ORIGINAL RESEARCH

Continuity of Care and Avoidable Hospitalizations for Chronic Obstructive Pulmonary Disease (COPD)

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Background: **Numerous studied suggest that better continuity of care could result in better health outcomes. However, few studies have examined the relationship between continuity of care and avoidable hospitalizations.**

Methods: **A retrospective cohort study design was adopted. We used secondary data analysis based on claim data regarding health care utilization under a universal coverage health insurance scheme in Taiwan. The study population included 3,015 subjects who were newly diagnosed with chronic obstructive pulmonary disease (COPD) in 2006. The main outcome was COPD-related avoidable hospitalization, and the continuity of care index (COCI) was used to measure continuity of care. A logistic regression model was used to control for sex, age, low-income status, and health status.**

Results: **With regard to the effects of continuity of care on avoidable hospitalizations, dose–response trends were observed. The logistic regression model showed that after controlling for covariables, subjects in the low COCI group were 129% (adjusted odds ratio, 2.29; 95% confidence interval, 1.26–4.15) more likely to undergo COPD-related avoidable hospitalizations than those in the high COCI group.**

Conclusions: **Patients with COPD with higher continuity of care had a significantly lower likelihood of avoidable hospitalization. To prevent future hospitalizations, health policy stakeholders should encourage physicians and patients to develop long-term relationships to further improve their health outcomes. (J Am Board Fam Med 2015;28:222–230.)**

Keywords: **Chronic Obstructive Pulmonary Disease, Continuity of Care, Hospitalization**

Chronic obstructive pulmonary disease (COPD) is a major global public health problem. In 2011 COPD was the fourth leading cause of death worldwide,[1] and in 2006 it was the fourth leading cause of death in the United States.[2] According to World Health Organization estimates, 65 million people worldwide have moderate to severe COPD. Unless COPD receives increased attention and disease management improves, it will become the third leading cause of death worldwide in 2030.[3]

COPD constitutes an increasing burden on society and has material effects on health care expenditure. The Global Burden Disease study showed that in 2000 COPD was the cause of more than 26 million disability-adjusted life years and ranked as the 10th leading cause of disease burden in the world.[4] In 2007, the costs of COPD exceeded US$49.9 billion, with US$29.5 billion attributable to direct health care expenditures.[5] Hospitalization is the largest contributor to the cost of COPD.[6,7] The hospitalization expenditures among Medicare beneficiaries with COPD were 2.7 times those of the Medicare beneficiaries without COPD.[8] An economic burden analysis of 7 countries in North America and Europe (Canada, France, Italy, the Netherlands, Spain, the United Kingdom, and the United States) suggested that hospitalization of patients with COPD comprised the majority (52% to 84%) of the direct costs of COPD in most countries. Acute exacerbations of COPD are a key driver

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of secondary care costs. [9]Although COPD cannot be completely cured, the Global Initiative for Chronic Obstructive Lung Disease recommends regular and continuous medication and appropriate disease management to reduce the symptoms and frequency of exacerbations, as well as improve the quality of life of patients with COPD.[10] However, previous studies have demonstrated that more than 50% of patients with COPD do not continuously receive prescribed medication.[9,11]

Continuity of care (COC) is considered to be a core element of primary care. Continuity is generally regarded as having 3 aspects: informational continuity, management continuity, and relational continuity.[12] For patients with chronic diseases, relational continuity is the most important. This continuity refers to the ongoing therapeutic relationship between a patient and care provider. This relationship is usually characterized by personal trust and responsibility. The patient trusts the physician on a personal basis, and the physician is responsible for the patient's overall health care.[12,13] For chronic patients, a long-term physician–patient relationship could improve mutual communication. In addition, the care provider could help enhance the patient's understanding of his or her medical history. The relationship can contribute to effective management of a chronic condition and enable the development of a long-term disease monitoring mechanism.[14] Previous studies suggest that better COC is associated with fewer hospitalizations,[15–18] fewer emergency department (ED) visits,[15–17] better chronic disease control,[19,20] and better patient satisfaction.[21,22] To the best of our knowledge, however, few studies have examined the relationship between COC and health outcomes in patients with COPD. Only 1 study examined the relationship between COC and hospital admission for patients with COPD in Korea (65–84 years old). The study indicated that elderly patients with COPD with better COC had fewer hospitalizations. A continuous relationship between patient and physician would be likely to reduce disease progression and reduce unnecessary hospitalization.[17]

Avoidable hospitalizations are defined as conditions for which timely and appropriate ambulatory care can decrease the likelihood of future hospitalization.[23] These conditions also are called ambulatory care–sensitive conditions that could be used to reflect the quality, access, and performance of ambulatory care.[24] To date, many investigators and institutions have identified avoidable hospitalizations using a range of methods.[25–28] Among these definitions, those defined by the Agency of Healthcare Research and Quality (AHRQ)[28] and by Billings and colleagues[26] were widely used by researchers. Moreover, both these definitions identified COPD as an ambulatory care–sensitive condition. Previous studies showed that personal socioeconomic status,[23,29,30] health status,[24,31] and health care access[24,30,32] are associated with avoidable hospitalizations. To the best of our knowledge, however, few studies examined the relationship between COC and avoidable hospitalizations; the majority of these studies included several diseases,[33–35] but only 1 study focused on diabetes.[18]

Taiwan implemented a compulsory National Health Insurance (NHI) scheme in 1995. Approximately 99% of Taiwan's 23 million residents were enrolled in the NHI scheme. Under this scheme, health care facilities have to submit patient diagnoses and treatment plans to the NHI Administration (NHIA) to claim health care costs. Using the nationwide NHI database, this study aims to determine the relationship between COC and the risk of future hospitalization for patients with COPD.

Methods

Data

This study adopted a retrospective cohort study design. The main data source was the Longitudinal Health Insurance Database 2005, maintained by the National Health Research Institute in Taiwan. The Longitudinal Health Insurance Database 2005 consists of 1 million beneficiaries randomly sampled from the entire NHI enrollee population in 2005. The data contain comprehensive inpatient and ambulatory care records, including unique patient and physician numbers, patient sex, date of birth, and International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes for each encounter.[36] This study analyzed the health care utilization data of patients with COPD from January 1, 2005, to December 31, 2009.

Study Subjects

We included incident patients with confirmed COPD diagnosis from January 1, 2006, to December 31, 2006, as the subjects of this study. Patients with either 1 inpatient or at least 2 ambulatory claims for COPD (ICD-9-CM codes 491, 492, or

496) in the primary or secondary diagnosis position were identified. In addition, the subjects were required to be aged ≥40 years on the date of confirmed diagnosis.[37–39] We excluded subjects with claims records for COPD treatment before the date of confirmed diagnosis. The date of confirmed diagnosis was defined as the date of the second ambulatory claim or the date of the first inpatient claim for COPD. For patients with more than 1 claim in 2006, the earlier date was defined as the date of confirmed diagnosis. Because the study involved analysis of secondary data, institutional review was not necessary.

Because studies result in time-dependent bias and incorrect conclusions if COC and health outcome measures are examined concurrently,[40] in this study we measured COC before the outcomes. In addition, we used some previous studies as references[17,18,33,41,42] to measure our COC and health outcomes. Subject data were analyzed for 3 years following the date of confirmed diagnosis in 2006. For the first 2 years, which we defined as the COC period, COC measures were evaluated, whereas in the last year, which we defined as the health outcome period, the measures were evaluated for health outcomes. Previous studies suggested that a reliable COC index (COCI) is more robust with more visits; hence, we excluded subjects with fewer than 3 physician visits during the COC period.[15,17,33,35,43,44]

Variable Definitions

Dependent Variable

The dependent variable of this study is dichotomous and indicates whether a patient with COPD had a COPD-related avoidable hospital admission in the health outcome period. We used the Prevention Quality Indicator (PQI) 05, "Chronic Obstructive Pulmonary Disease [COPD] Admission Rate," from AHRQ as the definition of the dependent variable. When the subject's inpatient claims included an ICD-9-CM principal diagnosis code (listed in Table 1), the patient was defined as having a COPD-related avoidable hospital admission.[28]

Independent Variable

The COCI was developed by Bice and Boxerman[45] and is widely used in COC-related studies. In previous studies, the COCI was considered to be a more stable measurement, being less sensitive to the number of physician visits.[41,43] There is no formal family physician arrangement in Taiwan. Patients could visit a specialist in a community clinic or in a hospital without a referral. Moreover, for each physician visit, patients pay only a small copayment of about US$1.6 to US$12. This situation has led to some patients having a considerable number of physician visits in Taiwan. Therefore we selected COCI as the primary predictor variable.

Table 1. International Classification of Diseases, 9th Revision, Clinical Modification, Diagnosis Codes for Chronic Obstructive Pulmonary Disease–Related Avoidable Hospitalization from the Agency for Healthcare Research and Quality Prevention Quality Indicators 05

4660*	490*	4910	4911	49120	49121	4918
4919	4920	4928	494	4940	4941	496

*Must be accompanied by a secondary diagnosis code of chronic obstructive pulmonary disease.

COCI measures the dispersion in patient–physician contact, ranging between 0 and 1, with a higher value corresponding to greater COC. The general formula is

$$\mathrm{COCI} = \frac{\sum_{i=1}^{M} n_i^2 - N}{N(N-1)}$$

where N is the total number of visits, n_i is the number of visits to a given physician (i), and M is the number of physicians.

The total number of visits (N) and the number of visits to a given physician (n_i) included ambulatory claims (consisting of both community clinic or hospital physician visits and refilling a chronic illness prescription) of COPD (ICD-9-CM codes 491, 492, or 496) in the primary or secondary diagnosis position. In accordance with previous studies we categorized COCI into 3 equal tertiles (low, medium, and high) per the distribution of scores across the entire study population.[15,17,35,41,43]

Covariables

The covariables concerning patient characteristics included in this study were sex, age, low-income status, COPD-related ED visits, and the Charlson comorbidity index (CCI). We used COPD-related ED visits in the COC period as a proxy for COPD severity[46,47] and used CCI as a proxy indicator of health status. We used the Romano-CCI to calculate subjects' comorbidity index scores. The Romano-CCI contains 17 categories of comorbid conditions defined by ICD-9-CM codes.[48] We obtained the subjects' inpatient claims data before the date of confirmed diagnosis to calculate their comorbidity index score.

Statistical Analysis

We conducted descriptive statistical analyses to present the distribution of subject characteristics and performed χ^2 tests and one-way analyses of variance to analyze the associations between individual characteristics and COC. Furthermore, we used a logistic regression model to estimate the adjusted odds ratio (OR) of avoidable hospitalizations and 95% confidence intervals (CIs) associated with COC while controlling for other covariables. All analyses were conducted using SPSS software version 12.0 for Windows (SPSS Inc., Chicago, IL) and SAS software version 9.2 (SAS Institute, Cary, NC).

Results

As shown in Table 2, 3,015 patients with newly diagnosed COPD were included in this study. There were 1,048 subjects (34.8%) with a COCI value of 1, indicating that these patients visited the same physician for all COPD-related visits. Across the entire sample, 64.8% of the subjects were male, 32.0% were <65 years old, 3.2% had a low-income status, and 77.3% had a CCI score of 0. The mean (standard deviation [SD]) number of COPD-related ED visits was 0.22 (0.81). The mean (SD) COCI of all patients was 0.65 (0.32); the categorical breakdown for subjects with higher COCI values is as follows: 0.69 (0.32) for female subjects, 0.69 (0.32) for subjects <65 years old, 0.65 (0.32) for non-low-income subjects, 0.66 (0.31) for subjects with a CCI score between 1 and 2, and 0.65 (0.32) for subjects without avoidable hospitalization.

Among the 3 groups of COCI (low, medium, high), male subjects were more likely to be in the

Table 2. Individual Characteristics of Subjects by Continuity of Care Index Group

Variable	Subjects, n (%)	COCI Score, mean (SD)	COCI Groups by Score, n (%)			*P* Value
			Low (<0.44)	Medium (0.44–1)	High (1)	
All subjects	3015 (100)	0.65 (0.32)	1011 (33.5)	956 (31.7)	1048 (34.8)	
Sex						<.001*
Female	1062 (35.2)	0.69 (0.32)	316 (29.8)	304 (28.8)	442 (41.6)	
Male	1683 (64.8)	0.63 (0.32)	695 (35.6)	652 (33.4)	606 (31.0)	
Age (years)						<.001*
<65	964 (32.0)	0.69 (0.32)	280 (29.0)	276 (28.6)	408 (42.3)	
65–69	421 (14.0)	0.65 (0.32)	135 (32.1)	138 (32.8)	148 (35.2)	
70–74	485 (16.1)	0.64 (0.32)	164 (33.8)	156 (32.2)	165 (34.0)	
75–79	546 (18.1)	0.61 (0.31)	200 (36.6)	187 (34.2)	159 (29.1)	
80–84	363 (12.0)	0.62 (0.31)	139 (38.3)	119 (32.8)	105 (28.9)	
≥85	236 (7.8)	0.60 (0.30)	93 (39.4)	80 (33.9)	63 (26.7)	
Low-income status						.047*
No	2919 (96.8)	0.65 (0.32)	973 (33.3)	920 (31.5)	1026 (35.1)	
Yes	96 (3.2)	0.58 (0.31)	38 (39.6)	36 (37.5)	22 (22.9)	
CCI score						.095*
0	2331 (77.3)	0.65 (0.32)	793 (34.0)	711 (30.5)	827 (35.5)	
1–2	494 (16.4)	0.66 (0.31)	155 (31.4)	174 (35.2)	165 (33.4)	
≥3	190 (6.3)	0.63 (0.30)	63 (33.2)	71 (37.4)	56 (29.5)	
Avoidable hospitalization						.001*
Yes	95 (3.2)	0.55 (0.29)	45 (47.4)	34 (35.8)	16 (16.8)	
No	2920 (96.8)	0.65 (0.32)	966 (33.1)	922 (31.6)	1032 (35.3)	
ED visits†	0.22 (0.81)§		0.31 (0.94)	0.27 (0.94)	0.10 (0.46)	<.001‡

*χ^2 Test for the differences among the 3 Continuity of Care Index (COCI) groups.
†Chronic obstructive pulmonary disease–related emergency department (ED) visits in the continuity of care period.
‡One-way analysis of variance test for the difference in mean by COCI groups.
CCI, Charlson Comorbidity Index; SD, standard deviation.

low COCI group (35.6%), whereas female subjects were more likely to be in the high COCI group (41.6%). Moreover, we noted that subjects <75 years old had a higher distribution in the high COCI group; however, subjects aged ≥75 had a higher distribution in the low COCI group. Within the group of subjects <75 years of age, 42.3%, 35.2%, and 34.0% of subjects in the high COCI group were aged <65, 65 to 69, and 70 to 74 years, respectively. Among the 3 categories of subjects aged ≥75 (75–79, 80–84, ≥85), 36.6%, 38.3%, and 39.4%, respectively, were included in the low COCI group. Subjects with a CCI score of 0 (35.5%) were more likely to be in the high COCI group. Ninety-five patients (3.2%) underwent COPD-related avoidable hospitalization, and 45 of them (47.4%) were in the low COCI group. Subjects in the low COCI groups had the highest number of ED visits (mean, 0.31; SD, 0.94). According to the χ^2 tests and one-way analyses of variance, there were significant differences in COC based on sex, age, low-income status, COPD-related avoidable hospital admission, and COPD-related ED visits.

The logistic regression model is shown in Table 3. Without controlling for covariables and using the high COCI group as a reference, we observed significant dose–response trends for the effect of COC on avoidable hospitalizations. After controlling for covariables (sex, age, low-income status, CCI score, and number of ED visits) and using the high COCI group as a reference, subjects in the low COCI group were 129% more likely (OR, 2.29; 95% CI, 1.26–4.15) to undergo COPD-related avoidable hospitalizations.

Discussion

We found that elderly adults with chronic diseases had better COC. This study used the COCI to measure the COC for patients with COPD, the mean value of which was 0.65 (SD, 0.32) for the

Table 3. Factors Associated With Chronic Obstructive Pulmonary Disease–Related Avoidable Hospital Admissions Using Logistic Regression Models*

Variables	Crude OR (95% CI)	*P* Value	Adjusted OR (95% CI)	*P* Value
COCI				
High (1)	Reference		Reference	
Medium (0.44–1)	2.38 (1.30–4.34)	.005	1.81 (0.97–3.36)	.061
Low (<0.44)	3.01 (1.69–5.35)	<.001	2.29 (1.26–4.15)	.007
Sex				
Female	Reference		Reference	
Male	1.84 (1.13–2.97)	.014	1.52 (0.92–2.51)	.100
Age (years)				
<65	Reference		Reference	
65–69	0.63 (0.23–1.71)	.367	0.64 (0.23–1.76)	.388
70–74	2.50 (1.33–4.70)	.005	2.25 (1.16–4.34)	.016
75–79	1.79 (0.92–3.47)	.084	1.57 (0.79–3.13)	.202
80–84	3.06 (1.60–5.86)	.001	2.23 (1.13–4.41)	.021
≥85	2.82 (1.34–5.93)	.006	2.19 (1.00–4.78)	.050
Low-income status				
No	Reference		Reference	
Yes	2.53 (1.14–5.62)	.023	2.05 (0.88–4.79)	.096
CCI score				
0	Reference		Reference	
1–2	2.96 (1.90–4.61)	<.001	2.54 (1.60–4.05)	<.001
≥3	1.58 (0.71–3.53)	.261	1.37 (0.60–3.09)	.453
ED visits	1.59 (1.40–1.80)	<.001	1.47 (1.30–1.66)	<.001

*Logistic regression was adjusted for sex, age, low-income status, Charlson comorbidity index (CCI), and COPD-related emergency department (ED) visits in the continuity of care period. The dependent variable was chronic obstructive pulmonary disease–related avoidable hospital admission.
CI, confidence interval; COCI, Continuity of care index; OR, odds ratio.

entire sample. A previous study reported that the mean COCI value in Taiwan across the 3 age categories of ≤18, 19 to 64, and ≥65 years ranged from 0.31 to 0.36, 0.28 to 0.29, and 0.32 to 0.33, respectively, between 2001 and 2006.[35] For asthmatic children <18 years old in the United States[41] and those aged 12 to 17 years in Canada,[49] the mean COCI values were 0.39 and 0.26, respectively. Compared with the results of these previous studies, our study subjects showed a higher COC. However, the mean of the COCI value in diabetic patients aged 18 to 64 years in the United States was 0.51[50]; it was 0.7 for patients with COPD aged 65 to 84 years in Korea.[17] The COCI value of our study (mean, 0.65; SD, 0.32) was between those of the 2 studies. Consequently, we found that in different health care systems younger people had lower COCI values and chronic patients had higher COCI values, especially in the case of elderly adults with chronic diseases. The key symptom of COPD is persistent airflow limitation that is usually progressive. It is a chronic condition that cannot be completely cured by medication. Nevertheless, regular and continuous medication can contribute to the alleviation of symptoms, a reduction in the frequency of acute exacerbations, and further improvement of quality of life.[10] In Taiwan, NHIA launched a program to encourage patients with chronic diseases to regularly visit a physician when he or she diagnosed to be suffering from a chronic disease as defined by the NHIA (including COPD); the patient then is prescribed a "chronic illness refill prescription" by the doctor. The refill prescription is valid for 90 days; the patient can refill up to 3 times, with 28 to 30 days of dispensed medicine per refill, without copayment. This program could further improve COC for patients with chronic diseases in Taiwan.

An import finding of our study is that, irrespective of whether covariables were controlled, a dose–response effect of COC on COPD-related avoidable hospitalization occurred. According to the results of bivariate analysis, using the high COCI group as reference, the medium and low COCI groups were 138% ($P = .005$) and 201% ($P < .001$) more likely to undergo COPD-related avoidable hospitalizations, respectively. After controlling for covariables, the risk of hospitalization showed a small decrease; nevertheless, both medium (OR, 1.81; $P = .061$) and low (OR, 2.29; $P = .007$) COCI groups still demonstrated a higher risk of hospitalization than the high COCI group. Few studies have examined the relationship between COC and avoidable hospitalization with a specific disease. One previous study indicated that diabetic patients with low COC had a higher risk of avoidable hospitalization than those with medium COC.[18] Previous similar studies including several diseases (respiratory and nonrespiratory diseases) also reported that better COC indicated a lower risk of avoidable hospitalization.[33–35] Consequently, our finding is consistent with that of previous studies, irrespective of the number of diseases included. Because physicians adopt varying approaches to treat different diseases, if the study included several diseases, the effect of COC on health outcomes could differ by disease.[44] Therefore, this study included only patients with COPD as study subjects, which could prevent the difference in diseases from confounding the effect of COC on health outcomes.

Our study has several limitations. First, the claims data do not include clinical data on pulmonary function. Therefore we could not define the severity of COPD or identify whether patients were diagnosed early. However, we used ED visit data as a proxy for disease severity.[46,47] Second, claims data do not include information about informal carers. Therefore neither the role of informal carers in COC and hospital avoidance nor whether hospital avoidance puts more stress on informal carers and their quality of life could be analyzed in this study. Third, under the reimbursement system, hospitals have to claim medical expenses from the NHI based on the diagnosis or treatment codes for the disease with which their patients present. The codes consist of a principal diagnosis and up to 4 secondary diagnoses for inpatient care and 2 secondary diagnoses for outpatient care. In this study we used all COPD codes to define patients with COPD. We therefore expect patients with COPD that is underdiagnosed or diagnosed later along the disease progression are rare and are unlikely to influence the results. Fourth, patients with better continuity had better medication adherence,[51] which could lead to fewer hospitalizations among patients with chronic respiratory diseases.[52] Therefore, medication compliance might be a confounder. Fifth, NHI claims data do not collect patient characteristics such as marital status, race, educational background, and smoking behavior, which may affect both COC and hospitalizations. Sixth, while physician visits are an important aspect of

COC, other factors include the use of other clinicians and carers (eg, physiotherapy, psychologist, and formal care assistants), which can have a shared dynamic care management plan, and use of eHealth system enablers for integrated care. We could not obtain the above data from the claims data. Finally, a temporal relationship could exist between the measurement of COC and outcomes. Hospital admission might in some way adversely affect continuity. We adopted the suggestions of a previous study[40] and measured continuity before the outcomes. However, that might not completely avoid temporal ambiguity between continuity and outcomes. We recommend that other studies further investigate this in primary care in the future.

This study has several strengths. First, we focused on a specific disease, which could more precisely estimate the association between COC and avoidable hospitalization. Second, the NHI scheme is a compulsory insurance program in Taiwan. Approximately the entire population is enrolled in the NHI scheme. Our study used NHI claims data for analysis, which enabled our study subjects to be highly representative of the whole population. Third, COCI is an objective measurement that could prevent information bias from subjective measurements. Forth, we adopted PQI 05 from the AHRQ, which clearly defines subject ages to include, exclusion criteria, and the ICD-9-CM codes for each indicator. In addition, AHRQ occasionally updates PQIs, which are more systematic indicators of avoidable hospitalization. Fifth, the study used longitudinal data to measure continuity before the health outcome, which offers better evidence for a cause-and-effect relationship.

Conclusions

A long-term relationship between physicians and patients could promote mutual trust and understanding. Based on the condition, physicians can treat patients appropriately, which decreases the risk of future hospitalization. In Taiwan's health care system patients have the freedom to choose specialists without a referral. This could undermine the development of a long-term relationship between doctors and patients. Based on nationally representative samples, our findings suggest that patients with COPD with lower COC are associated with increased avoidable hospitalizations. Hence, we suggest that policy stakeholders should develop a pay-for-performance program for COPD; this would encourage doctors to take the initiative to make the next appointment and to continuously follow-up on the patient's condition, which would enhance the patient-physician relationship. In addition, policy stakeholders could reduce copayments of patients with better continuity in order to encourage patients to return to the same doctor and further improve their health outcomes.

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