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Continuity of Care and the Risk of Preventable Hospitalization in Older Adults

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Abstract

IMPORTANCE—Preventable hospitalizations are common among older adults for reasons that are not well understood.

OBJECTIVE—To determine whether Medicare patients with ambulatory visit patterns indicating higher continuity of care have a lower risk of preventable hospitalization.

DESIGN—Retrospective cohort study.

SETTING—Ambulatory visits and hospital admissions.

PARTICIPANTS—Continuously enrolled fee-for-service Medicare beneficiaries older than 65 years with at least 4 ambulatory visits in 2008.

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Study concept and design: Nyweide, Anthony, Bynum, Weeks, Casalino, Fisher.
Acquisition of data: Nyweide.
Analysis and interpretation of data: Nyweide, Anthony, Bynum, Strawderman, Weeks, Casalino.
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Study supervision: Anthony, Bynum, Weeks, Fisher.

EXPOSURES—The concentration of patient visits with physicians measured for up to 24 months using the continuity of care score and usual provider continuity score on a scale from 0 to 1.

MAIN OUTCOMES AND MEASURES—Index occurrence of any 1 of 13 preventable hospital admissions, censoring patients at the end of their 24-month follow-up period if no preventable hospital admissions occurred, or if they died.

RESULTS—Of the 3 276 635 eligible patients, 12.6% had a preventable hospitalization during their 2-year observation period, most commonly for congestive heart failure (25%), bacterial pneumonia (22.7%), urinary infection (14.9%), or chronic obstructive pulmonary disease (12.5%). After adjustment for patient baseline characteristics and market-level factors, a 0.1 increase in continuity of care according to either continuity metric was associated with about a 2% lower rate of preventable hospitalization (continuity of care score hazard ratio [HR], 0.98 [95% CI, 0.98–0.99; usual provider continuity score HR, 0.98 [95% CI, 0.98–0.98). Continuity of care was not related to mortality rates.

CONCLUSIONS AND RELEVANCE—Among fee-for-service Medicare beneficiaries older than 65 years, higher continuity of ambulatory care is associated with a lower rate of preventable hospitalization.

Upward of $25 billion in annual health care spending in the United States is attributable to preventable hospitalizations, defined as admissions that potentially could be avoided with better treatment of acute conditions or management of chronic conditions in ambulatory care.[1] Preventable hospitalizations occur disproportionately in elderly patients,[2] particularly for the more than 80% of older adults with at least 1 chronic illness.[3] The most common reason for preventable hospitalization in 2007, congestive heart failure (CHF), occurred at a rate of 14.3 per 10 000 for adults 45 to 64 years old but at a rate of 190.5 per 10 000 for adults 65 years or older.[4]

Understanding the factors beyond poor health that contribute to older adults' risk of preventable hospitalization has been elusive. Preventable hospitalizations may stem in part from difficulty in accessing ambulatory care,[5] although the Medicare program eases financial barriers to care for older adults in the United States. Socioeconomic gradients seem to have little to no effect among the elderly population after controlling for other individual characteristics such as age, sex, health status, and prior utilization.[6–8] Likewise, differences in preventable hospitalization between blacks and whites seem to be mixed or nonexistent.[2,6–8]

The Agency for Healthcare Research and Quality (AHRQ) has called for more research on how ambulatory care affects the risk of preventable hospitalization.[9] For example, older adults in fair or poor health who reside in areas with a shortage of primary care are 70% more likely to have a preventable hospitalization after controlling for their individual-level characteristics,[10] yet the risk factors for older adults in the health care system as a whole are unclear. A high number of annual office visits has been shown to be a risk factor for preventable hospitalization in elderly individuals,[6] which may partly reflect the fact that sicker patients need more care. It is not known, however, whether fragmented visit patterns are related to preventable hospitalization. The average Medicare patient 65 years or older sees a median of 7 physicians annually.[11] Older adults with multiple visits across a variety of physicians may be more prone to a preventable hospitalization arising from deficiencies in the delivery of care, such as poor information transfers between multiple health care providers.[12,13] Previous research has shown that higher continuity of care is related to less hospital utilization in other patient populations.[14–18] We studied the relationship between

continuity of care and the risk of preventable hospitalization among the elderly Medicare population.

Methods

Beneficiary Sample

The beneficiary sample was based on the 2008 20% sample of fee-for-service Medicare beneficiaries. Eligible beneficiaries were older than 65 years and continuously enrolled in fee-for-service Medicare with at least 4 visits, either ambulatory evaluation and management visits in Part B claims or visits to rural health clinics or federally qualified health centers in outpatient claims (n = 3 276 635 beneficiaries). Claims and enrollment data from 2007 and 2008 were used to measure baseline risk of preventable hospitalization, and 2008–2010 claims data were used to measure continuity and the first preventable hospitalization, if one occurred, during the observation period for each patient included in the analysis. Institutional review was not necessary because the study involved analysis of secondary data.

Preventable Hospitalization

The Medicare Provider Analysis and Review 2009 and 2010 files were used to identify preventable hospitalizations using the Prevention Quality Indicators definitions and technical specifications from the AHRQ that are also endorsed by the National Quality Forum.[19] A preventable hospitalization was indicated by the occurrence of any 1 of 13 AHRQ Prevention Quality Indicators: angina without procedure, asthma, bacterial pneumonia, CHF, chronic obstructive pulmonary disease (COPD), dehydration, short- or long-term complications from diabetes mellitus, uncontrolled diabetes mellitus, diabetes mellitus–related lower extremity amputation, hypertension, perforated appendix, or urinary infection.

Measuring Continuity

Continuity was conceptualized as the degree to which a patient's visits are concentrated among providers. Using this definition, we measured continuity using 2 separate metrics. The primary metric, the continuity of care score, is based on the Herfindahl-Hirschman index, which is a measure of market share–in this case, physicians' share of a patient's visits.[20] It measures the concentration of a patient's visit pattern by ascribing a higher score to visit patterns in which a larger share of the patient's total visits are with fewer providers.[21] The secondary metric, the usual provider continuity score, measures the highest concentration of a patient's total visits to a single provider[22] (see Table 1 and eFigure in the Supplement for further explanation).

Both continuity metrics were calculated based on a patient's ambulatory evaluation and management visits with physicians or visits to rural health clinics or federally qualified health centers. The unique provider identifier in claims data transitioned from Unique Physician Identification Number (UPIN) to National Provider Identifier (NPI) during 2007 and 2008, so all UPINs in 2008 were converted to NPIs using a crosswalk file. Approximately 1% of ambulatory evaluation and management claims could not be crosswalked to a unique NPI and were removed from the analysis. The specialty code in Part B claims was used to identify the NPIs of physicians, but because outpatient claims do not include the specialty code, each NPI in outpatient claims was effectively considered a unique physician. By including all visits to rural health clinics or federally qualified health centers in outpatient claims, some visits would have been with nonphysician providers, such as nurse practitioners or physician assistants.

Because continuity cannot be assessed well with few visits and it is relatively easy to attain a minimum continuity of care score of 0 or maximum continuity of care score of 1 with a total of 1, 2, or 3 visits, analyses were restricted to patients with 4 or more visits in 2008, which represented approximately 74% of otherwise eligible patients.[23]

Covariates

Beneficiary characteristics from the 2008 Beneficiary Summary File in the Chronic Condition Warehouse[24] were used to assess baseline risk of preventable hospitalization and included age, sex, race, Medicaid dual-eligible status, and residential zip code. Sex was coded as female or not, and race was coded into 5 categories: white non-Hispanic, black, Hispanic, Asian, or other race.[25] A beneficiary with any enrollment in Medicaid was considered a dual-eligible beneficiary. Baseline illness burden was accounted for in 3 ways. First, the Hierarchical Condition Categories score was measured from 2007 data and divided into data-derived quartiles for easier interpretation (low, 0–0.55; mild, 0.56–0.92; moderate, 0.93–1.54; severe, ≥1.55). The hierarchical classification system was developed for risk adjustment for Medicare patients and gives more weight to comorbidities that have a larger bearing on utilization.[26] In addition, total visits and total preventable hospitalizations occurring in the 365 days prior to a patient's fourth visit in 2008 were included to control for baseline illness burden since sicker patients generally need more visits and have more hospitalizations.[14,17] Beneficiary residential zip code was linked to hospital referral region to control for the fixed effects of regional market-related characteristics, such as hospital bed supply and practice styles that can affect diagnostic coding practices.

Statistical Analyses

We used time-dependent Cox proportional hazards regression to determine the relationship between continuity and rate of preventable hospitalization. Time-dependent Cox proportional hazards regression allowed visit patterns to be more accurately captured at different points during each patient's observation period.[27] Time was measured monthly starting from the first month a patient accumulated at least 4 visits during 2008 and ending up to 24 months later. The continuity of care score and usual provider continuity score were recalculated cumulatively each succeeding month until the occurrence of the event–a preventable hospitalization in 2008, 2009, or 2010–or if no preventable hospitalization occurred, until the patient was censored at date of death or the end of his or her 24-month observation period. If there were no visits in a particular month, then the values of time-dependent variables would carry over from the previous month. The highest percentage of visits with 1 physician in the usual provider continuity score was not necessarily measured relative to the same physician across months.

Because the continuous versions of the continuity of care score and usual provider continuity score are on a 0–1 scale, the regression parameter represents the 1-unit change in the log-hazard ratio from the lowest value of 0 to the highest value of 1. To make the results more interpretable, we multiplied these scores by 10; the regression parameter estimate then corresponds to the effect of a 0.1-unit increment in the score on the original 0–1 scale. Separate models were constructed for each continuity metric, with adjusted models including all covariates. Several sensitivity analyses were undertaken to check whether the results were robust to baseline risk stratification, "healthy survivor" effects, patients with 1 or more visits, lagged values of continuity scores, and for subgroups of chronically ill patients.[28]

To perform the analyses, the SAS PHREG procedure was used with the Efron option to account for tied events (SAS EG, version 4.3).

Results

The baseline demographic characteristics of patients who had at least 4 ambulatory visits are shown in Table 2. Of 3 276 635 eligible patients, 12.6% had a preventable hospitalization during the 2-year period. Compared with the other patients, those with a preventable hospitalization were slightly older; a higher proportion were black or Hispanic, or Medicaid dual eligible; and had a greater illness burden and more visits and preventable hospitalizations in the year preceding their observation period. Table 3 displays the distribution of preventable hospitalizations by type, the most prevalent reason being CHF (25%), followed by bacterial pneumonia (22.7%), urinary infection (14.9%), and COPD (12.5%).

Table 4 shows snapshots of the mean continuity scores of patients who did and did not have a preventable hospitalization every 6 months. Over the course of 24 months of observation, patients with a preventable hospitalization had lower continuity for both continuity metrics relative to those without a preventable hospitalization.

The continuity of care score was associated with a change in preventable hospitalization rates in bivariate and multivariate models (Table 5). In the bivariate models, a 0.1-unit increase in the continuity of care score or usual provider continuity score reduced the rate of preventable hospitalization about 2% (continuity of care score hazard ratio [HR], 0.98 [95% CI, 0.98–0.98]; usual provider continuity score HR, 0.98 [95% CI, 0.97–0.98]). The rate remained unchanged in the multivariate models (continuity of care score adjusted HR, 0.98 [95% CI, 0.98–0.99]; usual provider continuity score adjusted HR, 0.98 [95% CI, 0.98–0.98]). In the multivariate models, patients who were female, black, Hispanic, or Medicaid dual-eligible were at a higher risk of preventable hospitalization. Sicker patients were more likely to incur a preventable hospitalization: compared with patients with low illness burden, those with mild, moderate, or severe illness burden were incrementally more likely to have a preventable hospitalization. Patients with more visits or preventable hospitalizations in the year prior to the start of their observation periods were more likely to have a preventable hospitalization as well.

Sensitivity analyses showed that continuity of care was unrelated to mortality rates (see eMethods and eTables 1–5 in the Supplement). Higher continuity was associated with a lower rate of preventable hospitalization for the year preceding a preventable hospitalization during the study period and specifically for patients with CHF and diabetes mellitus. The sensitivity analyses otherwise yielded similar results to the main analyses, although there was some evidence of a slight increase in rate of preventable hospitalization for patients with COPD (continuity of care score adjusted HR, 1.02 [95% CI, 1.01–1.02]; usual provider continuity score adjusted HR, 1.01 [95% CI, 1.01–1.02]).

Discussion

Because preventable hospitalizations may be a consequence of poor ambulatory care, we sought to determine if the continuity of ambulatory visits among fee-for-service Medicare patients was related to preventable hospitalization. Our analysis showed an association between a higher level of continuity and a decreased rate of preventable hospitalization, even after adjustment for the patient's illness burden. Measuring continuity using either the continuity of care score or usual provider continuity score showed that more-concentrated visit patterns were associated with about a 2% reduced rate of preventable hospitalization per 0.1-unit increase in each continuity metric. To provide some perspective of the magnitude of this effect, a patient with the highest value of continuity of 1 compared with a

patient with the lowest value of 0 would have roughly a 20% reduction in the rate of preventable hospitalization.

Previous studies with different methodological approaches and patient populations have demonstrated a reduction in risk of hospitalization for patients with higher continuity of care scores. Among pediatric patients, the risk of visiting the emergency department or being hospitalized decreased up to almost 40% with higher continuity.[18] The relative risk of emergent hospitalization was halved for elderly men with higher continuity.[16] For all age groups in Taiwan, higher continuity was associated with as much as a 60% reduction in risk of avoidable hospitalization.[17] Our study extends prior research by examining this question in the older adults in the fee-for-service Medicare program.

Our study measured continuity using claims data rather than patient reports. Although claims data have been shown to minimize recall biases that can overestimate the relationship between continuity and outcomes of care,[29] they do not illuminate the reasons why some patients have higher continuity of care. It is possible that patients with higher continuity may have a usual care physician who maintains contact with them to reduce the chance that they are referred to specialists but no longer have a single physician at the center of their care. Although the continuity metrics are not able to directly measure activities related to coordination of care, it is plausible that visit patterns indicative of higher continuity indicate more coordination or make it easier for physicians to coordinate care. Coordination of care activities, such as orchestrating referrals, managing prescriptions, or ensuring that patient information is transferred clearly between physicians, might lessen a patient's susceptibility to a hospital admission. An alternative, though not mutually exclusive, explanation for our results is that patients with lower continuity of care may differ from patients with higher continuity in ways that we were unable to measure. Patients, for example, might have preferences for seeing many physicians or be sicker in ways not accounted for by the risk adjustment methods we used.

Our study has several additional limitations. First, organizational affiliations cannot be reliably identified from claims data, so we were unable to study continuity of care at the practice level.[30] Second, we do not know the extent to which patients who saw multiple physicians were referred by physicians to each other or simply chosen by the patient. Third, because higher hierarchical condition categories scores may reflect more intense diagnostic coding practices in different areas of the country, we may have overadjusted for illness burden. We compensated for this possibility by using hospital referral region fixed effects in the full models.[31] Fourth, we analyzed death and preventable hospitalization as independent competing risks. In fact, death and preventable hospitalization are semicompeting risks because death can censor preventable hospitalization but not vice versa.[32] Consequently, the extent to which death and preventable hospitalization are dependent might distort the relationship between continuity and preventable hospitalization, particularly if continuity is also strongly related to mortality. In sensitivity analyses, we found that continuity was unrelated to mortality, helping to mitigate such concerns. Fifth, our analysis was restricted to older fee-for-service Medicare beneficiaries; we did not study beneficiaries enrolled in Medicare Advantage plans or beneficiaries younger than 65 years. Finally, the association we found between higher continuity of care and lower risk of preventable hospitalization cannot be used to assert that this relationship is causal.

Our findings may be of interest to policymakers and physicians. Continuity is frequently claimed to be an integral part of delivering primary care,[33] yet fee-for-service Medicare patients make many visits each year to different physicians, and these visits are frequently not coordinated. Efforts to strengthen physicians' ability to provide high-quality primary care through, for example, patient-centered medical homes,[34,35] may help patients cultivate

a relationship with a physician they trust, improve their continuity of care, and perhaps help to deter the occurrence of some hospital admissions.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Comparison of the Continuity of Care Score and Usual Provider Continuity Score

Name	Definition	Formula	Range	Strengths	Limitations
Continuity of care score	Relative concentration of patient's visit pattern across visits with all health care providers	$(\Sigma n_i^2 - N) / N(N - 1)$, where n_i = number of visits that the patient has with the *i*th physician and N = total visits	0–1	Accounts for distribution of visits across all health care providers Value increases with more visits to the same health care providers and decreases as health care providers are added to the visit pattern	Unstable for visit patterns with 1, 2, or 3 total visits
Usual provider continuity score	Proportion of a patient's visits that are with the most commonly visited health care provider	n/N, where n = number of visits with the physician with whom the patient has the most visits and N = total visits	0–1	Simple to understand	Measured with respect to a single health care provider, who a patient may not consider his or her usual health care provider Value can stay constant regardless of how dispersed visits are across health care providers

Table 2

Patient Baseline Demographic Characteristics[a]

Characteristic	Preventable Hospitalization, %	No Preventable Hospitalization, %
No. (%)	414 198 (12.6)	2 862 437 (87.4)
Female	59.9	59.2
Age, mean (SD), y	79.5 (7.8)	76.0 (7.4)
Race/ethnicity		
White non-Hispanic	85.1	85.5
Black	7.7	6.2
Hispanic	4.7	4.6
Asian	1.4	2.5
Other	1.0	1.1
Medicaid dual eligibility	22.1	12.9
Hierarchical condition categories score		
Low	7.5	28.0
Mild	14.1	26.2
Moderate	26.2	24.8
Severe	52.2	21.1
Total visits in prior year, mean (SD)	12.3 (8.2)	9.5 (6.3)
Total preventable hospitalizations in prior year, mean (SD)	0.23 (0.6)	0.04 (0.2)

[a]Medicare patients older than 65 years with at least 4 ambulatory visits during up to 2 years of follow-up between 2008 and 2010. Total visits and preventable hospitalizations in prior year refer to utilization that occurred during the 365 days before the start of a patient's observation period in 2008.

No statistical comparisons were made because significance is easily reached with large numbers of observations.

Table 3

Preventable Hospitalizations by Type[a]

Type	No. (%)
Congestive heart failure	103 752 (25.0)
Bacterial pneumonia	94 025 (22.7)
Urinary infection	61 531 (14.9)
Chronic obstructive pulmonary disease	51 577 (12.5)
Dehydration	44 657 (10.8)
Diabetes mellitus[b]	22 762 (5.5)
Asthma	15 081 (3.6)
Hypertension	12 337 (3.0)
Angina	4737 (1.1)
Perforated appendix	2633 (0.6)
Diabetes mellitus–related amputation	1106 (0.3)
Total	**414 198 (100)**

[a]Total number of initial preventable hospitalizations by type between 2008 and 2010 for Medicare patients older than 65 years with at least 4 ambulatory visits.

[b]Includes short- and long-term complications of diabetes mellitus as well as uncontrolled diabetes mellitus.

Table 4

Continuity of Care Over Time by Preventable Hospitalization Status[a]

	Preventable Hospitalization		No Preventable Hospitalization	
Month	**No.**	**Mean (SD)**	**No.**	**Mean (SD)**
Continuity of Care Score				
1	414 198	0.358 (0.28)	2 862 437	0.350 (0.28)
6	316 634	0.350 (0.24)	2 807 291	0.345 (0.24)
12	226 929	0.337 (0.22)	2 747 215	0.337 (0.22)
18	152 270	0.323 (0.21)	2 693 968	0.327 (0.21)
24	84 304	0.306 (0.20)	2 641 889	0.319 (0.21)
Usual Provider Continuity Score				
1	414 198	0.578 (0.22)	2 862 437	0.575 (0.22)
6	316 634	0.535 (0.21)	2 807 291	0.537 (0.21)
12	226 929	0.509 (0.21)	2 747 215	0.514 (0.20)
18	152 270	0.490 (0.20)	2 693 968	0.497 (0.20)
24	84 304	0.471 (0.19)	2 641 889	0.486 (0.20)

[a] Mean values of the continuity of care score and usual health care provider continuity score for Medicare patients older than 65 years with at least 4 ambulatory visits at 6-month intervals for patients who had and did not have a preventable hospitalization between 2008 and 2010.

Table 5

Relationship of Continuity of Care and Rate of Preventable Hospitalization[a]

	Hazard Ratio (95% CI)	
Characteristic	**Continuity of Care Score**	**Usual Provider Continuity Score**
Bivariate model		
Continuity	0.98 (0.98–0.98)	0.98 (0.97–0.98)
Multivariate model		
Continuity	0.98 (0.98–0.99)	0.98 (0.98–0.98)
Female	1.17 (1.16–1.18)	1.17 (1.17–1.18)
Age	1.00 (1.00–1.00)	1.00 (1.00–1.00)
Race/ethnicity		
White non-Hispanic	1 [Reference]	1 [Reference]
Black	1.07 (1.06–1.08)	1.07 (1.06–1.09)
Hispanic	1.07 (1.05–1.09)	1.07 (1.05–1.09)
Asian	0.84 (0.82–0.87)	0.84 (0.82–0.87)
Other	1.01 (0.98–1.05)	1.02 (0.98–1.05)
Medicaid dual eligibility	1.06 (1.05–1.07)	1.06 (1.05–1.07)
Hierarchical condition categories score		
Low	1 [Reference]	1 [Reference]
Mild	1.41 (1.39–1.43)	1.41 (1.39–1.43)
Moderate	1.77 (1.75–1.80)	1.77 (1.75–1.80)
Severe	1.84 (1.81–1.86)	1.83 (1.81–1.86)
Total visits in prior year	1.01 (1.01–1.01)	1.01 (1.01–1.01)
Total preventable hospitalizations in prior year	1.17 (1.17–1.18)	1.17 (1.17–1.18)

[a]Hazard ratios (95% CIs) show rates of preventable hospitalization between 2008 and 2010 for Medicare patients older than 65 years with at least 4 visits in 2008. Bivariate model is the relationship between preventable hospitalization and continuity; multivariate model is the relationship between preventable hospitalization and continuity, controlling for all covariates. For every 0.1 increase in the continuity of care score or usual provider continuity score, results show the decrease in rate of preventable hospitalization. Female is relative to male; Medicaid dual eligibility is relative to Medicare-only coverage. Age is in units of years; total visits in prior year are in units of ambulatory visits; and total preventable hospitalizations in prior year are in units of hospitalizations. Total visits and preventable hospitalizations in prior year refer to utilization that occurred during the 365 days before the start of a patient's observation period. The multivariate model includes hospital referral region fixed effects.