content 1 for list of conditions and percentage of subjects with each condition) We defined community-dwelling as a person with no length of stay exceeding 29 days in an inpatient facility, either hospital or skilled nursing facility, and with an annual total of less than 60 inpatient days during the study period. We excluded remaining participants if they had fewer than 3 provider visits during the period in which COC was calculated because a minimum of 3 visits is required for a meaningful calculation of continuity

(n=110).[20-22] We also excluded participants if they were missing any covariate data (n=145). The final study population included 3,651 participants.

Figure 1 shows the cohort study design. People with chronic conditions were identified using claims data for the year prior to the 2006 HRS interview date. Functional status was measured during the HRS interview at baseline and follow-up in 2006 and 2008, respectively. Medicare claims data for 2006-2008 were used to calculate COC for each subject.

Dependent Variable: Functional status decline

To measure functional status, the HRS asked respondents about their ability to perform 12 mobility, strength, gross motor, and fine motor tasks. (see Supplemental digital content 1 for the list of tasks) The tasks in the functional status questions were based on early works by Rosow and Breslau (1966) and Nagi (1976).[23,24] Functional status was measured as the number of tasks the respondent reported having difficulties performing. Scores ranged from 0-12 with a higher score indicating poorer functioning. We subtracted the baseline functioning score from the follow-up score and classified participants as having either stable or declining functional status (a difference in scores that was greater than or equal to 1). We conducted additional analyses with declining functional status defined as a difference in scores greater than or equal to 2 and greater than or equal to 3 to test the robustness of our results to our definition of decline.

Independent Variable: COC

We used the Continuity of Care Index (COCI) developed by Bice and Boxerman (1977) as our primary measure of COC.[25] (the formula can be found in the Supplemental digital content 1) This frequently used measure quantified the extent to which health care visits were spread over multiple providers or practices.[26] The COCI ranged from 0 to 1, where 1 indicated perfect continuity. We conducted sensitivity analyses using the Usual Provider Continuity (UPC) Index,

another frequently used measure of continuity that captured the proportion of all health care visits that were made to the participant's predominant provider (described below) or practice.[27] The UPC also varied from 0 to 1, with higher values indicating higher COC.

We identified unique providers using the National Provider Identifier (NPI). Some claims were submitted prior to implementation of the NPI and, instead, included only the Medicare Unique Physician Identification Number (UPIN). For these claims, we determined the associated NPI using the identifier crosswalk available from the National Bureau of Economic Research. Unique practices were identified using the taxpayer identification number in the carrier files and provider number in the institutional outpatient files.

We defined the predominant provider as the provider that saw the participant for the plurality of their health care visits.[4] If ties occurred between a PCP and a specialist, the PCP was selected. However, if ties occurred between PCPs or between specialists, we selected the provider that claimed the greatest total charges for the participant.[4,8]

We defined a provider visit as a face-to-face evaluation and management (E&M) visit in the outpatient setting. We determined the specialty for each provider by linking the NPI to the National Plan and Provider Enumeration System (NPPES) downloadable file. Physicians, physician assistants, advanced practice nursing providers and other select non-physician providers were considered eligible providers. Visits to pathologists, dentists, registered nurses, and medical technicians were excluded. The Supplemental digital content 1 lists all eligible provider taxonomy codes as well as primary and specialty care classifications. The Current Procedural Terminology (CPT) and revenue center codes used to identify face-to-face E&M visits are also listed in the Supplemental digital content 1. Selected codes from both the CPT and Berenson-Eggers Type of Service (BETOS) E&M code categories were included. Visits that

occurred in an office, hospital outpatient department, home, or assisted living facility were included; nursing home, custodial care, and ED visits were excluded.

Statistical Analysis

To assess the independent contribution of COC to functional status decline, multivariate logistic regression models with robust variance estimates were constructed with COC modeled as a continuous variable. Models controlled for predominant provider type, age, sex, race, marital status, educational attainment, labor force status, household assets, household income below the poverty threshold, and Beale Rural-Urban Continuum Codes. We also controlled for health at baseline by including baseline functional status, self-rated health, and number of chronic conditions in the models. The adequacy of model-fit was examined with the Hosmer-Lemeshow goodness-of-fit test. We explored a non-linear association between COC and functional status decline by including a quadratic term for COC in the model. We also tested for moderation by predominant provider type by incorporating an interaction term between COC and provider type. To aid in interpretation of model results, we generated predicted probabilities of functional status decline at the mean COC level for the study sample and 1 standard deviation above and below the mean. Analyses utilized the 2006 HRS sampling weights, weighting the sample to the Current Population Survey from March 2006. All analyses were conducted in Stata 13 (StataCorp LP, College Station, TX).

3.4 RESULTS

Characteristics of the population

Characteristics of the study population are presented in Table 2. About 70% of subjects had a PCP as their predominant provider and nearly 30% of subjects had a specialist. Among the latter group, cardiology was the most common specialty reported (20.9%) followed by

ophthalmology (14.2%), hematology/oncology (7.2%), and surgery (6.5%). The mean age in both groups was 75.3 years, however subjects with a specialist predominant provider were more likely to be male (45.9% versus 37.2%), married (61.3% versus 55.3%), have $500,000 or more in household assets (36.9% versus 27.8%), and live in a metro area (78.0% versus 69.9%) than subjects with a primary care predominant provider.

Baseline health characteristics were comparable between the two groups, with a mean of 4.1 and 4.2 chronic conditions in the primary care and specialist predominant provider group, respectively. On average, subjects with a primary care predominant provider had difficulty performing 4.7 functional status tasks at baseline, while subjects with a specialty care provider had difficulty performing 4.4 tasks. At follow-up, the mean functional status scores were 5.0 and 4.7 in the primary care and specialist predominant provider group, respectively. Overall, 41.5% of subjects experienced functional status decline, with 41.7% of those with a primary care and 41.2% of those with a specialty care predominant provider reporting functional decline.

Despite similar baseline health, subjects with a specialist predominant provider had a greater number of provider visits during the study period and saw more providers and practices. At both the practice and provider levels, subjects with a specialist predominant provider experienced lower levels of COC. When the indexes were calculated using only primary care visits, subjects with a primary care predominant provider had a mean COCI of 0.760 and, on average, saw their predominant provider for 85% of their visits. When the indexes were calculated using only specialty care visits, subjects with a specialist predominant provider had a mean COCI of 0.337 and saw their predominant provider for 51% of their visits.

Bivariate associations between COC and functional status decline

Table 3 displays the percentage of subjects experiencing functional status decline by COC tertiles. Among all subjects, the percentage reporting subsequent functional decline was similar across all levels of continuity, whether calculated at the practice or provider level. Similarly, among subjects with a predominant provider in primary care, the percentage reporting functional decline was comparable across levels of practice-level COC and provider-level continuity calculated with all visits or only primary care visits. Among subjects with a predominant provider in specialty care, the percentage reporting functional decline was highest in the lowest COC tertile (44.2%), with similar percentages observed in the medium and higher tertile groups (40.6% and 38.8%, respectively). This pattern held when COC was calculated at the practice and provider levels, and when continuity was calculated using only specialty care visits.

Multivariate regression model results

In multivariate models, neither practice or provider-level COC was significantly associated with functional status decline [practice-level COCI odds ratio (OR), 0.82; 95% confidence interval (CI), 0.59-1.16; provider-level COCI OR, 0.98; 95% CI, 0.66-1.44]. (Table 4) Amongst subjects with a predominant provider in primary care, COC calculated using only primary care visits was also not associated with functional status decline [COCI OR, 1.26; 95% CI, 0.90-1.75]. However, amongst subjects with a specialist predominant provider, higher COC calculated using only specialty care visits was significantly associated with a lower odds of functional status decline [COCI OR, 0.52; 95% CI, 0.28-0.96]. This corresponds to a predicted probability of functional decline of 0.41 for those with a specialty care COCI at the mean, 0.44

for those 1 standard deviation below the mean, and 0.38 for those 1 standard deviation above the mean.

Conclusions from the multivariate models did not change when functional status decline was defined as a change score of 2 or more. When a change score of greater than or equal to 3 was used, the results among all subjects and the primary care predominant provider subgroup were similar. Amongst subjects with a specialist predominant provider, the odds ratios remained below 1 but were no longer significant. However, the number of subjects with functional status decline in this latter group was also nearly 70 percent smaller.

There was no strong evidence that predominant provider type moderated the relationship between COC, calculated using all visits, and functional status decline. There was also no significant evidence of a non-linear relationship between COC and functional decline (results not shown).

3.5 DISCUSSION

In our study of older adults in the HRS with Medicare claims, subjects averaged about 4 chronic conditions at baseline, and 3 of every 10 subjects had a predominant provider in specialty care. These subjects had lower levels of provider and practice-level COC than did subjects with a predominant provider in primary care. Even so, for adults with a specialist predominant provider, higher provider-level COC was associated with less functional status decline.

Functional status is a complex construct influenced by a variety of factors that may be unrelated to health care, including biological functioning, symptoms, qualities of the individual, and social and environmental characteristics.[28,29] There are, however, a couple of mechanisms by which COC may have a positive influence on health outcomes, including functional status, for

people with MCCs. Continuity with a provider increases the provider's knowledge of the patient, including knowledge of their medical history, status of current medical issues and management plans, and values and preferences regarding medical care. This increased knowledge aids in the diagnosis of new conditions and in the management of ongoing conditions, prevents medical errors, reduces service duplication, and improves coordination of care.[18,20,30-32] Continuity also increases a patient's trust in their provider. This trust, in turn, may improve patient adherence to recommended medications, self-management behaviors, and preventive care.[30,33-37] These mechanisms may be at play for those subjects with a specialist as the predominant provider.

Despite the benefits of COC, it is likely not possible or even desirable to achieve perfect continuity among older adults with MCCs. Due to their medical complexity, a single provider is unlikely to have the necessary expertise to address all of their diagnostic and therapeutic needs.[10,38-41] Consequently, there is a balance between unnecessary care fragmentation and inadequate access to specialized care. Our results showed that subjects with a predominant provider in primary care had very high levels of primary care continuity; on average, they saw their predominant provider for 85% of their primary care visits. One possible explanation for the lack of an association between COC and functional status decline in this sub-population is that those with a primary care predominant provider experienced close to optimal care continuity and were thus, less likely to show any benefits of higher continuity.

Current delivery system reform efforts emphasize COC, but usually do so within the context of a PCP. Our results confirm prior studies that demonstrated a substantial minority of Medicare beneficiaries have a predominant provider in specialty care.[4,8,42] Additionally, our results highlight the importance of type of provider in COC considerations, a factor frequently overlooked. In one prior study that considered provider type, Romaire, Haber, Wensky, et al.

(2014) found that higher COC was associated with fewer all-cause hospitalizations and ED visits and lower total costs in a population of Medicare beneficiaries, regardless of predominant provider type and whether COC was calculated with all visits, or only primary care or specialty visits.[8] In their examination of older adults with MCCs receiving care in an integrated health system, Bayliss, Ellis, Shoup, et al. (2015) found that both higher primary care and higher specialty care continuity were associated with a lower risk of hospitalization and ED visits.[10] The mechanisms through which COC exerts beneficial effects on health outcomes are likely to apply across different types of providers. For example, familiarity with a patient's medical history should support the development of an effective care management plan, irrespective of the type of provider administering the care. However, PCPs and specialists differ in their depth and breadth of knowledge of different organ systems and diseases, care coordination efforts, and in resource use, such that continuity with one type may not provide the same benefit as continuity with the other.[42-47] Studies of older adults that restrict their analyses to overall COC or to just primary care COC may be missing important nuances.

Though it is recognized that people with MCCs may require care from multiple providers, the optimal mix of primary and specialty care has not been established. Studies that have compared the quality of care for patients receiving care from both PCPs and specialists to patients receiving care from only one or the other type of provider found that those getting a combination of primary and specialty care received the highest quality care on disease-specific quality measures and measures of general preventive care.[39-41] Continuity of care itself has been proposed as a measure of care quality, thus it is interesting to note that those with a predominant provider in specialty care had lower levels of both provider and practice continuity.[38] It suggests that COC is more likely to be optimized when the predominant provider is in primary care.

Results from this analysis should be viewed within the limitations of the study. First, this was an observational study and a causal interpretation should not be assumed. Second, we excluded from our analysis HRS participants who did not take part in both the 2006 and 2008 interview waves. Just over 10 percent of 2006 participants were non-respondents in 2008; 60 percent of non-responses were due to death (6 percent of 2006 interview participants). Alternative approaches to handling non-response due to death when using a patient-reported outcome measure include imputation of missing values or assigning a poor outcome value to those who died.[48] However, participants at the end-of-life are most likely to experience lower COC as a result of increased health care utilization as well as increased functional decline. Thus, inclusion of these participants would have strengthened the relationship between high COC and decreased functional decline. Finally, we included only Medicare FFS beneficiaries with MCCs in our study population. Our results may not be generalizable to healthier patients or those insured through a managed care plan with capitation payment.

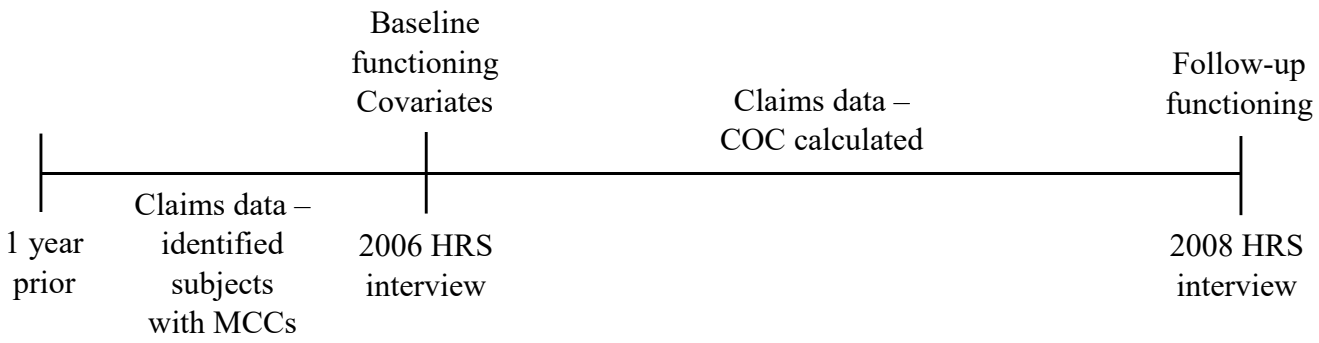
Despite its limitations, this study has important strengths. It is the first study we are aware of to examine the association between COC and a patient-reported health outcome. Given the substantial interest in patient-reported health outcome measures as measures of health care quality, it is vital to understand the associations between these measures and important processes of care, such as care continuity. Additionally, the dataset used for the study contained an extremely rich set of covariates, allowing for greater control of confounding than is typical in studies investigating claims-based COC. Finally, the HRS uses a nationally representative sample and our findings may be broadly generalizable.

Most current delivery system reform efforts emphasize primary care provider COC. Our study results demonstrate the importance of specialty care continuity and suggest that limiting

the dispersion of patients' specialty care visits may lead to improved patient-reported functional status in Medicare populations.

3.6 FIGURES

Figure 1. Study design



* MCC – Multiple chronic conditions
* HRS – Health and Retirement Study
* COC – Continuity of care

3.7 TABLES

Table 1. Study population flow chart

(1) Participated in both the 2006 and 2008 HRS interviews and provided their Medicare number n=11,568
(2) Continuously enrolled in Medicare FFS during the study period 5,772 excluded
(3) Two or more chronic conditions present in the year prior to the 2006 HRS interview 1,383 excluded
(4) 65 years or older at the start of the study period 261 excluded
(5) Community-dwelling for duration of study 246 excluded
(6) Three or more E&M visits in the outpatient setting during COC calculation period 110 excluded
(7) Complete covariate data 145 excluded
(8) Final study sample n=3,651

* HRS – Health and Retirement Study
* FFS – Fee-for-service
* E&M – Evaluation and management
* COC – Continuity of care

Table 2. Select characteristics of study population

	All subjects (n=3,651)	Predominant provider type	
		Primary care (n=2,566)	Specialist (n=1,085)
Sociodemographic characteristics			
Age in years, mean (sd)	75.3 (6.8)	75.3 (7.0)	75.3 (6.4)
Male, %	39.8	37.2	45.9
Race, %			
Non-hispanic white	83.0	82.1	85.1
Non-hispanic black	10.6	10.6	10.6
Hispanic	5.2	5.9	3.6
Non-hispanic other	1.2	1.4	0.7
Foreign born, %	6.9	6.9	6.9
Marital status, %			
Married	57.1	55.3	61.3
Separated/divorced	8.1	7.8	8.9
Widowed	32.4	34.6	27.2
Never married	2.4	2.3	2.6
Educational attainment, %			
No degree	22.4	24.4	17.6
High school graduate or GED	54.6	54.9	53.7
Associate's degree	2.7	2.7	2.9
Bachelor's degree	11.8	11.0	13.7
Graduate degree	8.5	7.0	12.1
Labor force status, %			
In labor force	14.7	14.7	14.8
Retired	74.3	73.7	75.8
Disabled	1.2	1.3	1.0
Not in labor force	9.8	10.3	8.4
Veteran, %	26.8	24.3	32.5
Household income below poverty threshold, %	8.1	8.8	6.3
Household assets in dollars, %			
< 49,999	20.3	22.1	16.0
50,000 - 174,999	21.1	22.2	18.5
175,000 - 499,999	28.2	28.0	28.57
500,000 +	30.5	27.8	36.9
Geographic characteristics			
Beale rural-urban continuum, %			
Metro area	72.3	69.9	78.0
Urban area	26.8	29.0	21.8
Rural area	0.9	1.1	0.3
PCSA with any population in primary care HPSA, %	69.4	70.3	67.5

PCSA with any population in MUA, %	85.7	87.0	82.5
General health characteristics			
Number of chronic conditions at baseline, mean (sd)	4.1 (1.8)	4.1 (1.8)	4.2 (1.9)
Self-rated health at baseline, %			
Excellent	6.5	6.2	7.2
Very good	26.7	27.4	25.1
Good	34.6	34.3	35.1
Fair	24.4	24.2	24.7
Poor	7.8	7.8	7.9
Functional status			
Functional status score at baseline, mean (sd)	4.6 (3.1)	4.7 (3.0)	4.4 (3.1)
Functional status score at follow-up, mean (sd)	4.9 (3.2)	5.0 (3.2)	4.7 (3.1)
Change in functional status scores, mean (sd)	0.3 (2.1)	0.3 (2.1)	0.3 (2.1)
Functional decline, %	41.5	41.7	41.2
Healthcare utilization			
No. of provider visits between interviews, mdn (IQR)	18 (16)	18 (16)	20 (19)
No. of providers seen between interviews, mdn (IQR)	6 (4)	6 (4)	7 (5)
No. of practices seen between interviews, mdn (IQR)	5 (4)	4 (3)	5 (4)
Practice-level COCI: all visits, mean (sd)	0.368 (0.23)	0.394 (0.23)	0.305 (0.20)
Practice-level UPC: all visits, mean (sd)	0.531 (0.21)	0.560 (0.21)	0.463 (0.19)
Provider-level COCI: all visits, mean (sd)	0.290 (0.19)	0.311 (0.20)	0.240 (0.17)
Provider-level UPC: all visits, mean (sd)	0.465 (0.19)	0.490 (0.20)	0.407 (0.17)
Provider-level COCI: primary care visits, mean (sd)	--	0.760 (0.27)	--
Provider-level UPC: primary care visits, mean (sd)	--	0.849 (0.19)	--
Provider-level COCI: specialty care visits, mean (sd)	--	--	0.337 (0.23)
Provider-level UPC: specialty care visits, mean (sd)	--	--	0.512 (0.21)

* GED – General education development
* PCSA – Primary care service area
* HPSA – Health professional shortage area
* MUA – Medically underserved area
* IQR – Interquartile range
* COCI – Continuity of care index
* UPC – Usual provider continuity
* Note that subject sociodemographic and geographic characteristics were measured at baseline.

Table 3. Percentage of subjects experiencing functional status decline by continuity of care tertiles

	All subjects			Predominant provider type: Primary care			Predominant provider type: Specialist		
	Low COC	Med COC	High COC	Low COC	Med COC	High COC	Low COC	Med COC	High COC
Continuity of care index									
Practice-level COCI: all visits	41.7	40.5	42.4	39.8	43.5	41.7	44.2	40.6	38.8
Practice-level UPC: all visits	42.6	39.8	42.3	40.7	42.2	42.2	46.0	38.3	39.3
Provider-level COCI: all visits	41.1	40.1	43.3	40.5	40.7	43.9	45.6	38.9	39.1
Provider-level UPC: all visits	42.2	39.4	42.9	40.3	40.5	44.3	46.4	36.1	41.0
Provider-level COCI: primary care visits*	--	--	--	42.8	--	40.5	--	--	--
Provider-level UPC: primary care visits*	--	--	--	42.8	--	40.6	--	--	--
Provider-level COCI: specialty care visits	--	--	--	--	--	--	44.7	39.3	39.4
Provider-level UPC: specialty care visits	--	--	--	--	--	--	45.4	39.3	38.8

* COC – Continuity of care
* COCI – Continuity of care index
* UPC – Usual provider continuity
* Note that the COCI and UPC for subjects with a primary care provider as the predominant provider could not be split into tertiles because of the high proportion with extremely high levels of COC (46% had a COCI of 1 and 46% had a UPC of 1). Instead, this group was split at the median.

Table 4. Adjusted odds ratios for the test of the association between continuity of care and functional status decline

	Odds ratio (95% CI)	p-value
All subjects		
Practice-level COCI: all visits	0.82 (0.59, 1.16)	0.267
Practice-level UPC: all visits	0.77 (0.53, 1.11)	0.164
Provider-level COCI: all visits	0.98 (0.66, 1.44)	0.905
Provider-level UPC: all visits	0.95 (0.63, 1.42)	0.794
Predominant provider type		
Primary care		
Provider-level COCI: primary care visits	1.26 (0.90, 1.75)	0.183
Provider-level UPC: primary care visits	1.36 (0.84, 2.21)	0.210
Specialist		
Provider-level COCI: specialty care visits	0.52 (0.28, 0.96)	0.036
Provider-level UPC: specialty care visits	0.40 (0.20, 0.78)	0.008

* Models controlled for the following variables measured at baseline: age, sex, race, marital status, educational attainment, labor force status, household assets, household income below the poverty threshold, Beale Rural-Urban Continuum Codes, functional status, self-rated health, and number of chronic conditions.

3.8 APPENDIX

List of chronic conditions used to count number of chronic conditions and percent of subjects with each condition at baseline (chronic conditions identified using the Medicare Chronic Condition Warehouse indicators available in the claims data – www.ccwdata.org):
Acquired hypothyroidism, 14.4%
Alzheimer's disease and related disorders, 6.2%
Anemia, 21.0%
Asthma, 4.1%
Atrial fibrillation, 8.9%
Benign prostatic hyperplasia, 6.9%
Cancer (combines breast, colorectal, prostate, lung, and endometrial), 10.3%
Chronic kidney disease, 8.1%
Chronic obstructive pulmonary disease, 10.9%
Congestive heart failure, 15.5%
Depression, 7.9%
Diabetes, 31.3%
Eye disorders (combines cataract and glaucoma), 43.0%
Hip or pelvic fracture, 0.3%
Hyperlipidemia, 62.5%
Hypertension, 73.3%
Ishcemic heart disease (combines acute myocardial infarction and ischemic heart disease), 41.2%
Osteoporosis, 8.0%
Rheumatoid arthritis and osteoarthritis, 35.5%
Stroke or transient ischemic attack, 3.5%

Questions assessing functional status in the HRS interview

Introduction: We need to understand difficulties people may have with various activities because of a health or physical problem. **Instructions:** Please tell me whether you have any difficulty doing each of the everyday activities that I read to you. Exclude any difficulties that you expect to last less than three months. Because of a health problem, do you have any difficulty with:
Walking one block
Walking several blocks
Running or jogging about one mile
Sitting for about two hours
Getting up from a chair after sitting for long periods
Climbing one flight of stairs without resting
Climbing several flights of stairs without resting
Lifting or carrying weights over 10 lbs, like a heavy bag of groceries
Stooping, crouching or kneeling
Picking up a dime from a table
Reaching or extending your arms above shoulder level

Pulling or pushing large objects like a living room chair

***** Note that skip patterns were in place so that if a respondent had no difficulty completing a challenging task, then they did not need to be asked about a relatively easier task. For example, if the respondent had no difficulty running or jogging about one mile, they were not asked if they could walk one block or several blocks.

Bice and Boxerman Continuity of Care Index (COCI) formulas:

(1) $$\text{Provider-level continuity}_{COCI} = \frac{\sum_{j=1}^{s} n_j^2 - N}{N(N-1)}$$

N = the total number of provider visits during the study period
n_j = the number of visits to provider j
s = the total number of providers seen during the study period

(2) $$\text{Practice-level continuity}_{COCI} = \frac{\sum_{i=1}^{q} n_i^2 - N}{N(N-1)}$$

N = the total number of provider visits during the study period
n_i = the number of visits to practice i
q = the total number of practices visited during the study period

Usual Provider Continuity Index (UPC) formulas:

(1) $$\text{Provider-level continuity}_{UPC} = n/N$$

N = the total number of provider visits during the study period
n = the number of visits to the predominant provider during the same period

(2) $$\text{Practice-level continuity}_{UPC} = q/N$$

N = the total number of provider visits during the study period
q = the number of visits to the practice most frequently attended during the same period

Health care provider taxonomy codes classified as primary care:

- General practice: 208D00000X
- Family medicine (restricted to general family medicine, adult medicine, geriatric medicine): 207Q00000X, 207QA0505X, 207QG0300X
- Internal medicine (restricted to general internal medicine, geriatric medicine): 207R00000X, 207RG0300X
- Preventive medicine (restricted to public health and general preventive medicine): 2083P0901X

- Nurse practitioner (restricted to general NP, acute care, adult health, community health, family, gerontology, primary care, women's health): 363L00000X, 363LA2100X, 363LA2200X, 363LC1500X, 363LF0000X, 363LG0600X, 363LP2300X, 363LW0102X
- Clinical nurse specialist (restricted to general, adult health, community health, family health, gerontology, holistic, women's health, home health, acute care, chronic care): 364S00000X, 364SA2200X, 364SC1501X, 364SF0001X, 364SG0600X, 364SH1100X, 364SH0200X, 364SW0102X, 364SA2100X, 364SC2300X
- Physician assistant (restricted to general, medical): 363A00000X, 363AM0700X

Health care provider taxonomy codes classified as specialty care:

- Allergy and immunology: 207K******
- Anesthesiology: 207L******
- Colon and rectal surgery: 208C00000X
- Dermatology: 207N******
- Emergency medicine: 207P******
- Family medicine (excludes those codes listed above in primary care): 207Q******
- Hospitalist: 208M00000X
- Internal medicine (excludes those codes listed above in primary care): 207R******
- Clinical genetics: 207SG0201X
- Neurological surgery: 207T00000X
- Nuclear medicine: 207U******
- Neuromusculoskeletal medicine and OMM: 204D00000X
- Neuromusculoskeletal medicine, sports medicine: 204C00000X
- Obstetrics and gynecology: 207V******
- Ophthalmology: 207W******
- Oral and maxillofacial surgery: 204E00000X
- Orthopedic surgery: 207X******
- Otolaryngology: 207Y******
- Physical medicine and rehabilitation: 2081******
- Plastic surgery: 2082******
- Preventive medicine (excludes those codes listed above in primary care): 2083******
- Psychiatry and neurology: 2084******
- Pain medicine: 208VP*****
- Radiology: 2085******
- Surgery: 2086******
- Thoracic surgery: 208G00000X
- Transplant surgery: 204F00000X
- Urology: 2088******
- Clinical neuropsychologist: 103G******
- Counselor: 101Y******
- Psychologist: 103T******
- Social worker: 1041******
- Chiropractor: 111N******
- Optometrist: 152W******

- Clinical nurse specialist (excludes those codes listed above in primary care): 364S******
- Nurse practitioner (excludes those codes listed above in primary care): 363L******
- Physician assistant (excludes those codes listed above in primary care): 363A******
- Podiatrist: 213E******

CPT codes used to identify evaluation and management visits in the carrier file:
From the CPT evaluation and management code category:
99201, 99202, 99203, 99204, 99205, 99211, 99212, 99213, 99214, 99215, 99241, 99242, 99243, 99244, 99245, 99324, 99325, 99326, 99327, 99328, 99334, 99335, 99336, 99337, 99341, 99342, 99343, 99344, 99345, 99347, 99348, 99349, 99350, 99354, 99355, 99386, 99387, 99396, 99397, G0402, G0438, G0439, 99401, 99402, 99403, 99404, 99406, 99407, 99408, 99409, 99411, 99412, 99420, 99429

From the BETOS evaluation and management code category:
90801, 90802, 90804, 90805, 90806, 90807, 90808, 90809, 90810, 90811, 90812, 90813, 90814, 90815, 90845, 90847, 92002, 92004, 92012, 92014

Revenue center codes used to identify outpatient visits to federally qualified health centers and rural health centers in the outpatient file:
0521, 0522

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Chapter 4. CONTINUITY OF CARE ASSOCIATED WITH LOWER EXPENDITURES IN OLDER ADULTS WITH MULTIMORBIDITY

4.1 ABSTRACT

Background

Research on the relationship between continuity of care (COC) and health care costs among people with multiple chronic conditions (MCCs) has been limited.

Objectives

To examine whether higher practice and provider-level COC were separately associated with lower health care expenditures in a population of older adults with MCCs. To determine whether any observed association between provider-level COC and expenditures was moderated by the type of provider, primary care provider (PCP) or specialist, the patient primarily saw for their health care visits.

Research design and methods

We conducted a retrospective, longitudinal cohort study using a five-year panel of Health and Retirement (HRS) survey and linked Medicare claims data. Generalized linear and negative binomial models were used in multivariate regression modeling.

Subjects

Community-dwelling HRS participants interviewed in either one or both of the 2006 and 2008 interview waves, who had two or more chronic conditions, and were enrolled in a Medicare fee-for-service plan were studied.

Results

Higher provider-level COC was significantly associated with lower health care expenditures irrespective of provider type. A significant negative association was also observed between practice-level COC and expenditures.

Conclusions

Higher continuity with either a PCP or specialist, or even with a medical practice, has the potential to reduce costs for older adults with MCCs.

4.2 BACKGROUND

Nearly three out of four people over 65 years of age, or greater than 35 million older adults, have two or more chronic conditions.[1] Compared to people with zero or only one chronic condition, those with multiple chronic conditions (MCCs) are heavier users of health care services, with more visits to health care providers, an increased number of emergency department (ED) visits and hospitalizations, and a greater risk of readmission after hospital discharge.[2] Total costs of care for people with MCCs are, therefore, higher than for those without, accounting for 93% of total Medicare spending.[2]

In studies of older adults with chronic conditions, higher continuity of care (COC) with a health care provider has been associated with a lower odds of chronic condition-associated complications, a reduced risk of ED visits and hospitalizations, lower mortality, and lower expenditures.[3-6] Care continuity has, consequently, been promoted as a means to improving outcomes and lowering costs of care for people with MCCs.

Yet, prior research on the relationship between COC and costs of care among older adults or those with chronic conditions have some limitations. In particular, it is not clear whether the association between COC and health care costs is the same for patients who establish continuity with a specialist as opposed to a primary care provider (PCP). One of every three Medicare beneficiaries will primarily see a specialist for their health care visits.[7] However, fees are higher for services performed by specialists. Primary care providers and specialists also differ in their practice styles in ways that impact health care resources consumed. Furthermore, the comprehensiveness and the quality of services provided may differ by provider type, resulting in different outcomes and associated cost trajectories.

There have also been very few health care costs studies that have examined differences between continuity with an individual health care provider and continuity with a practice.[4] Providers within the same practice share a medical record and may utilize protocols or management plans that have been institutionalized to ensure care consistent with best practices.[8,9] Continuity with a practice may, thus, provide much of the same benefit as continuity with an individual provider.

Using data from the Health and Retirement Study (HRS) linked with Medicare claims data, we examined whether higher practice-level and provider-level COC were separately associated with lower health care expenditures in a population of older adults with MCCs. We also explored whether the relationship between provider-level COC and expenditures was moderated by the type of provider the patient primarily saw for their health care visits.

4.3 METHODS

Study design, data and study population

We conducted a retrospective, longitudinal cohort study of older adults with MCCs using a five-year panel of HRS survey and linked Medicare claims data. The HRS is a longitudinal study that conducts a biennial survey of 20,000 adults over the age of 50, collecting information on respondents' physical and mental health, health services utilization, and economic circumstances. For our analysis, we linked HRS survey responses to Medicare claims for the subset of HRS participants who provided their Medicare number and had fee-for-service (FFS) coverage. Study procedures were approved by the Institutional Review Board at the University of Washington.

Figure 1 shows the longitudinal cohort study design. Medicare part A and B claims from 2006 through 2010 were used in the analysis. We divided the study period into overlapping two-year observational periods, termed person-waves, with the first year serving as the baseline and the subsequent year as the follow-up period, for a total of four person-waves. Study subjects could contribute between one and four person-waves to the analysis. We calculated COC in each baseline year from 2006 through 2009 and health care expenditures and utilization in all follow-up years from 2007 through 2010. The HRS survey data provided sociodemographic, geographic, and patient-reported health variables for the analysis, with the 2006 interview wave providing covariates for the 2006 and 2007 baseline years and the 2008 interview wave providing covariates for the 2008 and 2009 baseline years.

A total of 13,469 subjects participated in either one or both of the 2006 and 2008 HRS interview waves and had a Medicare number, contributing a possible 50,074 person-waves to the analysis. We included person-waves in the analysis if the subject was at least 65 years of age at the start of the baseline year (6,405 person-waves and 1,093 subjects excluded), was continuously enrolled in parts A and B fee-for-service coverage throughout the person-wave (19,522 person-waves and 4,752 subjects excluded, including 579 subjects who died during the first person-wave they contributed), had two or more of 20 common chronic conditions during the baseline year (4,709 person-waves and 776 subjects excluded), and was community-dwelling (1,889 person-waves and 344 subjects excluded). Chronic conditions were identified using the Medicare Chronic Condition Warehouse indicators (see Appendix for list of conditions). We defined community-dwelling as a subject who had no stays in a skilled nursing facility, as determined through the Medicare skilled nursing facility file, throughout the person-wave.[10] To allow for a meaningful calculation of COC, an additional 1,122 person-waves (304 subjects)

were excluded because they had fewer than three provider visits in the baseline year.[11-13] We excluded a final 204 person-waves (55 subjects) because of incomplete covariate data. Ultimately, 6,145 subjects contributed 16,223 person-waves to the analysis. The unit of analysis was the person-wave.

Dependent variables: Health care expenditures and utilization

We defined our primary outcome, health care expenditures, as the sum of amounts paid by Medicare for all part A and B claims, including inpatient, skilled nursing facility, institutional outpatient, carrier, home health, durable medical equipment, and hospice services. Expenditures for prescription drugs were not included. We adjusted expenditures for inflation using the Consumer Price Index for medical care and report all amounts in 2010 dollars. We also measured the number of ED visits and hospitalizations in each follow-up year. These secondary outcomes were included in the analyses because they constitute a significant portion of total expenditures and are often avoidable outcomes given high quality outpatient care.

Independent variable: COC

We measured COC during each baseline year with the Continuity of Care Index (COCI) by Bice and Boxerman (1977) and the Usual Provider Continuity (UPC) Index (see Appendix for the formula for each index).[14,15] The COCI quantified the dispersion of health care visits to multiple providers or practices. The UPC captured the proportion of visits that were made to the subject's predominant provider (described below) or practice. Each index ranged from zero to one with higher values indicating higher care continuity.

We identified unique providers using the National Provider Identifier (NPI) and unique practices using the taxpayer identification number in the carrier files and provider number in the institutional outpatient files. Implementation of the NPI occurred in 2006 and 2007. Thus, some

claims contained only the Medicare Unique Physician Identification Number (UPIN), the predecessor to the NPI. For these claims, we used the crosswalk available from the National Bureau of Economic Research to identify the associated NPI. We also linked each NPI to the National Plan and Provider Enumeration System (NPPES) downloadable file to determine the specialty of every provider. Visits to physicians, physician assistants, advanced practice nursing providers and other select non-physician providers were used to construct our COC indexes. Visits to pathologists, dentists, registered nurses, and medical technicians were excluded from our calculations. All eligible provider taxonomy codes as well as primary care and specialty care classifications are listed in the Appendix.

We defined the predominant provider as the provider the subject visited most frequently for their health care visits.[7,10] When ties occurred between a PCP and specialist, we selected the PCP. However, when ties occurred between PCPs or between specialists, the provider claiming the greatest total charges was chosen.[7,10]

We used only face-to-face evaluation and management (E&M) visits occurring in the outpatient setting to calculate COC. A list of the Current Procedural Terminology (CPT) and revenue center codes used to identify these visits can be found in the Appendix. Codes from both the CPT and Berenson-Eggers Type of Service (BETOS) E&M code categories were included. We defined the outpatient setting as visits occurring in an office, hospital outpatient department, home, or assisted living facility; nursing home, custodial care, and ED visits were excluded.

Statistical Analysis

To test the independent association of COC with our primary outcome, expenditures, we used generalized estimating equations to fit generalized linear models with gamma distribution and log link function. For our secondary outcomes, number of ED visits and hospitalizations,

generalized linear models with a negative binomial distribution and log link function were fitted. The use of generalized estimating equations allowed us to account for the correlation in observations due to repeated measures by subject. We categorized COC values into tertiles based on the distribution of values for the whole study population and included indicator variables for the tertiles in the models. For analyses stratified by predominant provider type, the tertiles were calculated using the distribution of COC values within each strata. All models controlled for age, gender, race, educational attainment, marital status, nativity status, veteran status, and Beale Rural-Urban Continuum Codes. We also controlled for health at baseline by including functional status, self-rated health, smoking status, number of chronic conditions, and total health care expenditures from the baseline year in the model. It should be noted that covariates were time-varying for subjects with multiple person-waves. Robust standard errors clustered at the subject-level were used for all models. Since data from multiple HRS interview waves were included in our dataset, we did not use survey sampling weights in our primary analyses. However, in sensitivity analyses, data was limited to person-waves one and two and models weighted the sample to the Current Population Survey from March 2006. All analyses were conducted in Stata 14.1 (StataCorp LP, College Station, TX).

4.4 RESULTS

Characteristics of subjects and person-waves

Table 1 provides the sociodemographic and health characteristics for all subjects in the first person-wave in which they participated. Seventy percent of subjects had a PCP as their predominant provider and 30% a specialist. Among the latter group, cardiology was the most frequently reported specialty (17.3%), followed by ophthalmology (13.3%), surgery (10.7%), and hematology/oncology (6.5%). The mean age of subjects in both provider type groups was 75

years. However, subjects with a specialty care predominant provider were more likely to be male (45% versus 38%), a veteran (30% versus 24%), have a bachelor's or graduate degree (24% versus 18%), have household assets greater than $500,000 (35% versus 27%), and live in a metro area (75% versus 70%) than subjects with a primary care predominant provider. Subjects in both groups had similar health at baseline with an average of four chronic conditions and difficulty with five functional status tasks, though a slightly higher percentage of subjects with a primary care predominant provider reported their health to be excellent or very good (35% versus 32%).

Continuity of care and other measures of health care utilization from the baseline year for all person-waves included in the analysis are presented in Table 2, as are outcomes from the follow-up year. Person-waves from subjects with a specialty care predominant provider had a greater number of visits to all types of providers as well as a larger number of providers and practices seen than person-waves from subjects with a primary care predominant provider. They also had lower COC at both the practice (COCI of 0.32 versus 0.40) and provider levels (COCI of 0.25 versus 0.32). Health care expenditures during the follow-up year were far higher for the person-waves in the specialty care group, averaging $9,957 compared with $7,171 in the primary care group. A similar percentage of person-waves in both provider type groups had no ED visits (71% in both groups) and no hospitalizations (82% and 80% for primary care and specialist group, respectively) during the follow-up year.

Association between COC and health care expenditures

Tables 3 and 4 provide the results of the multivariate regression models. Subjects with higher COC at the provider-level had significantly lower total health care expenditures, whether continuity was measured by the Bice-Boxerman index or the UPC. For example, using the Bice-Boxerman index, subjects in the medium and high COC groups had expenditures that were 8%

and 15% lower than those in the low continuity group, respectively. We also observed a significant negative association between provider-level COC and expenditures among subjects with a primary care predominant provider. Among subjects with a specialty care predominant provider, however, only those in the high COC group were found to have significantly lower expenditures. Notably, there appeared to be a small dose-response effect such that those in the high COC groups had larger reductions in expenditures than those in the medium COC groups. Results were very similar when COC was calculated at the practice level.

Association between COC and number of ED visits and hospitalizations

Subjects with medium or high levels of provider-level COC had lower rates of ED visits [COCI incidence rate ratio (IRR): 0.91 (95% CI: 0.85, 0.98) and COCI IRR: 0.90 (95% CI: 0.83, 0.98), respectively] compared to subjects with low continuity. When subjects were stratified by predominant provider type, the significant negative association was still observed when measuring continuity with the UPC. However, the associations were no longer significant when the COCI was used, although the incident rate ratios remained below one. We found no significant associations between COC at the practice level and number of ED visits.

We observed no significant association between provider-level continuity measured with the Bice-Boxerman index and number of hospitalizations, either amongst all subjects or within provider type strata. However, when provider-level continuity was measured with the UPC index, a significant negative association was found amongst all subjects [IRR 0.86 (95% CI: 0.78, 0.94) and 0.88 (95% CI: 0.80, 0.97) for medium and high COC groups, respectively]. Subjects with a specialist predominant provider who experienced high COC also had a significantly lower rate of hospitalizations compared to those with low continuity [IRR 0.79 (95% CI: 0.66, 0.94)]. Results were similar when COC was calculated at the practice-level.

Overall conclusions did not differ when sensitivity analyses were conducted using weighted data from person-waves one and two (results not shown). Point estimates were similar to those produced in the unweighted analyses, though a few were no longer significant.

4.5 DISCUSSION

In our investigation of older adults with MCCs, we found a very consistent and significant negative association between COC and health care expenditures irrespective of predominant provider type, COC measure, and provider or practice levels. We also observed a general trend toward a lower rate of ED visits and hospitalizations with higher COC, though the significance of the associations depended on whether continuity was measured with the Bice-Boxerman Index or the UPC and whether continuity at the provider or practice-level was being examined.

Our results both confirm and extend those from prior studies of COC and health care costs. They demonstrate the benefits of continuity to patients with MCCs, a population at particular risk of fragmented care. They also suggest that the benefits of continuity can broadly apply to relationships with PCPs, specialists, and even practices. Two prior studies focused on patients with discrete chronic conditions showed significant associations between higher continuity and lower condition-related expenditures, though neither of these studies examined the role of provider type.[4,16] One prior study of general Medicare beneficiaries also demonstrated a significant inverse association between COC and total health care expenditures, regardless of provider type, but did not explore differences in provider and practice-level continuity.[10]

There are several hypothesized mechanisms by which COC may reduce health care costs. Continuity with a provider or practice can ensure adequate access to care when needed.[9] It

promotes greater familiarity with a patient's medical history and current medical concerns, leading to quicker recognition of new problems and superior management of chronic conditions.[17-20] This familiarity with a patient's medical information can also reduce service duplication.[11] Continuity with a provider fosters increased trust, which can lead to better adherence to treatment and self-care recommendations.[17,20-24] Thus, COC may both directly reduce costs through more efficient use of health care resources and may indirectly reduce costs through improved health outcomes. Our results demonstrated an association between higher continuity and lower rates of ED visits and hospitalizations. ED visits and hospitalizations constitute a significant component of health care costs. Consequently, it suggests that continuity may be associated with lower costs through lower utilization of high-cost services, possibly resulting from improved outcomes.

Continuity of care has primarily been conceptualized in the context of a PCP, who acts as the first point of contact for a patient and is responsible for the provision of comprehensive care to the patient.[20] Prior research would suggest that PCPs and specialists differ in their practice styles; continuity with one type might not necessarily provide the same benefit as continuity with another. For example, numerous studies have demonstrated that specialists deliver a more resource-intensive style of care than do PCPs. As compared to patients under the treatment of PCPs, patients seeing specialists will undergo more diagnostic tests, take a greater quantity of and use more expensive medications, have longer lengths of stay in the hospital, and have higher costs of care.[25-29] The literature regarding differences by provider specialty on health outcomes for specific conditions has been more inconclusive. A number of studies suggest patients receiving care from a specialist have superior outcomes compared with patients receiving care from only a PCP, but a number also demonstrate equivalent outcomes.[27,29-35] It is notable then

that, despite these differences in practice styles, we found lower costs regardless of the type of provider with whom the patient had continuity.

It is also notable that, in terms of expenditures, practice-level continuity provided the same benefit as continuity with an individual provider. Continuity of care has been conceptualized as a hierarchical construct progressing from informational to longitudinal to interpersonal continuity.[9] Practice-level continuity encompasses the first two levels, ensuring that information pertinent to the care of the patient is available to all of the patient's providers and ensuring that a patient has a familiar place to go that is responsible for the coordinated delivery of their care. Provider-level continuity encompasses all three levels of continuity, adding the relationship with a trusted personal provider. Delivery system reform efforts, such as patient-centered medical homes and accountable care organizations, place differing emphases on informational and longitudinal continuity as opposed to interpersonal continuity. Our results suggest that these efforts may encourage similar cost savings.

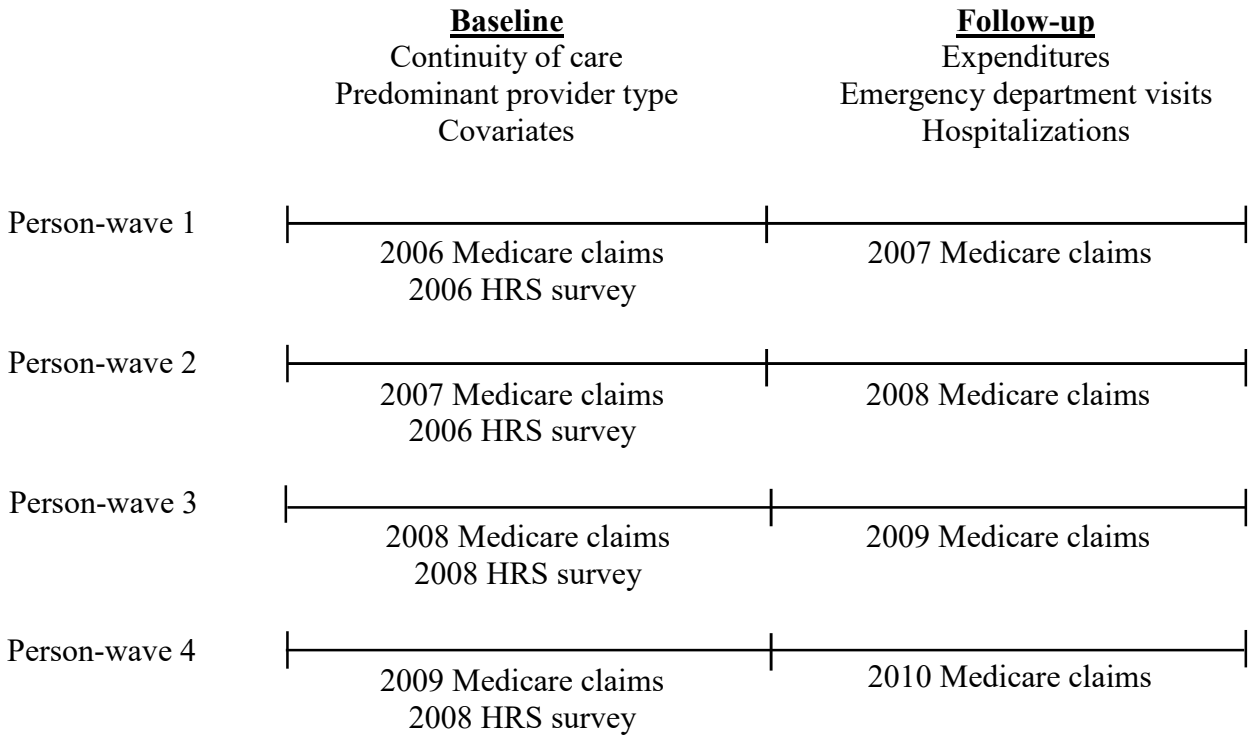
This study had several limitations. First, this was an observational study and, as such, a causal association should not be assumed. Second, the study population was limited to Medicare FFS beneficiaries with two or more chronic conditions. Findings may not be generalizable to younger or healthier populations or those with other types of health insurance. Finally, unmeasured confounding may be an issue. In particular, unmeasured illness severity may influence both patterns of care and costs of care. We were, however, able to incorporate a number of patient-reported health measures into our regression models, allowing for greater control of confounding than most claims-based studies of continuity.

As the population in the United States ages the number of older adults with MCCs is expected to grow as will their accompanying health care costs. Higher COC has been suggested

as a means to reduce costs for this population, but studies supporting this suggestion have been limited. Our study suggests that higher continuity with either a PCP or specialist, or even with a medical practice, has the potential to reduce costs for older adults with MCCs.

4.6 FIGURES

Figure 1. Study design



4.7 TABLES

Table 1. Sociodemographic and health characteristics of subjects during the first person-wave in which they participated

	All subjects (n=6,145)	Predominant provider type	
		Primary care (n=4,310)	Specialist (n=1,835)
Sociodemographic characteristics			
Age in years, mean (sd)	74.7 (7.3)	74.8 (7.4)	74.5 (7.0)
Male, %	40.1	38.1	44.6
Race, %			
Non-hispanic white	80.8	79.9	82.7
Non-hispanic black	11.5	11.6	11.5
Hispanic	6.2	6.8	4.8
Non-hispanic other	1.5	1.7	1.0
Foreign born, %	7.8	8.0	7.4
Marital status, %			
Married	58.9	57.8	61.5
Separated/divorced	9.2	9.2	9.1
Widowed	29.6	30.7	26.9
Never married	2.4	2.3	2.6
Educational attainment, %			
No degree	23.1	25.1	18.5
High school graduate or GED	53.8	53.6	54.2
Associate's degree	3.3	3.4	3.1
Bachelor's degree	11.5	10.7	13.4
Graduate degree	8.3	7.3	10.8
Labor force status, %			
In labor force	18.3	18.4	18.0
Retired	71.3	71.1	71.7
Disabled	1.3	1.4	1.0
Not in labor force	9.1	9.1	9.3
Veteran, %	25.5	23.6	29.9
Household income below poverty threshold, %	8.7	9.5	6.8
Household assets in dollars, %			
< 49,999	21.4	22.8	18.0
50,000 - 174,999	21.3	21.7	20.2
175,000 - 499,999	28.0	28.5	26.9
500,000 +	29.4	27.0	34.9
Beale rural-urban continuum, %			
Metro area	71.6	70.0	75.3

Urban area	27.5	29.0	23.9
Rural area	1.0	1.0	0.8
Baseline health characteristics			
Number of chronic conditions, mean (sd)	4.2 (1.9)	4.2 (1.9)	4.2 (2.0)
Self-rated health, %			
Excellent	7.1	7.7	5.7
Very good	27.0	27.2	26.5
Good	34.1	33.6	35.2
Fair	23.7	23.6	23.9
Poor	8.1	7.9	8.6
Functional status score, mean (sd)	4.5 (3.1)	4.5 (3.1)	4.5 (3.1)
Smoking status, %			
Never smoked	43.8	44.0	43.5
Smoked in the past only	47.5	47.3	48.1
Current smoker	8.7	8.8	8.4

* GED – General education development

* Functional status was defined as the number of mobility, strength, gross motor, and fine motor tasks a subject reported having difficulty performing. Scores ranged from 0-12 with a higher score indicating poorer functioning.

Table 2. Health care utilization during baseline year and outcomes during follow-up year for all person-waves included in analysis

	All waves (n=16,223)	Predominant provider type	
		Primary care (n=11,317)	Specialist (n=4,906)
Healthcare utilization during baseline year			
Total health care expenditures in dollars, mean (sd)	7,786 (13,691)	6,837 (12,114)	9,977 (16,568)
No. of provider visits, mdn (IQR)	9 (9)	9 (8)	11 (10)
No. of providers, mdn (IQR)	4 (3)	4 (3)	5 (4)
No. of practices, mdn (IQR)	4 (3)	3 (3)	4 (3)
Practice-level COCI: all visits, mean (sd)	0.38 (0.25)	0.40 (0.26)	0.32 (0.22)
Practice-level UPC: all visits, mean (sd)	0.56 (0.21)	0.59 (0.22)	0.50 (0.20)
Provider-level COCI: all visits, mean (sd)	0.30 (0.22)	0.32 (0.23)	0.25 (0.18)
Provider-level UPC: all visits, mean (sd)	0.50 (0.20)	0.52 (0.21)	0.45 (0.17)
Provider-level COCI: primary care visits, mean (sd)	0.75 (0.30)	0.79 (0.29)	--
Provider-level UPC: primary care visits, mean (sd)	0.85 (0.19)	0.88 (0.18)	--
Provider-level COCI: specialty care visits, mean (sd)	0.28 (0.23)	--	0.36 (0.25)
Provider-level UPC: specialty care visits, mean (sd)	0.50 (0.20)	--	0.55 (0.21)
Outcomes during follow-up year			
Total health care expenditures in dollars, mean (sd)	8,013 (14,383)	7,171 (12,653)	9,957 (17,590)
Number of ED visits, %			
0	70.8	70.9	70.5
1-2	24.7	24.5	25.2
3+	4.5	4.6	4.3
Number of hospitalizations, %			
0	81.2	81.8	79.6
1	13.0	12.6	13.9
2+	5.9	5.6	6.5

* COCI – Continuity of care index
* UPC – Usual provider continuity index
* Primary care continuity calculated only amongst those with two or more visits to a primary care provider (n=11,871)

* Specialty care continuity calculated only amongst those with two or more visits to a specialty care provider (n=11,973)

Table 3. Multivariate regression results showing associations between Bice-Boxerman Continuity of Care Index and expenditures, emergency department visits, and hospitalizations

	Bice-Boxerman Continuity of Care Index					
	Provider-level					
	All subjects		**Primary care predominant provider**		**Specialty care predominant provider**	
	Medium (referent: Low) IRR (95% CI)	**High (referent: Low) IRR (95% CI)**	**Medium (referent: Low) IRR (95% CI)**	**High (referent: Low) IRR (95% CI)**	**Medium (referent: Low) IRR (95% CI)**	**High (referent: Low) IRR (95% CI)**
No. of ED visits	0.91 (0.85, 0.98)*	0.90 (0.83, 0.98)*	0.90 (0.83, 0.99)*	0.91 (0.83, 1.00)	0.90 (0.79, 1.02)	0.88 (0.77, 1.02)
No. of hospitalizations	0.95 (0.87, 1.05)	0.99 (0.89, 1.09)	0.98 (0.87, 1.09)	1.03 (0.92, 1.15)	0.90 (0.77, 1.06)	0.88 (0.74, 1.04)
	e^{β} (95% CI)	**e^{β} (95% CI)**	**e^{β} (95% CI)**	**e^{β} (95% CI)**	**e^{β} (95% CI)**	**e^{β} (95% CI)**
Total expenditures	0.92 (0.86, 0.98)**	0.85 (0.80, 0.91)***	0.90 (0.84, 0.97)**	0.89 (0.82, 0.96)**	0.93 (0.83, 1.05)	0.88 (0.79, 0.98)*
	Practice-level					
	IRR (95% CI)	**IRR (95% CI)**	**IRR (95% CI)**	**IRR (95% CI)**	**IRR (95% CI)**	**IRR (95% CI)**
No. of ED visits	0.98 (0.91, 1.06)	1.04 (0.96, 1.13)	0.98 (0.90, 1.07)	1.02 (0.93, 1.12)	0.96 (0.84, 1.08)	1.01 (0.87, 1.16)
No. of hospitalizations	0.96 (0.87, 1.05)	0.94 (0.85, 1.04)	0.94 (0.84, 1.06)	0.93 (0.83, 1.04)	0.93 (0.79, 1.09)	0.94 (0.80, 1.11)
	e^{β} (95% CI)	**e^{β} (95% CI)**	**e^{β} (95% CI)**	**e^{β} (95% CI)**	**e^{β} (95% CI)**	**e^{β} (95% CI)**
Total expenditures	0.89 (0.83, 0.95)***	0.85 (0.79, 0.91)***	0.86 (0.80, 0.92)***	0.85 (0.79, 0.92)***	0.94 (0.84, 1.06)	0.87 (0.78, 0.98)*

*p<0.05

**p<0.01

***p<0.001

* ED – Emergency department

* IRR – Incidence rate ratio

Table 4. Multivariate regression results showing associations between Usual Provider Continuity Index and expenditures, emergency department visits, and hospitalizations

	Usual Provider Continuity Index					
	All subjects		**Provider-level**			
			Primary care predominant provider		**Specialty care predominant provider**	
	Medium (referent: Low) IRR (95% CI)	**High (referent: Low) IRR (95% CI)**	**Medium (referent: Low) IRR (95% CI)**	**High (referent: Low) IRR (95% CI)**	**Medium (referent: Low) IRR (95% CI)**	**High (referent: Low) IRR (95% CI)**
No. of ED visits	0.90 (0.83, 0.97)**	0.86 (0.79, 0.93)***	0.91 (0.84, 1.00)*	0.85 (0.78, 0.94)**	0.88 (0.77, 1.00)*	0.85 (0.74, 0.99)*
No. of hospitalizations	0.86 (0.78, 0.94)**	0.88 (0.80, 0.97)*	0.89 (0.80, 1.00)	0.91 (0.80, 1.02)	0.86 (0.74, 1.01)	0.79 (0.66, 0.94)*
	e^{β} (95% CI)	**e^{β} (95% CI)**	**e^{β} (95% CI)**	**e^{β} (95% CI)**	**e^{β} (95% CI)**	**e^{β} (95% CI)**
Total expenditures	0.85 (0.79, 0.90)***	0.79 (0.74, 0.84)***	0.87 (0.80, 0.93)***	0.83 (0.76, 0.90)***	0.92 (0.82, 1.02)	0.82 (0.73, 0.92)**
			Practice-level			
	IRR (95% CI)	**IRR (95% CI)**	**IRR (95% CI)**	**IRR (95% CI)**	**IRR (95% CI)**	**IRR (95% CI)**
No. of ED visits	0.97 (0.90, 1.04)	0.94 (0.86, 1.02)	0.95 (0.87, 1.04)	0.99 (0.90, 1.09)	0.89 (0.78, 1.00)	0.90 (0.78, 1.04)
No. of hospitalizations	0.92 (0.83, 1.01)	0.86 (0.78, 0.95)**	0.95 (0.85, 1.07)	0.91 (0.81, 1.03)	0.79 (0.67, 0.93)**	0.81 (0.68, 0.95)*
	e^{β} (95% CI)	**e^{β} (95% CI)**	**e^{β} (95% CI)**	**e^{β} (95% CI)**	**e^{β} (95% CI)**	**e^{β} (95% CI)**
Total expenditures	0.88 (0.83, 0.94)***	0.79 (0.74, 0.85)***	0.88 (0.82, 0.94)***	0.84 (0.77, 0.91)***	0.87 (0.77, 0.98)*	0.78 (0.69, 0.88)***

*p<0.05

**p<0.01

***p<0.001

* ED – Emergency department

* IRR – Incidence rate ratio

4.8 APPENDIX

List of chronic conditions used to count number of chronic conditions at baseline (chronic conditions identified using the Medicare Chronic Condition Warehouse indicators available in the claims data – www.ccwdata.org):

Acquired hypothyroidism
Alzheimer's disease and related disorders
Anemia
Asthma
Atrial fibrillation
Benign prostatic hyperplasia
Cancer (combines breast, colorectal, prostate, lung, and endometrial)
Chronic kidney disease
Chronic obstructive pulmonary disease
Congestive heart failure
Depression
Diabetes
Eye disorders (combines cataract and glaucoma)
Hip or pelvic fracture
Hyperlipidemia
Hypertension
Ishcemic heart disease (combines acute myocardial infarction and ischemic heart disease)
Osteoporosis
Rheumatoid arthritis and osteoarthritis
Stroke or transient ischemic attack

Bice and Boxerman Continuity of Care Index (COCI) formulas:

(3) $$\text{Provider-level continuity}_{COCI} = \frac{\sum_{j=1}^{s} n_j^2 - N}{N(N-1)}$$

N = the total number of provider visits during the study period
n_j = the number of visits to provider j
s = the total number of providers seen during the study period

(4) $$\text{Practice-level continuity}_{COCI} = \frac{\sum_{i=1}^{q} n_i^2 - N}{N(N-1)}$$

N = the total number of provider visits during the study period
n_i = the number of visits to practice i
q = the total number of practices visited during the study period

Usual Provider Continuity Index (UPC) formulas:

(3) $\text{Provider-level continuity}_{UPC} = n/N$

N = the total number of provider visits during the study period
n = the number of visits to the predominant provider during the same period

(4) $\text{Practice-level continuity}_{UPC} = q/N$

N = the total number of provider visits during the study period
q = the number of visits to the practice most frequently attended during the same period

Health care provider taxonomy codes classified as primary care:

- General practice: 208D00000X
- Family medicine (restricted to general family medicine, adult medicine, geriatric medicine): 207Q00000X, 207QA0505X, 207QG0300X
- Internal medicine (restricted to general internal medicine, geriatric medicine): 207R00000X, 207RG0300X
- Preventive medicine (restricted to public health and general preventive medicine): 2083P0901X
- Nurse practitioner (restricted to general NP, acute care, adult health, community health, family, gerontology, primary care, women's health): 363L00000X, 363LA2100X, 363LA2200X, 363LC1500X, 363LF0000X, 363LG0600X, 363LP2300X, 363LW0102X
- Clinical nurse specialist (restricted to general, adult health, community health, family health, gerontology, holistic, women's health, home health, acute care, chronic care): 364S00000X, 364SA2200X, 364SC1501X, 364SF0001X, 364SG0600X, 364SH1100X, 364SH0200X, 364SW0102X, 364SA2100X, 364SC2300X
- Physician assistant (restricted to general, medical): 363A00000X, 363AM0700X

Health care provider taxonomy codes classified as specialty care:

- Allergy and immunology: 207K******
- Anesthesiology: 207L******
- Colon and rectal surgery: 208C00000X
- Dermatology: 207N******
- Emergency medicine: 207P******
- Family medicine (excludes those codes listed above in primary care): 207Q******
- Hospitalist: 208M00000X
- Internal medicine (excludes those codes listed above in primary care): 207R******
- Clinical genetics: 207SG0201X
- Neurological surgery: 207T00000X
- Nuclear medicine: 207U******
- Neuromusculoskeletal medicine and OMM: 204D00000X

- Neuromusculoskeletal medicine, sports medicine: 204C00000X
- Obstetrics and gynecology: 207V******
- Ophthalmology: 207W******
- Oral and maxillofacial surgery: 204E00000X
- Orthopedic surgery: 207X******
- Otolaryngology: 207Y******
- Physical medicine and rehabilitation: 2081******
- Plastic surgery: 2082******
- Preventive medicine (excludes those codes listed above in primary care): 2083******
- Psychiatry and neurology: 2084******
- Pain medicine: 208VP*****
- Radiology: 2085******
- Surgery: 2086******
- Thoracic surgery: 208G00000X
- Transplant surgery: 204F00000X
- Urology: 2088******
- Clinical neuropsychologist: 103G******
- Counselor: 101Y******
- Psychologist: 103T******
- Social worker: 1041******
- Chiropractor: 111N******
- Optometrist: 152W******
- Clinical nurse specialist (excludes those codes listed above in primary care): 364S******
- Nurse practitioner (excludes those codes listed above in primary care): 363L******
- Physician assistant (excludes those codes listed above in primary care): 363A******
- Podiatrist: 213E******

CPT codes used to identify evaluation and management visits in the carrier file:
From the CPT evaluation and management code category:
99201, 99202, 99203, 99204, 99205, 99211, 99212, 99213, 99214, 99215, 99241, 99242, 99243, 99244, 99245, 99324, 99325, 99326, 99327, 99328, 99334, 99335, 99336, 99337, 99341, 99342, 99343, 99344, 99345, 99347, 99348, 99349, 99350, 99354, 99355, 99386, 99387, 99396, 99397, G0402, G0438, G0439, 99401, 99402, 99403, 99404, 99406, 99407, 99408, 99409, 99411, 99412, 99420, 99429

From the BETOS evaluation and management code category:
90801, 90802, 90804, 90805, 90806, 90807, 90808, 90809, 90810, 90811, 90812, 90813, 90814, 90815, 90845, 90847, 92002, 92004, 92012, 92014

Revenue center codes used to identify outpatient visits to federally qualified health centers and rural health centers in the outpatient file:
0521, 0522

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Chapter 5. CONCLUSION

5.1 SUMMARY

In 2010, 13% of the United States (U.S.) population was 65 years of age or older. By 2030, this number is projected to rise to nearly 20%.[1] As a result of this demographic shift, the number of older adults with multiple chronic conditions (MCCs) is expected to increase dramatically in the coming years. Despite the increasing prevalence of multimorbidity, the U.S. health care system remains focused on the diagnosis and care of single diseases.[2] Very little clinical and health services research is conducted within the population of patients with MCCs.[2-5] Consequently, there is a significant need to identify effective care practices for this population to improve their outcomes and lower their health care costs.

This dissertation attempts to address this need by focusing on one particular process of care, continuity of care (COC) with individual health care providers and practices. To address the specific dissertation aims, survey data from the Health and Retirement Study (HRS) and linked Medicare claims data were used. The HRS produces data that is nationally representative and thus, findings from the dissertation may be generalizable broadly in the U.S. population of adults 65 years of age and older.

Aim 1 contributes novel results on the association between morbidity burden and COC. Our findings suggest that multimorbidity is an independent risk factor for lower COC. Results demonstrated a significant association between increasing morbidity burden and lower provider and practice-level COC. The magnitude of the association was such that people with high levels of morbidity burden would be expected to experience a decrease in continuity that was clinically meaningful, and could impact their clinical outcomes. Interestingly, associations differed depending on whether patients primarily saw a primary care provider (PCP) or specialist for their

health care visits. Among those seeing primarily a specialist, the negative association was somewhat stronger and was evident in their continuity with both primary and specialty care providers. Among those seeing primarily a PCP, the negative association was limited to visits with specialty care providers.

Aim 2 contributes to the literature by providing the first examination of the association between COC and a patient-reported health outcome. Overall, we found that neither provider nor practice-level continuity was significantly associated with functional status decline. However, we again found some interesting differences when we delved further and stratified patients by the type of provider they primarily saw for their health care visits. Though we observed no association between primary care continuity and functional status decline among patients seeing primarily a PCP, we did find that specialty care continuity was significantly associated with a lower odds of functional status decline among patients seeing primarily a specialty care provider.

Aim 3 addresses limitations in the literature regarding COC and health care costs by focusing on older adults with MCCs and examining differences in the association depending on provider type and continuity level. We observed a significant association between higher continuity and lower costs that was irrespective of provider type and provider or practice levels. Our results also suggested the lower costs may have arisen from lower rates of emergency department visits and hospitalizations among those with higher COC.

5.2 FUTURE RESEARCH

Our findings suggest several avenues for future research. For instance, results from Aim 1 demonstrated a significant association between higher morbidity burden and lower COC. Our study was limited to patients with Medicare fee-for-service plans, under which patients are able to visit any covered provider without a referral. This may contribute to unnecessary reductions in

care continuity. Thus, it would be informative to investigate the association within an integrated health system, where greater control is exerted over access to specialized providers in the system's provider network. Findings from Aims 1 and 2 also demonstrated some important differences in the characteristics, care patterns, and outcomes of patients seeing primarily a PCP for their visits compared with patients who primarily see a specialist. Future COC studies should incorporate provider type into their analyses. Some medical care organizations are now delivering primary care services through a team of providers. Thus, a further extension on provider type would be an examination of COC with a provider team. Is continuity with the team important or is it more important to have continuity with the leading physician? Finally, given the increasing prominence of patient-reported measures as tools guiding decision-making in clinical care and evaluating health care quality, additional studies are needed that explore the relationships between COC and frequently used patient-reported measures.

Beyond the specific findings of this dissertation, a couple of other avenues exist to move the COC literature forward. First, all recent studies of COC have relied on observational data. Consequently, it is challenging to draw conclusions about causal relationships between COC and outcomes of interest. In the conduct of this dissertation, several possible instrumental variables were examined as a means to addressing this shortcoming. However, we failed to identify any that were sufficiently strong to use in an analysis. Future studies using instrumental variables or natural experiments to strengthen causal inference would contribute significantly to this area of research. Second, numerous studies have explored the associations between COC and various outcomes of care, but there is a dearth of studies on the mechanisms by which COC may be influencing outcomes. A number of possible causal pathways have been hypothesized in the literature, however, evidence elucidating the relevant pathways would be extremely informative.

Qualitative studies examining the pathways in-depth might be particularly useful for this area of research.

5.3 IMPLICATIONS FOR CLINICAL PRACTICE AND HEALTH POLICY

Our findings lend further support for the value of COC, a process of care that should be encouraged, particularly among high morbidity patients who are at risk of greater care fragmentation. They also provide insight into the possible effects of delivery system reform efforts that emphasize COC. Our results suggest they may provide benefits in terms of costs and utilization, though not necessarily patient-reported health outcomes. They also suggest that emphases on different levels of continuity might not produce appreciable differences in terms of lowered costs, but differences may arise for patient-reported health outcomes. Our findings also speak to the role of specialists in the care of patients with MCCs. While results from Aims 2 and 3 suggest that continuity with one type might not be more or less beneficial than continuity with another, Aim 1 results show that patients who primarily saw a specialist for their health care visits had lower levels of continuity and were at particular risk of lower continuity with higher morbidity burden. Overall, our findings suggest that medical care organizations should take meaningful steps to support care continuity. Possible ways this may be accomplished include reductions in physician turnover, scheduling mechanisms, or through careful construction of provider panels.

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