Individual and Hospital Factors Associated With Hospitalization for Chronic Medical Conditions

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This study identified individual and hospital characteristics significantly associated with U.S. hospital admissions for chronic medical conditions (i.e., asthma, hypertension, congestive heart failure, chronic obstructive pulmonary disease, and diabetes) and assessed whether the results based on hospital admissions for chronic medical conditions were consistent with analysis based on hospital admissions for ambulatory care sensitive conditions (ACSC). Data for this study were from the 1994 U.S. National Hospital Discharge Survey. Bivariate statistical comparisons were performed to test the differences between hospitalized individuals with chronic medical conditions and those without. Logistic regression followed to determine the significance of independent variables in relation to hospitalizations for chronic medical conditions. The logistic regression results of using hospital admissions for chronic medical conditions as the dependent variable and using hospital admissions for ACSC as the dependent variable was compared to examine the level of congruence for the two models using different dependent measures. Individual and hospital characteristics significantly associated with hospital admissions for chronic medical conditions (objective 1) included age, gender, race, marital status (individual predisposing factors), principal and secondary sources of payment (individual enabling factors), length of stay (individual need factor), and number of hospital beds and geographic region (system factors). The results of analyses based on hospital admissions for chronic medical conditions were consistent with analysis based on hospital admissions for ACSC (objective 2). Hospital admissions for chronic medical conditions can serve as an efficient way of identifying subpopulations facing access barriers. **(Mid Taiwan J Med 1999 ; 4 : 9-21)**

Key words

chronic medical conditions, factor, hospitalization

INTRODUCTION

The analysis of variations in hospitalization rates for ambulatory care sensitive conditions (ACSC) has emerged as an alternative measure of health care access [1-6]. Billings and his colleagues defined ACSC as diagnoses for which timely and effective outpatient or ambulatory care can help reduce the risks of hospitalization by either preventing the onset of an illness or condition, or managing a chronic illness or condition [1]. Heretofore, researchers have relied on state-wide hospital discharge datasets for the analysis. For example, Weissman et al. found that the uninsured and Medicaid patients in

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Massachusetts and Maryland were more likely to be admitted to a hospital for chronic medical conditions (CMC) than privately insured patients [3]. Billings and his associates studied patterns of hospital use in New York City and found that the hospitalization rates for ACSC were higher in low-income areas than in higher income areas where appropriate outpatient or ambulatory care was more readily available [1,4]. The Codman Research Group conducted a 15-state comparative study and noted that per capita admission rates for ACSC were directly related to poverty rates for all states with a significant urban population [5].

The current study aimed at expanding the analysis by using a national hospital discharge dataset and focusing on a set of CMC including asthma, hypertension, congestive heart failure, chronic obstructive pulmonary disease, and diabetes. Analysis based on national data will be more generalizable than state level studies. The choice of a subset of ACSC identified by Billing and his colleagues was due to two factors. First, CMC such as those identified can often be treated more timely, effectively, and efficiently in an ambulatory setting rather than inpatient setting. Therefore, hospitalization for these conditions generally indicates lack of access to ambulatory care. Second, the validity of using variations in CMC hospitalization rates as measure of access to care has been established by previous researchers.

Bindman et al. assessed the validity of using CMC as measure of health care access using California Hospital Discharge Data and a random digit telephone survey [6]. They compared respondents' reports of access to medical care in an area with the area's hospital admission rate for five CMC, namely, asthma, hypertension, congestive heart failure, chronic obstructive pulmonary disease, and diabetes. The results indicated that access to care was inversely associated with hospitalization rates for the five CMC after controlling for the prevalence of the conditions, health care seeking, and physician practice style. They concluded that low-income communities where people perceived poor access to medical care had higher rates of preventable hospitalization and hospitalization for CMC.

The first objective of this study was to identify individual and hospital characteristics significantly associated with hospital admissions for CMC in the United States (U.S.). Given the linkage between access to care and hospital admis-sions for CMC, the results of the study would produce a profile of individuals experiencing access barriers to primary and ambulatory care, thus assisting policy makers in developing programs that aim at improving access to care for these individuals. The second objective was to assess whether the results based on hospital admissions for CMC were consistent with results based on hospital admissions for ACSC as identified by Billing and associates. Specifically, the results of the analyses using hospital admissions for CMC and for ACSC were compared. The congruence of the results would indicate that using hospital admissions for CMC could serve as an efficient way of identifying subpopulations facing access barriers.

MATERIALS AND METHODS

Data

The 1994 National Hospital Discharge Survey (NHDS) was used as the primary data source for conducting the analysis. The NHDS is conducted annually by the National Center for Health Statistics (NCHS) and is a principal source of information on inpatient hospital utilization in the U.S. This survey collects medical and demographic information from a sample of discharge records selected from non-institutional hospitals, exclusive of Federal, military, and Veterans Administration hospitals, located in the 50 states and the District of Columbia. Only short-stay hospitals (hospitals with an average length of stay for all patients of less than 30 days) or those that specialize in general care (medical or surgical) or pediatric general care are included in the survey. The hospitals surveyed have six or more beds staffed for patients' use.

Data collection included both manual and automated procedures. The manual system of sample selection and data abstraction was used for approximately 62% of the responding hospitals. The automated procedure involved the purchase of computerized data tapes from abstracting service organizations, state data systems, or from the hospitals themselves. This method was used for approximately 38% of the respondent hospitals. The system used for coding the diagnoses and procedures on the medical abstract forms as well as on the commercial abstracting services data tapes was the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) [7].

Detailed descriptions of the sampling design and data collection procedures have been published elsewhere [8,9]. The 1994 sample consisted of 525 hospitals. Of these, 13 were found to be ineligible because they went out of business or otherwise failed to meet the criteria for the NHDS. Of the 512 eligible hospitals, 478 responded to the survey with a response rate of 93%.

Consistent with previous related research [1,4,6], our study limited the analysis to adults aged 18-64 who were formally admitted to the inpatient services of a short-stay hospital surveyed in 1994 for observation, care, diagnosis, or treatment. The pediatric (age 0 to 17), elderly (age 65 years or more), and obstetrical patients with completely normal deliveries were excluded from the analysis. The pediatric and elderly patients were excluded because it is likely that the ACSC applicable to children are different from those applicable to adults. Analyses on the pediatric patients are published elsewhere. The elderly population was excluded due to Medicare coverage which pays for a significant amount of outpatient medical care and provides adequate reimbursement level for most physicians to accept Medicare patients. Previous research on ACSC indicated insignificant association between income level and hospital admissions for ACSC among elderly patients [1,4]. Obstetrical patients with normal delivery were excluded because normal delivery was not considered an illness.

Variables

For the purpose of this study, we selected variables of individual and hospital characteristics associated with hospitalization. The purpose was to find out which characteristics were significantly related to variations in hospitalizations for CMC and if these characteristics were also significantly associated with hospitalization for ACSC.

With respect to the first research objective, the dependent variable examined was discharge diagnoses grouped as CMC or non-CMC. The five CMC selected were based on the work by Bindman and his colleagues [6]. The conditions were asthma, diabetes (A, B, C), chronic obstructive pulmonary disease, congestive heart failure, and hypertension. To classify the hospitalization for these conditions, both primary and secondary diagnoses based on the ICD-9-CM code were used. The code specifications for the chronic medical conditions studied are listed in Table 1.

With respect to the second research objective, the second dependent variable examined in this study was discharge diagnoses grouped as ACSC or non-ACSC. Only the primary diagnosis was used for classification of the hospitalization for medical conditions. The selection of diagnoses for ACSC conditions was based on the listing of ICD-9-CM codes for ACSC developed by Billings and his colleagues [1,4]. A medical advisory panel of internists and pediatricians, including experts on access barriers, developed a diagnostic framework for analyzing hospital use patterns [4]. Using the Delphi approach, they grouped hospital admissions into ACSC and marker conditions, diagnoses for which the provision of timely and effective outpatient care is likely to have little impact on the need for hospital admission.

Table 1. Code specifications for the chronic medical conditions

Chronic Conditions	ICD-9-CM Code	Exclusions
Asthma	493	
Diabetes A, B, C	250.1, 250.2, 250.3, 250.8, 250.9, 250.0	
Chronic obstructive pulmonary disease	491, 492, 494, 496, 466.0	
Congestive heart failure	428, 402.01, 402.11, 402.91, 518.4	Congestive heart failure cases with surgical procedures: 36.01, 36.02, 36.05, 36.1, 37.5, or 37.7
Hypertension	401.0, 401.9, 402.00, 402.10, 402.90	Hypertension cases with surgical procedures: 36.01, 36.02, 36.05, 36.1, 37.5 or 37.7

The independent variables used in our study were demographics, geographic regions, hospital and hospitalization characteristics, and sources of payment for inpatient care. Specifically, individual demographics included age, sex, race and marital status. Geographic region included Northeast, Midwest, South and West. The hospital and hospitalization characteristics included number of beds in a hospital, hospital ownership, and days of inpatient care (length of stay). Sources of payment for inpatient care were measured using the principal expected source of payment. A new independent variable, the additional source of payment, was created from variables of principal expected source of payment and secondary expected source of payment which have the same categories. Table 2 provides the operational definitions of the measures used in the analysis.

The independent variables used in this study were based on the framework for access to care developed by Aday and Andersen [10]. The framework conceptualizes access to care as determined by both the characteristics of the individuals at risk and the delivery system. Individual characteristics include predisposing, enabling, and need factors. System characteristics include resources, volume, distribution, organization, entry, and structure measures. For the purpose of this study, the predisposing individual characteristics used were age, sex, race, and marital status. Information of occupation and education was not available in the dataset. The variation of access explained by these two predisposing variables was either very small or non-significant when need variables were taken into account [11,12]. Excluding these two variables did not have much effect on the results. Insurance status or sources of payment was used as a measure of enabling factor. Specifically, sources of payment included both principal and secondary sources of payment for inpatient care. Length of hospital stay was used as a proxy for need. The system characteristics were limited to hospital related measures available in the dataset, including the number of beds in a hospital, hospital ownership, and geographic region such as the Northeast, Midwest, South, and West. Table 2 provides the operational definitions of the measures used in the analysis.

Analysis

The analytical strategy in relation to the first research objective was to examine patient and hospital characteristics associated with hospital admissions for CMC. First, descriptive statistics (i.e., means, standard deviations and distributions) were generated to provide a profile of the general characteristics of the measures used in the study (Table 2). Next, bivariate statistical comparisons were performed to test the differences between individuals admitted due to CMC and those due to other conditions. Chi-square tests were used for categorical independent variables and *t*-tests for continuous measures. Logistic regression followed to determine the significance of independent variables in relation to dependent variables—hospitalizations for the five CMC.

Table 2. Definitions, means, standard deviations, and distributions of variables used in the analysis (N=125,621)

Variables	Description	Distribution*		Mean (SD)	Max. (Min.)
Age	The age of the patient on the birthday prior to admission to the hospital inpatient service			40.27 (13.36)	64.00 (18.00)
Sex	1 = male	46794	(37.3%)		
	2 = female	78827	(62.7%)		
Race	1 = White	71646	(57.0%)		
	2 = Black	19153	(15.2%)		
	3 = American Indian/Eskimo	834	(0.7%)		
	4 = Asian/Pacific Islander	2431	(1.9%)		
	5 = Other	6638	(5.3%)		
	9 = Not stated	24919	(19.8%)		
Marital status	0 = Married	28685	(22.8%)		
	1 = Other, including single, widowed, divorced, separated, unknown and, not stated	96936	(77.2%)		
Geographic region	1 = Northeast, includes Maine, New Hampshire, Vermont Massachusetts, Rhode Island, Connecticut, New York, New Jersey, and Pennsylvania	33460	(26.6%)		
	2 = Midwest, includes Michigan, Ohio, Illinois, Indiana, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, and Kansas	34888	(27.8%)		
	3 = South, includes Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, and Texas	37832	(30.1%)		
	4 = West, includes Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, California, Hawaii, and Alaska	19441	(15.5%)		
Number of beds	1 = 6-99	13934	(11.1%)		
	2 = 100 - 199	21959	(17.5%)		
	3 = 200 - 299	28520	(22.7%)		
	4 = 300 - 499	39028	(31.1%)		
	5 = 500 and over	22180	(17.7%)		
Hospital ownership	The type of organization that controls and operates the hospital				
	1 = Proprietary: Hospitals operated by individuals, partnerships, or corporations for profit	11903	(9.5%)		
	2 = Government: Hospitals operated by State and local government	14174	(11.3%)		
	3 = Nonprofit: Hospitals operated by a Church or another not for profit organization	99544	(79.2%)		
Principal expected source of payment	0 = No charge	928	(0.7%)		
	1 = Workmen compensation	2217	(1.8%)		
	2 = Medicare	11346	(9.0%)		
	3 = Medicaid	24040	(19.1%)		
	4 = Other government payments, including Title V	2589	(2.1%)		
	5 = Blue Cross	18745	(14.9%)		
	6 = Other private/commercial insurance	47274	(37.6%)		
	7 = Self-Pay	8854	(7.0%)		
	8 = Other	6826	(5.4%)		
	9 = Not stated	2802	(2.2%)		
Additional source of payment	1= With expected secondary source of payment	10107	(8.0%)		
	0 = Without expected secondary source of payment	115514	(92.0%)		
Length of stay	The total number of patient days accumulated at time of discharge by patients discharged from short-stay hospitals during a year			5.08 (7.99)	383.00 (1.00)

Table 2. Continued

Variables	Description	Distribution*	Mean (SD)	Max. (Min.)
Chronic conditions†	1 = With chronic conditions based on primary and secondary diagnoses	14664 (11.7%)		
	0 = Without chronic conditions based on primary and secondary diagnoses	110957 (88.3%)		
Asthma	With asthma based on primary and secondary diagnoses	2011 (13.7%)		
CHF	With CHF based on primary and secondary diagnoses	2584 (17.6%)		
COPD	With COPD based on primary and secondary diagnoses	2779 (19.0%)		
Diabetes A, B, C	With diabetes A, B, or C based on primary and secondary diagnoses.	3698 (25.2%)		
Hypertension	With hypertension based on primary and secondary diagnoses.	3592 (24.5%)		

*For categorical variables, the frequencies and percentage distributions are provided. †The chronic conditions include asthma, chronic heart failure, chronic obstructive pulmonary disease, diabetes A, B, C, and, hypertension. CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease.

The categorical variables were coded as sets of dummy variables in the logistic regression. Race was classified as White (default category), Black, Asian/Pacific Islander, and other (including American Indian/Eskimo, other race, and those "not stated"). Marital status was classified as Married (default category) and Non-married (including single, widowed, divorced, separated, unknown, and those "not stated"). Principal source of payment was classified as No charge, Medicare, Medicaid, Workmen compensation (including other government payment), Private insurance (including Blue Cross and other private/commercial insurance) (default category), Self-pay, and Other (including those "not stated"). Additional source of payment were grouped as those who had secondary expected source of payment and those who did not (default category).

The analytical strategy in relation to the second research objective was to compare the logistic regression results of using hospital admissions for CMC as the dependent variable and using hospital admissions for ACSC as the dependent variable. The same patient and hospital characteristics were entered in both models. The standardized regression coefficients and the odds ratios (OR) of the significant parameter estimates were compared in the two models to examine the level of congruence between the two models using different dependent variables.

RESULTS

Table 2 provides the definitions and descriptive statistics of the variables used in our study. In terms of individual characteristics, the mean age of the patients was 40 years. Almost two-thirds (62.7%) of the patients were female and 22.8% were married. White patients accounted for 57%, followed by Blacks (15.2%), Asian/Pacific Islanders (1.9%), American Indians/Eskimos (0.7%), other (5.3%), and not stated (19.8%). The average length of hospital stay was 5.1 days. Most patients (52.5%) had private insurance and 32% of patients had public insurance. Eight percent of the patients also had secondary source of payment.

In terms of hospital characteristics, most hospitals (79.2%) were nonprofit, followed by government (11.3%) and proprietary (9.5%).

There were more patients from the Southern region (30.1%) than from other regions. The bed distribution of the hospitals was: 11.1% of the hospitals had 6-99 beds, 17.5% had 100-199 beds, 22.7% had 200-299 beds, 31.1% had 300-499 beds, and 17.7% had 500 or more beds.

Among the 125,621 adult discharged patients included in the analysis, 11.7% were diagnosed with at least one of the five selected CMC (5.3% based on principal diagnosis and 6.4% based on secondary diagnosis). Among those diagnosed with chronic conditions, 13.7% had asthma (10.5% based on principal diagnosis and 3.2% based on secondary diagnosis), 17.6% had congestive heart failure (10.8% based on principal diagnosis and 6.8% based on secondary diagnosis), 19% had chronic obstructive pulmonary disease (7.5% based on principal diagnosis and 11.5% based on secondary diagnosis), 25.2% had diabetes (11.0% based on principal diagnosis and 14.2% based on secondary diagnosis), and 24.5% had hypertension (5.6% based on principal diagnosis and 18.9% based on secondary diagnosis).

Table 3 lists the five CMC and the individual and hospital characteristics associated with them. Except for the patients with asthma, age and sex were significant variables related to admission with preventable chronic conditions; older people were more likely to be admitted than younger ones and males were more likely to be admitted than females. Except for the patients with pulmonary disease, blacks were more likely to be admitted with preventable chronic conditions than other races. Non-married individuals were more likely to be hospitalized for asthma and pulmonary disease than married individuals who were more likely to be hospitalized for hypertension. Hospitals in the west were the least likely to have patients admitted with preventable chronic conditions. Hospitals with 200-299 beds were more likely to have patients admitted with preventable chronic conditions.

Table 4 shows the results of two logistic regression models associating patients' individual (i.e., age, sex, race, marital status, principal and secondary expected sources of payment, length of stay) and hospital characteristics (i.e., ownership, geographic region, number of beds) with CMC and ACSC respectively. The OR of the significant parameter estimates are provided.

The significant individual factors associated with having a CMC included age, sex, race, and marital status. Specifically, controlling for other individual and hospital factors, older individuals were more likely than younger ones to have a CMC [OR=1.07; 95% confidence interval (CI)=1.05, 1.09]. The odds of having a CMC for men were 1.10 times greater than the odds for women (OR=1.10; 95% CI=1.06, 1.14). The odds of having a CMC for blacks were 1.63 times greater than the odds for whites (95% CI=1.55, 1.71). Asians were less likely than whites to have a CMC (OR=0.70; 95% CI=0.59, 0.83). In comparison with those who were married, non-married patients were more likely to have a CMC (OR=1.09; 95% CI=1.04, 1.15). Individuals' insurance status was also significantly and independently associated with admission with CMC. Specifically, compared with those with private insurance, those without insurance (i.e., self-pay) had 1.45 times the odds in favor of having a CMC (OR=1.45; 95% CI=1.48, 1.70). Individuals with Medicare or Medicaid were also significantly more likely to be admitted with a CMC. Those without secondary sources of payment were more likely to have a CMC than those with secondary sources of payment (OR=1.24; 95% CI=1.15, 1.32). Individuals with shorter lengths of stay were more likely to be admitted with a CMC (OR=0.99; 95% CI=0.98, 0.99).

With respect to hospital characteristics, the geographic location, hospital ownership, and number of beds were all independently associated with preventable hospital admissions. Hospitals in the Northwest, Midwest, and South were more likely to have individuals admitted for CMC than those in

Table 3. Bivariate statistics for chronic conditions by individual and hospital characteristics

	Asthma		Diabetes		COPD		CHF		Hypertension	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Age*	40.84 (12.72)	39.01 (13.08)	47.50 (12.31)	39.00 (13.08)	53.12 (9.98)	39.00 (13.08)	54.39 (8.75)	39.01 (13.08)	51.46 (9.26)	39.01 (13.08)
	$p>0.05$		$p<0.01$		$p<0.01$		$p<0.01$		$p<0.01$	
Sex										
Male	1.41	98.59	4.25	95.75	3.29	96.71	3.31	96.69	4.38	95.62
Female	1.99	98.01	2.64	97.36	1.96	98.04	1.68	98.32	2.42	97.58
	$p>0.05$		$p<0.01$		$p<0.01$		$p<0.01$		$p<0.01$	
Race										
White	1.65	98.35	2.99	97.01	2.92	97.08	2.07	97.93	2.98	97.02
Black	2.63	97.37	4.78	95.22	1.63	98.37	3.61	96.39	4.40	95.60
American Indian /Eskimo	2.52	97.48	1.02	98.98	1.02	98.98	1.02	98.98	2.03	97.97
Asian/Pacific Islander	0.87	99.13	1.56	98.44	0.78	99.22	1.39	98.61	2.15	97.85
Other	1.98	98.02	2.99	97.01	1.12	98.88	1.80	98.20	2.57	97.43
	$p<0.01$		$p<0.01$		$p<0.01$		$p<0.01$		$p<0.01$	
Marital status										
Married	1.39	98.61	3.07	96.93	2.27	97.73	2.22	97.78	3.75	96.25
Non-married	1.89	98.11	3.27	96.73	2.49	97.51	2.29	97.71	2.95	97.05
	$p<0.01$		$p>0.10$		$p<0.05$		$p>0.10$		$p<0.01$	
Region										
Northeast	2.36	97.64	2.77	97.23	2.06	97.94	1.98	98.02	2.97	97.03
Midwest	1.91	98.60	3.69	96.31	3.20	96.80	2.56	97.44	3.19	96.81
South	1.40	98.60	3.55	96.45	2.44	97.56	2.55	97.45	3.64	96.36
West	1.27	98.73	2.57	97.43	1.78	98.22	1.76	98.24	2.36	97.64
	$p<0.01$		$p<0.01$		$p<0.01$		$p<0.01$		$p>0.10$	
Number of beds										
6-99	1.72	98.28	2.98	97.02	3.06	96.94	2.10	97.90	3.14	96.86
100-199	1.56	98.44	3.34	96.66	2.82	97.18	2.01	97.99	2.97	97.03
200-299	2.03	97.97	3.47	96.53	2.66	97.34	2.58	97.42	3.35	96.65
300-499	1.84	98.16	3.20	96.80	2.39	97.61	2.31	97.69	3.07	96.93
500 and over	1.63	98.37	3.00	97.00	1.49	98.51	2.20	97.80	3.14	96.86
	$p<0.01$		$p<0.01$		$p<0.01$		$p<0.01$		$p>0.10$	
Hospital ownership										
Proprietary	1.23	98.77	3.88	96.12	2.65	97.35	3.04	96.96	3.23	96.77
Government	1.72	98.28	3.52	96.48	2.26	97.74	2.07	97.93	3.34	96.66
Nonprofit	1.85	98.15	3.10	96.90	2.45	97.55	2.21	97.79	3.10	96.90
	$p<0.01$		$p<0.01$		$p>0.10$		$p<0.01$		$p>0.10$	
Source of payment										
No charge	1.26	98.74	5.88	94.12	2.73	97.27	3.33	96.67	4.39	95.61
Workmen compensation	0.58	99.42	2.05	97.95	1.58	98.42	0.24	99.76	3.11	96.89
Medicare	2.16	97.84	6.12	93.88	6.10	93.90	7.00	93.00	3.58	96.42
Medicaid	2.09	97.91	2.88	97.12	2.23	97.77	2.20	97.80	1.78	98.22
Other government payment	1.67	98.33	3.16	96.84	2.21	97.79	2.42	97.58	2.70	97.30
Blue Cross	1.82	98.18	3.26	96.74	2.71	97.29	2.10	97.90	4.05	95.95
Other private insurance	1.52	98.48	2.61	97.39	1.84	98.16	1.59	98.41	3.38	96.62
Self-pay	2.47	97.53	4.14	95.86	1.89	98.11	1.87	98.13	3.13	96.87
Other	1.63	98.37	2.96	97.04	2.36	97.64	1.74	98.16	3.12	96.88
	$p<0.01$		$p<0.01$		$p<0.01$		$p<0.01$		$p<0.01$	

Table 3. Continued

	Asthma		Diabetes		COPD		CHF		Hypertension	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Length of stay* (days)	4.55 (4.82)	5.02 (8.11)	5.35 (6.46)	5.02 (8.11)	6.31 (7.97)	5.02 (8.11)	7.39 (8.94)	5.02 (8.11)	4.26 (5.71)	5.02 (8.11)
	p<0.01		p<0.01		p>0.10		p<0.01		p<0.01	

* Means and standard deviation are provided. Each chronic condition is compared with control group (excluding any other four chronic conditions). COPD = chronic obstructive pulmonary disease; CHF = congestive heart failure.

Table 4. Logistic regression results of individual and hospital characteristics associated with preventable hospitalizations

	Diagnosed with chronic medical conditions				Diagnosed with ambulatory care sensitive conditions			
Independent variable	β	(SE)	OR	(95% CI)	β	(SE)	OR	(95% CI)
Age	0.07 §§	(0.00)	1.07	(1.05, 1.09)	0.04 §§	(0.00)	1.04	(1.02, 1.06)
Sex (0-1)								
Male	0.10 §§	(0.02)	1.10	(1.06, 1.15)	0.10 §§	(0.02)	1.10	(1.06, 1.15)
Race*								
Black	0.49 §§	(0.03)	1.63	(1.54, 1.73)	0.49 §§	(0.02)	1.63	(1.57, 1.70)
Asian	-0.35 §§	(0.09)	0.70	(0.59, 0.84)	-0.23 §§	(0.08)	0.79	(0.68, 0.93)
Other	-0.04	(0.02)	0.96	(0.92, 1.00)	0.01	(0.02)	1.01	(0.97, 1.05)
Marital status (0-1)								
Non-married	0.09 §§	(0.02)	1.09	(1.05, 1.14)	0.08 §§	(0.02)	1.08	(1.04, 1.13)
Length of stay	-0.01 §§	(0.00)	0.99	(0.98, 0.995)	0.02 §§	(0.00)	0.98	(0.97, 0.99)
Geographic region†								
Northwest	0.16 §§	(0.03)	1.18	(1.11, 1.25)	0.25 §§	(0.03)	1.28	(1.21, 1.36)
Midwest	0.37 §§	(0.03)	1.45	(1.37, 1.54)	0.30 §§	(0.03)	1.35	(1.27, 1.43)
South	0.27 §§	(0.03)	1.31	(1.24, 1.39)	0.24 §§	(0.03)	1.27	(1.20, 1.35)
Principal source of payment‡								
No charge	0.47 §§	(0.10)	1.60	(1.32, 1.95)	0.37 §§	(0.10)	1.44	(1.19, 1.76)
Workmen compensation	-0.03	(0.05)	0.97	(0.88, 1.07)	-0.22 §§	(0.06)	0.80	(0.71, 0.90)
Medicare	0.46 §§	(0.03)	1.58	(1.49, 1.68)	0.45 §§	(0.03)	1.56	(1.48, 1.66)
Medicaid	0.36 §§	(0.03)	1.43	(1.35, 1.52)	0.33 §§	(0.03)	1.39	(1.31, 1.48)
Self-pay	0.37 §§	(0.04)	1.45	(1.34, 1.57)	0.46 §§	(0.03)	1.59	(1.49, 1.68)
Other	0.04	(0.03)	1.04	(0.98, 1.10)	0.06††	(0.04)	1.07	(0.98, 1.15)
No Secondary source of payment	0.21 §§	(0.03)	1.24	(1.16, 1.31)	0.12 §§	(0.03)	1.12	(1.06, 1.20)
Hospital ownership §								
Government	0.06	(0.04)	1.07	(0.98, 1.15)	0.24 §§	(0.04)	1.27	(1.18, 1.38)
Nonprofit	-0.00	(0.03)	1.00	(0.94, 1.06)	0.04	(0.03)	1.04	(0.98, 1.10)
Number of beds **								
6-99	0.22 §§	(0.04)	1.25	(1.15, 1.35)	0.46 §§	(0.03)	1.58	(1.68, 1.49)
100-199	0.24 §§	(0.03)	1.27	(1.20, 1.35)	0.33 §§	(0.03)	1.40	(1.31, 1.48)
200-299	0.25 §§	(0.03)	1.28	(1.21, 137)	0.35 §§	(0.03)	1.41	(1.34, 1.51)
300-499	0.14 §§	(0.03)	1.16	(1.09, 1.22)	0.20 §§	(0.03)	1.22	(1.15, 1.30)
Intercept	-5.90				-4.66			
-2 LOG likelihood	90,538.30				91,485.22			
Sample size	125,621				125,621			

*Default category is White. †Default category is West. ‡Default category is Private insurance. §Default category is Proprietary. ** Default category is bed number of 500 and over. †† $p < 0.10$; ‡‡ $p < 0.05$; §§ $p < 0.01$, two-sided.

the West. Hospitals with the number of beds less than 500 were more likely to have individuals admitted for CMC than hospitals with 500 or more beds. For example, the odds of admitting individuals with CMC for hospitals with 6-99 beds were 1.25 times greater than for hospitals with 500 or more beds (95% CI=1.16, 1.34) after controlling for patient and other for hospital related characteristics.

The regression results of using hospital admissions for CMC as the dependent variable were strikingly similar to those using hospital admissions for ACSC as the dependent variable. The standardized regression coefficients indicate that most individual and hospital characteristics were significantly associated with the dependent variables in the same direction. The only exception for the patient variable was insurance status. Workmen compensation was significant in the ACSC model but not in the CMC model. The only exception for the hospital-related variable was ownership. Government ownership was significant in the ACSC model but not in the CMC model.

DISCUSSION

Based on 1994 National Hospital Discharge Data, the results of this study showed that 11.7% of hospitalized adult patients younger than 65 years were diagnosed with at least one of the five CMC studied (5.3% based on principal diagnosis and 6.4% based on secondary diagnosis). Individual and hospital characteristics significantly associated with hospital admissions for CMC (objective 1) included age, gender, race, marital status (individual predisposing factors), principal and secondary sources of payment (individual enabling factors), length of stay (individual need factor), number of hospital beds, and geographic region (system factors). Hospital ownership was not a significant predictor of preventable hospitalization. Specifically, individuals likely to be admitted with CMC were older, male, black, non-married, without insurance or with Medicaid and Medicare, and without expected secondary sources of payment. These are population groups most likely to face access barriers to ambulatory and primary care. Hospitals likely to have a higher rate of preventable hospitalizations were relatively smaller as measured by the number of hospital beds and situated in the non-West regions.

These results are consistent with much of the research on the determinants of access to care [13-15]. For example, the finding that blacks were more likely to have preventable hospitalization than whites is consistent with the finding that after adjustment for age and health status, blacks had significantly fewer ambulatory visits than their white counterparts [16]. The linkage between access to care and hospital admissions for CMC indicates that the study of variations in hospitalization rates for CMC can be used as an alternative measure of health care access. Our results confirmed that certain demographic characteristics and socioeconomic disadvantage are significant barriers to the receipt of appropriate health services [17]. Factors significantly associated with higher hospitalization rates for CMC can be used to develop a profile of individuals experiencing access barriers to primary and ambulatory care. Policies and programs can then be developed that aim at improving access to care for these individuals.

The results of analyses based on hospital admissions for CMC were consistent with analyses based on hospital admissions for ACSC as identified by Billing and associates (second objective)[4]. By and large, the same sets of individual and hospital characteristics were associated with preventable hospitalizations whether measured by hospital admissions for CMC or ACSC. The results are also consistent with previous research on hospitalization for ACSC. For example, the finding that the uninsured and Medicaid patients were more likely to be admitted for CMC than privately insured patients corroborates the study by Weissman et al. with data from Massachusetts and Maryland that examined the predictors of ACSC hospitalization [3]. To the extent that insurance status serves as a proxy for income, the results of our analyses are also consistent with those of Billings and his associates [1,4] based on New York data, and Bindman and his colleagues [6] using California data.

The consistent findings based on admissions for CMC and ACSC suggest that using hospital admissions for CMC can serve as an efficient way of identifying subpopulations facing access barriers. The wide availability of hospital discharge data makes it easy and convenient to calculate preventable hospitalization rates. The analyses can be used to monitor and assess the effectiveness of programs and interventions aimed at improving access to care. Trend analyses can be conducted to measure progress over time. Analyses can also be conducted for comparisons across communities or health plans. Preventable hospitalization rates can be conveniently incorporated in community health needs assessment and health plan quality report cards. Caution, however, must be exercised in conducting the analyses. Our study indicates that individual sociodemographic characteristics significantly affect the preventable hospitalization rates and must be included in the analyses.

One may argue that the measure of CMC including diverse diagnoses might be too gross. More specific analyses should be related to particular diagnoses. Such analyses could more specifically examine the independent effects of a particular diagnosis, and might provide more complete and understandable results. While such explicit analyses are, in many ways, likely to be more informative, the more global analyses still have a role to play. For example, global measures provide needed comprehensive indicators of the overall effects of CMC to inform national health policy makers.

This study had a number of limitations. The cross-sectional nature of the data did not provide definitive conclusions about the specific causes associated with preventable hospitalizations. A longitudinal or case-control design would provide more valid conclusions. Furthermore, hospital admission rates for CMC alone are not sufficient proof that the provision of ambulatory care is inadequate since other factors might also affect preventable hospitalization including variations in disease prevalence, health care seeking behaviors, physician practice styles, and system characteristics [6,14]. However, for areas with consistently high preventable hospitalization rates, we can be confident that problems exist with the provision of ambulatory care. Finally, the NHDS did not contain individual identifiers that could be used to locate repeated hospitalizations for the same patients. To the extent there were systematic differences in readmission rates across population groups especially between the chronic medical users and others, estimation biases were likely to occur.

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個人及醫院因素與慢性病住院之關係

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慢性病患者若能有效的使用門診醫療服務，將可降低住院的機率，因此慢性病的住院率應可反應門診醫療的可近性。本研究之目的在探討與美國民眾慢性病(包括氣喘、高血壓、鬱血性心衰竭、慢性阻塞性肺病與糖尿病)住院相關之個人及醫院因素，並評估各因素和慢性病住院之相關是否相似於和門診敏感狀況(ambulatory care sensitivity conditions)而住院之相關。本研究資料來自1994年美國國家醫院出院調查研究，以雙變項統計方法比較因慢性病住院與非因慢性病住院二者之差異，再以羅吉斯迴歸分析探討與慢性病住院相關之自變項，羅吉斯迴歸分析之依變項為因慢性病住院及因門診敏感狀況住院，並比較二種模式中各相關因素之羅吉斯迴歸結果之相似程度。研究結果顯示顯著與慢性病住院相關之個人及醫院因素為年齡、性別、種族、婚姻狀態（個人傾向因素）、主要及次要住院醫療費用的來源（個人能力因素）、住院天數（個人需求因素）以及病床數與地理位置（系統因素）。有關比較慢性病住院或門診敏感狀況住院之相關因素，結果為二者相似。因此慢性病住院應可視為一種有效評估門診醫療服務使用是否有障礙之方法。（**中台灣醫學科學雜誌　1999；4：9-21**）

關鍵詞

慢性病，影響因素，住院

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