PREVENTING CHRONIC DISEASE

PUBLIC HEALTH RESEARCH, PRACTICE, AND POLICY

PCD Collection:
Multiple Chronic
Conditions

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Defining and Measuring Chronic Conditions: Imperatives for Research, Policy, Program, and Practice

Richard A. Goodman, MD, MPH; Samuel F. Posner, PhD; Elbert S. Huang, MD, MPH; Anand K. Parekh, MD, MPH; Howard K. Koh, MD, MPH

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Abstract

Current trends in US population growth, age distribution, and disease dynamics foretell rises in the prevalence of chronic diseases and other chronic conditions. These trends include the rapidly growing population of older adults, the increasing life expectancy associated with advances in public health and clinical medicine, the persistently high prevalence of some risk factors, and the emerging high prevalence of multiple chronic conditions. Although preventing and mitigating the effect of chronic conditions requires sufficient measurement capacities, such measurement has been constrained by lack of consistency in definitions and diagnostic classification schemes and by heterogeneity in data systems and methods of data collection. We outline a conceptual model for improving understanding of and standardizing approaches to defining, identifying, and using information about chronic conditions in the United States. We illustrate this model's operation by applying a standard classification scheme for chronic conditions to 5 national-level data systems.

> Although the literature does not support a single uniform definition for chronic disease, recurrent themes include the non−self-limited nature, the association with persistent and recurring health problems, and a duration measured in months and years, not days and weeks. *Thrall* (1)

> So far, many different approaches have been used to measure the prevalence and consequences of chronic diseases and health conditions in children, resulting in a wide variability of prevalence estimates that cannot be readily compared. *van der Lee et al* (2)

Introduction

Current trends in population growth, age distribution, and disease dynamics foretell rises in the prevalence of chronic diseases, other chronic conditions, and combinations of chronic conditions. Such trends threaten both the public and financial health of the United States and include the rapidly growing population of older adults, the increasing life expectancy associated with advances in public health and clinical medicine, and the persistently high prevalence of some risk factors (3).

Traditionally, medical, public health, and social programs targeting commonly defined chronic diseases have focused on individual chronic diseases without considering the broader context of multiple risk factors and multiply occurring chronic conditions. Now, however, health initiatives have begun to expand to include not only chronic disease but also chronic conditions such as functional limitations; anatomic problems that are not manifestations of physical disease but are permanent or long-standing (eg, developmental disorders, limb dysfunction, visual impairment); and a broad spectrum of behavioral health problems, some of which have traditionally not been classified as diseases (4−6).

The nation is recognizing the emerging high prevalence of multiple chronic conditions (MCC) and related implications for prevention, treatment, public health programs, and planning (5−7). People who have MCC may require increased coordination of care from clinicians, public health, and social programs to improve their overall quality of life. To coordinate a national response to issues related to MCC, in 2010 the US Department of Health and Human Services

(HHS) unveiled a strategic framework on MCC (6). Focus areas include monitoring the health of people who have MCC and facilitating the increased delivery of interventions, such as improved coordination of care to improve quality of life.

Preventing and mitigating the effect of any single chronic condition, or constellation of conditions, requires improved measurement. However, 2 major barriers exist. First is the lack of consistency in key definitions (eg, chronic disease, chronic illness, chronic condition) and in diagnostic classification schemes (eg, self-report, International Classification of Diseases [ICD] coding, Clinical Classifications Software [CCS]) (1,2,8). Second are differences in data collection methods and in the design of data sets that confound efforts to characterize the epidemiology and management of MCC in different population groups in different settings. To overcome these barriers, we need a conceptual model that includes standard case definitions for individually or multiply occurring chronic conditions and guidance for applying these definitions to systems that provide data on population health. This model would assist researchers and practitioners in monitoring and studying individual chronic conditions and MCC.

In this article, we outline such a conceptual model for improving understanding of and helping to standardize approaches to defining, identifying, and using information about multiple chronic conditions in the US population. We first provide further context regarding the lack of consistency in past definitional approaches. We then describe the conceptual model, developed by an MCC working group within the HHS Office of the Assistant Secretary of Health (OASH), and detail the working group's development of a list of selected chronic conditions. To demonstrate the opportunities and challenges associated with using this set of chronic conditions, we provide an overview of 5 data systems maintained by HHS that measure chronic conditions and illustrate the model's operation by applying a standard classification scheme for MCC to the HHS data systems. We conclude by suggesting options for policy makers, public health officials, researchers, practitioners, health plans, and others to consider for improving the collection, analysis, and use of data on chronic conditions.

## Variations in Defining and Classifying Chronic Conditions

Accurate case definitions are integral to public health surveillance efforts for monitoring population health and for conducting public health and clinical investigations (9). However, definitions for chronic conditions vary widely. Selected definitions (Table 1), drawn from peer-reviewed literature and other publicly available information sources, represent approaches used in academia, government, and other settings (4–6,10–16). These definitions exhibit heterogeneity in several characteristics, such as the duration or latency, need for medical attention, effect on function, pathology, departure from well-being, noncontagious nature, multiple risk factors, and nonamenability to cure. For example, most address duration and limitations in function, but only one requires the patient to have special training for rehabilitation (10).

The heterogeneity of these definitions stands in stark contrast to the process of measuring infectious conditions using established case definitions (17–19). As a result, lists of chronic conditions vary, and the accuracy and precision of estimating the magnitude of characteristics such as occurrence, burden, and associated costs are compromised.

The classification schemes currently used for identifying chronic conditions vary in origin, scope, and composition (Table 2 [which also includes the newly developed OASH list]), and few have been applied across multiple data systems. For example, 3 systems were developed through the combined use of expert opinion and ICD codes: the Chronic Condition Indicator suggested by Hwang and colleagues identifies 185 conditions (4); the Chronic Condition Data Warehouse, developed by the Centers for Medicare and Medicaid Services (CMS), identifies 26 conditions (21); and the Hierarchical Condition Category system identifies 70 conditions (22). In 1999, the Centers for Disease Control and Prevention (CDC) and the Council of State and Territorial Epidemiologists developed a set of 73 chronic disease indicators that later was expanded to 97 cross-cutting indicators for use by jurisdictions at different levels to "uniformly define, collect, and report chronic disease data that are important to public health practice" (20). These classification schemes have been applied to specific data systems for specific purposes, such as reporting state-level data for public health agencies. However, variations in the number of conditions and array of conditions constrain comparisons of findings that result from use of different classification schemes.

Conceptual Model for Standardizing the Analysis of Health Data Sets for Selected Chronic Conditions

To standardize the analysis of health-related data sets for chronic conditions, we propose a conceptual model that involves a classification scheme consisting of 2 related dimensions: 1) identifying and specifying conditions of interest, and 2) understanding the structure of the data system of interest. The intersection of these 2 dimensions (specifically, applying a coding scheme for the conditions of interest to the elements of a data system) allows for the production of chronic condition indicators for program, research, and policy purposes (Figure).
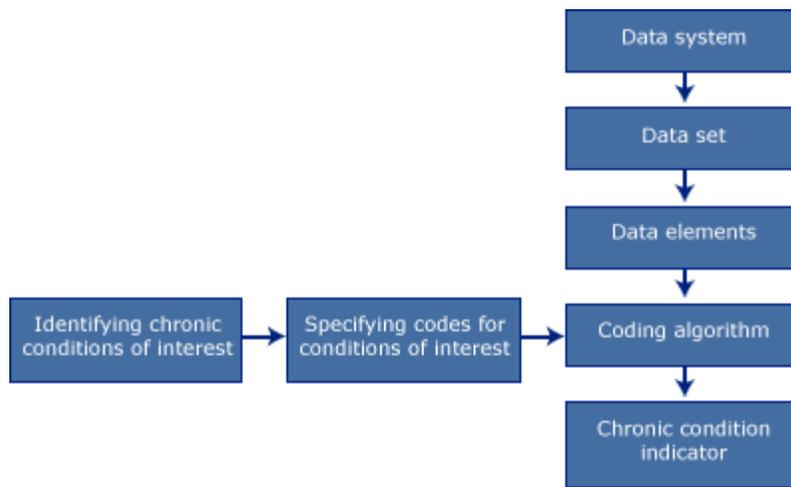
Figure. Conceptual model for developing and applying classification schemes for chronic conditions to data elements for studying and monitoring health conditions. [A text description of this figure is also available.]

The first dimension (identifying and specifying codes for conditions) creates a classification scheme of coding rules that enable a set of specific individual conditions to be identified in data records created in a given data system. This process initially requires the specification of criteria (eg, indicators for chronicity, need for ongoing medical management, duration of effect on function) for defining chronic conditions. These criteria may then be applied to sets of health conditions to select chronic conditions of interest. Finally, the set of chronic conditions of interest must be mapped to measures that use standard coding rules and algorithms that can be systematically applied across different data systems. The coding algorithms can be data system-specific, because they are a function of the type of data available (eg, ICD, CCS, survey responses).

The second dimension (understanding data systems) is a hierarchical model that generically describes major components of data systems. The highest level is a data system, such as a surveillance system or family of related systems. Such systems, in turn, consist of component data sets that are discrete units that can be used for analysis. In the example of surveillance systems, a data set could be the data collected for 1 year. Then data sets can be deconstructed further into data elements — that is, the individual components that form a data set, typically representing an individual person or encounter (eg, clinic visit, hospital discharge) as the unit of analysis.

The point at which the 2 dimensions intersect (ie, where the coding scheme is applied to the data elements) results in the output of an indicator of the number of chronic conditions. This indicator allows researchers and others to examine variability in a variety of outcome, cost, and use measures, including mortality, associated costs, health care use, and other parameters.

Development of the OASH List of Selected Chronic Conditions

Another key issue involves the decision basis on what to include in sets of selected conditions. An example of the ramifications is that patterns of key indicators, such as MCC prevalence, services utilization, and cost indicators may vary directly as a function of the type and number of conditions. The optimal list should comprise a number of conditions sufficient to be practically useful but not overly inclusive.

To address the need for such a list, and recognizing the need for a standard classification scheme for chronic conditions, OASH used a deliberative process involving its MCC working group subject matter experts in clinical medicine, epidemiology, and public health. The goal of this process was to develop a list that would include conditions that meet the definition for chronicity, are prevalent, and are potentially amenable to public health or clinical interventions or both. The criterion for chronicity was addressed by applying the definition of "chronic condition" used in the HHS strategic framework on MCC (6). This definition, which is based on approaches adapted from other sources, states that chronic illnesses are "conditions that last a year or more and require ongoing medical attention and/or limit activities of daily living" (such as physical medical conditions, behavioral health problems, and developmental disabilities) (4–6). To produce the OASH list, the working group applied this definition and related criteria to sets of conditions used in 3 sources: 1) the CMS Chronic Condition Data Warehouse (21); 2) the list of "Priority Conditions" identified by the Agency for Healthcare Research and Quality's Effective Health Care Program (23); and 3) the Robert Wood Johnson Foundation chart book, *Chronic Care: Making the Case for Ongoing Care* (5).

The result of this process was an aggregate set of 20 conditions (Table 3) — each of which was listed by at least 1 of these sources and the majority of which were drawn from at least 2 of the 3 sources — that represented a practical

balance of the above criteria. Identifying a manageable number of conditions helps to ensure comparability across data systems that encompass a spectrum of populations and settings. In addition, these conditions can be identified using ICD codes and applied to various data systems (Table 3), although how the conditions are coded varies as a function of data availability.

Selected HHS Health Data Systems for Studying Chronic Conditions

The component agencies of HHS maintain many privacy-protected data systems that provide information on the health and well-being of the US population. Many of these data systems include information about MCC and use of related health resources. In consultation with HHS agencies, the OASH working group selected 5 of these data systems on the basis of key criteria, including sufficiency of sample size; suitability for providing national-level, representative data; and recentness of data collection. These systems were the National Health Interview Survey (NHIS) (24,25); National Ambulatory Medical Care Survey (NAMCS) (26,27); Medical Expenditure Panel Survey (28); Nationwide Inpatient Sample of the Healthcare Cost and Utilization Project (29–31); and Medicare beneficiary enrollment and claims administrative data from CMS (21) (Appendix) (Table 4). Details on these 5 systems are available elsewhere (21,24–31).

Application of a Common Conceptual Model to HHS Health Data Systems

The OASH working group selected codes that could be used to link the OASH list of 20 selected chronic conditions to measures in the HHS data systems. Although the CCS codes used by the Medical Expenditure Panel Survey and National Inpatient Sample data systems are based on ICD, the ICD codes used by CMS in the Chronic Condition Data Warehouse do not completely correspond with those in the CCS. For this reason, the OASH working group identified ICD codes instead of CCS codes for the CMS Beneficiary Claims Data File. The complete list of CCS codes is maintained by the Agency for Healthcare Research and Quality (31).

Three patterns describe the specificity of the mapping for the selected conditions. The first pattern is characterized by the presence of a measure for a condition in each data system. For example, a measure for hypertension is in all 5 data systems. For this pattern, the data elements reflect various sources: for example, in NHIS, respondents provide the self -reported diagnosis for each condition, whereas in NAMCS, data are collected for both the reason for the current visit and for a checklist of ever existing conditions. However, not all data systems measure all 20 conditions: NHIS measures 10, NAMCS measures 19, and CMS measures 15; both the Nationwide Inpatient Sample and the Medical Expenditure Panel Survey measure all 20.

In the second pattern, although a 1-to-1 match was not found, related conditions could be mapped onto the same general condition described in the OASH list. For example, although NHIS does not have a specific question on chronic kidney disease, it does have questions on weak or failing kidneys, which could be mapped to chronic kidney disease.

For the third pattern, data in a given system could not be mapped to the condition identified in the OASH list. For example, data on congestive heart failure, cardiac arrhythmias, hyperlipidemia, dementia, and depression are not collected by NHIS, although data on these conditions are collected by the other 4 data systems. Other conditions for which data are not available in NHIS include autism spectrum disorder, HIV, osteoporosis, schizophrenia, and substance use. For NAMCS, data are not available for chronic kidney disease; and for CMS, for autism spectrum disorder, hepatitis, HIV, schizophrenia, or substance abuse disorders. Although claims data may be available from CMS, they are not now available in the analytic data sets.

Summary

As the prevalence of chronic conditions continues to increase in the US population, the United States will face even greater challenges in delivering care to people with MCC (32–35). Accurate, reproducible, and understandable measures of the occurrence and impact of MCC will be an important part of the solution for these challenges. Such measures can help in improving surveillance, program planning, targeting and evaluating interventions, and other essential activities. More accurate and reliable data on individual chronic conditions and on MCC are also foundational in enabling health systems and providers to target, measure, and ultimately improve population outcomes.

As this article has shown, improvements in measurement require that we first improve methods for characterizing and monitoring chronic conditions, including achieving common agreement on the meaning of the terms "chronic condition" and "multiple." Our review of existing definitions showed not only how existing definitions differ but how these differences affect research and practice, including difficulties in comparing results of studies and the prevalence of MCC across various data systems. Although some commentators have defined "multiple" as the presence of 2 or

more conditions in an individual (4,5), further study of the number of conditions and specific diagnoses may be improved by setting thresholds that are tailored to inform clinical practice, public health programs, and policy strategies.

Although the absence of standard case definitions for chronic conditions poses major challenges for uses across data systems, existing definitions and classification schemes might be applied more easily across multiple population subgroups within a given data system. For example, noting in the early 1990s the inherent limitations of condition-specific approaches to classifying chronic conditions among children, commentators associated with a research consortium on chronic illness in childhood pointed to the need for a widely applicable, but modifiable, definition of chronic conditions for use in research, program development and delivery, and development of health care policies (36). This approach, and similar conclusions by other investigators (2), although specific to children, bears relevance also to adults, even though the epidemiology of MCC varies by population group.

Our conceptual model provides a framework for more consistently applying lists of selected conditions to multiple data systems. For the OASH list of selected chronic conditions, the model explicitly documented data elements that were used to identify the selected conditions and how the data were collected and coded. This conceptual model can be used to document coding decisions that are applied to additional data sets, an especially important need when multiple data systems are used to examine the burden of chronic conditions. Although this model may be useful for improving the consistency in research and programs that address MCC, other opportunities allow for refining sets of conditions. For example, a rigorous measure development process that applied decision rules to data from multiple systems on key parameters (eg, the prevalence of different conditions and their effect on functional status, use of services, and costs) could assist in refining sets of conditions for analysis. Additional analysis to determine the optimal number of conditions also could help in refining measures of the impact of chronic conditions in the US population.

Although this article focused on consistency in defining and classifying chronic conditions, an important related issue is the coordination between essential actors involved in developing and using data, including coordination on methods for establishing classification schemes (ie, who does this, by what means, and how often). Deciding on the number of chronic conditions to include in a given list and addressing implications for key parameters (ie, measured prevalence, use, and cost) require a combination of clinical acumen and expertise in use of surveillance data. Thus, the gaps identified in this article help to sharpen focus on the need for collaboration among different organizations, agencies, and institutions at different levels (ie, national, regional, state, and local) that collect data and maintain data systems and that may benefit from using a common conceptual model and classification scheme. Beyond data managers, analysts, and researchers, other stakeholders need to engage in the process, including practitioners and policy makers, who can provide valuable input to guide analysis of the most pressing needs for data on chronic conditions.

Researchers, practitioners, and policy makers can consider using the issues identified in this article as the basis for improving the collection, analysis, and use of data on chronic conditions in the United States. Foremost, the examination of different classification schemes and their application to multiple data systems suggest that the terms "chronic disease" and "chronic illness" might be supplanted by wider adoption of a functionally more accurate and inclusive term, such as "chronic conditions." Greater consistency in and more complementary use of classification schemes for chronic conditions hold the promise for improving research and generating a stronger knowledge base for policy makers and program managers.

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Tables

Table 1. Selected Definitions for Chronic Disease and Other Chronic Conditions by Source and Year

Return

Sources, Definitions, and Key Components	
Hwang et al, 2001 (4)	
Definition	We defined a person as having a chronic condition if that person's condition had lasted or was expected to last 12 or more months and resulted in functional limitations and/or the need for ongoing medical care.
Key components	Duration: ≥12 months
	Functional limitation: yes
	Need for ongoing medical care: yes
Comments	Authors noted that they defined "chronic condition" broadly for several reasons, including the following: 1) a high proportion of individuals who have a chronic condition have more than 1 chronic condition; 2) functional limitations and other consequences of health problems often are independent of specific diseases; and 3) whereas diagnoses are important for medical management, a diagnosis alone may provide incomplete information on morbidity because of variations in condition-specific severity.
Bernstein et al, 2003 (10)	

Sources, Definitions, and Key Components	
Definition	A chronic disease or condition has 1 or more of the following characteristics: is permanent; leaves residual disability; is caused by nonreversible pathological alteration; requires special training of the patient for rehabilitation; or may be expected to require a long period of supervision, observation, or care.
Key components	Duration: permanent
	Functional limitation: yes (residual disability)
	Need for ongoing medical care: yes
Comments	Includes a broad spectrum of factors affecting health and functional status.

Warshaw, 2006 (11)

Definition	According to a common definition, chronic illnesses are "conditions that last a year or more and require ongoing medical attention and/or limit activities of daily living" (4).
Key components	Duration: ≥1 year
	Functional limitation: yes
	Need for ongoing medical care: yes
Comments	Authors used a modified version of the definition in Hwang et al (4).

Friedman et al, 2008 (12)

Definition	Chronic condition is defined as a condition that lasts 12 months or longer and meets 1 or both of the following tests: 1) it places limitations on self-care, independent living, and social interactions; and 2) it results in the need for ongoing intervention with medical products, services, and special equipment.
Key components	Duration: ≥12 months
	Functional limitation: yes
	Need for ongoing medical care: yes
Comments	Definition combines minimum duration with function and needs for treatment.

Anderson, 2010 (5)

Definition	Chronic condition is a general term that includes chronic illnesses and impairments. It includes conditions that are expected to last a year or longer, limit what one can do, and/or may require ongoing medical care. Serious chronic conditions are a subset of chronic conditions that require ongoing medical care and limit what a person can do.
Key components	Duration: ≥1 year
	Functional limitation: yes
	Need for ongoing medical care: yes
Comments	Definition further differentiates level of severity of condition.

National Center for Health Statistics, 2011 (13)

Definition	A health condition is a departure from a state of physical or mental well-being. In the National Health Interview Survey, each condition reported as a cause of an individual's activity limitation has been classified as chronic, not chronic, or unknown if chronic, based on the nature and duration of the condition. Conditions that are not cured once acquired (such as heart disease, diabetes, and birth defects in the original response categories, and amputee and old age in the ad hoc categories) are considered chronic, whereas conditions related to pregnancy are not considered chronic. Other conditions must have been present for 3 months or longer to be considered chronic. An exception is made for children aged less than 1 year who have had a condition since birth: such conditions are always considered chronic.
Key components	Duration: not cured once acquired or lasts ≥ 3 months
	Functional limitation: no
	Need for ongoing medical care: no
Comments	Combines multiple factors, including duration, nonamenability of condition to cure, and others.

Sources, Definitions, and Key Components	
US Department of Health and Human Services (HHS), 2010 (6)	
Definition	Chronic illnesses are "conditions that last a year or more and require ongoing medical attention and/or limit activities of daily living."
Key components	Duration: ≥1 year
	Functional limitation: yes
	Need for ongoing medical care: yes
Comments	This definition, adapted from other sources (4,11), incorporates elements of duration, medical requirements, and functional status. It also has the advantage of being compact. The HHS Strategic Framework (6) also adopts the definition of "multiple" used in another source (5) as 2 or more concurrent chronic conditions.
McKenna and Collins, 2010 (14)	
Definition	They are generally characterized by uncertain etiology, multiple risk factors, a long latency period, a prolonged course of illness, noncontagious origin, functional impairment or disability, and incurability.
Key components	Duration: prolonged course of illness or "incurability"
	Functional limitation: yes ("functional impairment or disability")
	Need for ongoing medical care: no
Comments	The most recent definition in this well known, practice-oriented guide evolved from the definition in the guide's first edition in 1993: "those that have a prolonged course, that do not resolve spontaneously, and for which a complete cure is rarely achieved."
World Health Organization, 2011 (15)	
Definition	Chronic diseases are diseases of long duration and generally slow progression.
Key components	Duration: "long duration"
	Functional limitation: no
	Need for ongoing medical care: no
Comments	Generic, highlighting progression.
Florida Department of Health, 2011 (16)	
Definition	Chronic diseases have a long course of illness. They rarely resolve spontaneously, and they are generally not cured by medication or prevented by vaccine.
Key components	Duration: "long course"
	Functional limitation: no
	Need for ongoing medical care: no
Comments	The definition of chronic disease includes an element on treatment.

Table 2. Classification Schemes for Chronic Conditions, by Source, Developmental Approach, and Number of Conditions Identified

Return

Characteristic	Classification Scheme				
	Chronic Disease Indicators	**Chronic Condition Indicator**	**Chronic Condition Data Warehouse**	**Hierarchical Condition Category**	**OASH List of Selected Chronic Conditions**
Source	Centers for Disease Control and Prevention (20)[a]	Hwang et al (4)	Centers for Medicare and Medicaid Services (21)	Pope et al (22)	OASH/HHS

Characteristic	Classification Scheme				
	Chronic Disease Indicators	**Chronic Condition Indicator**	**Chronic Condition Data Warehouse**	**Hierarchical Condition Category**	**OASH List of Selected Chronic Conditions**
First year published	1999	2001	2005	2004	2011
Method for identifying conditions and developing classification scheme	Consensus panel	3-digit ICD-9 code algorithm; consensus process, physician panel	ICD-9 code algorithm	2-tier system of aggregating ICD-9-CM codes; formal development and calibration by academics	Subject matter expert review of existing schemes
Number of chronic conditions identified	97	185	Originally 21, now 26	70	20

Abbreviations: OASH, Office of the Assistant Secretary for Health; HHS, US Department of Health and Human Services; ICD, International Classification of Diseases; ICD-9-CM, International Classification of Diseases, 9th Revision, Clinical Modification.
[a] The Council of State and Territorial Epidemiologists originally worked with epidemiologists and chronic disease program directors at the state and federal level to select, prioritize, and define 73 chronic disease indicators in 1999 (20).

Table 3. Twenty Chronic Conditions Selected by OASH for a Standard Classification Scheme and Their Corresponding Codes in 5 HHS Data Systems

Return

OASH List of Chronic Conditions	Name of Condition in Data Collection System	Data Collection System	Term or Code Used
Hypertension	Hypertension/high blood pressure	NHIS[a]	Self-reported
		NAMCS[b]	Checkbox
		MEPS[c]	98, 99
		NIS[d]	98, 99
		CMS[e]	401.0, 401.1, 401.9, 402.00, 402.01, 402.10, 402.11, 402.90, 402.91, 403.00, 403.01, 403.10, 403.11, 403.90, 403.91, 404.00, 404.01, 404.02, 404.03, 404.10, 404.11, 404.12, 404.13, 404.90, 404.91, 404.92, 404.93, 405.01, 405.09, 405.11, 405.19, 405.91, 405.99, 362.11, 437.2
Congestive heart failure	Congestive heart failure	NHIS[a]	Not applicable
		NAMCS[b]	Checkbox
		MEPS[c]	108
		NIS[d]	108
		CMS[e]	398.91, 402.01, 402.11, 402.91, 404.01, 404.11, 404.91, 404.03, 404.13, 404.93, 428.0, 428.1, 428.20, 428.21, 428.22, 428.23, 428.30, 428.31, 428.32, 428.33, 428.40, 428.41, 428.42, 428.43, 428.9
Coronary artery disease	Coronary artery disease	NHIS[a]	Not applicable
		NAMCS[b]	Included in ischemic heart disease
		MEPS[c]	100, 101
		NIS[d]	100, 101
		CMS[e]	410.00, 410.01, 410.02, 410.10, 410.11, 410.12, 410.20, 410.21, 410.22, 410.30, 410.31, 410.32, 410.40, 410.41,

OASH List of Chronic Conditions	Name of Condition in Data Collection System	Data Collection System	Term or Code Used
			410.42, 410.50, 410.51, 410.52, 410.60, 410.61, 410.62, 410.70, 410.71, 410.72, 410.80, 410.81, 410.82, 410.90, 410.91, 410.92, 411.0, 411.1, 411.81, 411.89, 412, 413.0, 413.1, 413.9, 414.00, 414.01, 414.02, 414.03, 414.04, 414.05, 414.06, 414.07, 414.12, 414.2, 414.3, 414.8, 414.9
	Coronary heart disease	NHIS[a]	Self-reported
		NAMCS[b]	Included in ischemic heart disease
		MEPS[c]	Included in coronary artery disease
		NIS[d]	Included in coronary artery disease
		CMS[e]	Included in coronary artery disease
	Ischemic heart disease	NHIS[a]	Not applicable
		NAMCS[b]	Checkbox
		MEPS[c]	Included in coronary artery disease
		NIS[d]	Included in coronary artery disease
		CMS[e]	Included in coronary artery disease
Cardiac arrhythmias	Cardiac arrhythmias	NHIS[a]	Not applicable
		NAMCS[b]	Not applicable
		MEPS[c]	105–106
		NIS[d]	105–106
		CMS[e]	427.31
Hyperlipidemia	Hyperlipidemia	NHIS[a]	Not applicable
		NAMCS[b]	Checkbox
		MEPS[c]	53
		NIS[d]	53
		CMS[e]	272.0, 272.1, 272.2, 272.3, 272.4
Stroke	Stroke	NHIS[a]	Self-reported
		NAMCS[b]	—
		MEPS[c]	109–112
		NIS[d]	109–112
		CMS[e]	—
	Cerebrovascular disease (stroke or transient ischemic attack)	NHIS[a]	—
		NAMCS[b]	Checkbox
		MEPS[c]	Included in stroke
		NIS[d]	Included in stroke
		CMS[e]	430, 431, 433.01, 433.11, 433.21, 433.31, 433.81, 433.91, 434.00, 434.01,434.10, 434.11, 434.90, 434.91, 435.0, 435.1, 435.3, 435.8, 435.9, 436, 997.02
Arthritis	Arthritis	NHIS[a]	Self-reported
		NAMCS[b]	Checkbox
		MEPS[c]	202, 203

OASH List of Chronic Conditions	Name of Condition in Data Collection System	Data Collection System	Term or Code Used
		NIS[d]	202, 203
		CMS[e]	714.0, 714.1, 714.2, 714.30, 714.31, 714.32, 714.33, 715.00, 715.04, 715.09, 715.10, 715.11, 715.12, 715.13, 715.14, 715.15, 715.16, 715.17, 715.18, 715.20, 715.21, 715.22, 715.23, 715.24, 715.25, 715.26, 715.27, 715.28, 715.30, 715.31, 715.32, 715.33, 715.34, 715.35, 715.36, 715.37, 715.38, 715.80, 715.89, 715.90, 715.91, 715.92, 715.93, 715.94, 715.95, 715.96, 715.97, 715.98, 720.0, 721.0, 721.1, 721.2, 721.3, 721.90, 721.91
Asthma	Asthma	NHIS[a]	Self-reported
		NAMCS[b]	Checkbox
		MEPS[c]	128
		NIS[d]	128
		CMS[e]	493.00, 493.01, 493.02, 493.10, 493.11, 493.12, 493.20, 493.21, 493.22, 493.81, 493.82, 493.90, 493.91, 493.92
Autism spectrum disorder	Autism	NHIS[a]	Not applicable
		NAMCS[b]	Not applicable
		MEPS[c]	29900, 29901
		NIS[d]	29900, 29901
		CMS[e]	Not applicable
Cancer	Cancer (all except nonmelanoma skin)	NHIS[a]	Self-reported
		NAMCS[b]	Checkbox
		MEPS[c]	11–43
		NIS[d]	11–43
		CMS[e]	Female breast cancer: 174.0, 174.1, 174.2, 174.3, 174.4, 174.5, 174.6, 174.8, 174.9, 175.0, 175.9, 233.0, V10.3. Colorectal cancer: 154.0, 154.1, 153.0, 153.1, 153.2, 153.3, 153.4, 153.5, 153.6, 153.7, 153.8, 153.9, 230.3, 230.4, V10.05. Prostate cancer: 185, 233.4, V10.46. Lung cancer: 162.2, 162.3, 162.4, 162.5, 162.8, 162.9, 231.2, V10.11.
Chronic kidney disease	Chronic kidney disease	NHIS[a]	Self-reported
		NAMCS[b]	Checkbox for chronic renal failure
		MEPS[c]	108
		NIS[d]	108
		CMS[e]	016.00, 016.01, 016.02, 016.03, 016.04, 016.05, 016.06, 095.4, 189.0, 189.9, 223.0, 236.91, 249.40, 249.41, 250.40, 250.41, 250.42, 250.43, 271.4, 274.10, 283.11, 403.01, 403.11, 403.91, 404.02, 404.03, 404.12, 404.13, 404.92, 404.93, 440.1, 442.1, 572.4, 580.0, 580.4, 580.81, 580.89, 580.9, 581.0, 581.1, 581.2, 581.3, 581.81, 581.89, 581.9, 582.0, 582.1, 582.2, 582.4, 582.81, 582.89, 582.9, 583.0, 583.1, 583.2, 583.4, 583.6, 583.7, 583.81, 583.89, 583.9, 584.5, 584.6, 584.7, 584.8, 584.9, 585, 585.1, 585.2, 585.3, 585.4, 585.5, 585.6, 585.9, 586, 587, 588.0, 588.1, 588.81, 588.89, 588.9, 591, 753.12, 753.13, 753.14, 753.15, 753.16, 753.17, 753.19, 753.20, 753.21, 753.22, 753.23, 753.29, 794.4

OASH List of Chronic Conditions	Name of Condition in Data Collection System	Data Collection System	Term or Code Used
Chronic obstructive pulmonary disease	Chronic obstructive pulmonary disease	NHIS[a]	Self-reported
		NAMCS[b]	Checkbox
		MEPS[c]	127
		NIS[d]	127
		CMS[e]	490, 491.0, 491.1, 491.20, 491.21, 491.22, 491.8, 491.9, 492.0, 492.8, 494.0, 494.1, 496
Dementia (including Alzheimer's and other senile dementias)	Dementia	NHIS[a]	Not applicable
		NAMCS[b]	Not applicable
		MEPS[c]	653
		NIS[d]	653
		CMS[e]	331.0, 331.1, 331.11, 331.19, 331.2, 331.7, 290.0, 290.10, 290.11, 290.12, 290.13, 290.20, 290.21, 290.3, 290.40, 290.41, 290.42, 290.43, 294.0, 294.10, 294.11, 294.8, 797
Depression	Depression	NHIS[a]	Not applicable
		NAMCS[b]	Checkbox
		MEPS[c]	567
		NIS[d]	567
		CMS[e]	296.20, 296.21, 296.22, 296.23, 296.24, 296.25, 296.26, 296.30, 296.31, 296.32, 296.33, 296.34, 296.35, 296.36, 2 296.51, 296.52, 296.53, 296.54, 296.55, 296.56, 296.60, 296.61, 296.62, 296.63, 296.64, 296.65, 296.66, 296.89, 298.0, 300.4, 309.1, 311
Diabetes	Diabetes (all nongestational)	NHIS[a]	Self-reported
		NAMCS[b]	Checkbox
		MEPS[c]	49,50
		NIS[d]	49,50
		CMS[e]	249.00, 249.01, 249.10, 249.11, 249.20, 249.21, 249.30, 249.31, 249.40, 249.41, 249.50, 249.51, 249.60, 249.61, 249.70, 249.71, 249.80, 249.81, 249.90, 249.91, 250.00, 250.01, 250.02, 250.03, 250.10, 250.11, 250.12, 250.13, 250.20, 250.21, 250.22, 250.23, 250.30, 250.31, 250.32, 250.33, 250.40, 250.41, 250.42, 250.43, 250.50, 250.51, 250.52, 250.53, 250.60, 250.61, 250.62, 250.63, 250.70, 250.71, 250.72, 250.73, 250.80, 250.81, 250.82, 250.83, 250.90, 250.91, 250.92, 250.93, 357.2, 362.01, 362.02, 366.41
Hepatitis	Hepatitis	NHIS[a]	Self-reported
		NAMCS[b]	Not applicable
		MEPS[c]	6
		NIS[d]	6
		CMS[e]	Not applicable
Human immunodeficiency virus (HIV)	HIV	NHIS[a]	Not applicable
		NAMCS[b]	Not applicable
		MEPS[c]	5

OASH List of Chronic Conditions	Name of Condition in Data Collection System	Data Collection System	Term or Code Used
Osteoporosis	Osteoporosis	NIS[d]	5
		CMS[e]	Not applicable
		NHIS[a]	Not applicable
		NAMCS[b]	Checkbox
		MEPS[c]	206
		NIS[d]	206
		CMS[e]	733.00, 733.01, 733.02, 733.03, 733.09
Schizophrenia	Schizophrenia	NHIS[a]	Not applicable
		NAMCS[b]	Not applicable
		MEPS[c]	659
		NIS[d]	659
		CMS[e]	Not applicable
Substance abuse disorders (drug and alcohol)	Substance use	NHIS[a]	Not applicable
		NAMCS[b]	Not applicable
		MEPS[c]	660–661
		NIS[d]	660–661
		CMS[e]	Not applicable

Abbreviations: OASH, Office of the Secretary of Health, HHS, US Department of Health and Human Services; NHIS, National Health Interview Survey; NAMCS, National Ambulatory Medical Care Survey; MEPS, Medical Expenditure Panel Survey; NIS, Nationwide Inpatient Sample; CMS, Centers for Medicare and Medicaid Services; CCS, Clinical Classification Software; ICD, International Classification of Diseases.

[a] The National Health Information Survey is based on self-report (24,25).

[b] The National Ambulatory Medical Care Survey uses a checkbox on a medical chart abstraction checklist, which indicates that the patient has the condition, regardless of the reason for the visit (26,27).

[c] Data elements identified are from the household component of the Medical Expenditure Panel Survey, which uses CCS codes (28).

[d] The Nationwide Inpatient Sample uses CCS codes from hospital discharge records (29–31).

[e] The CMS Beneficiary Claims Data File uses valid ICD codes from Medicare claims data (21). The complete coding algorithm, including reference period, number and type of claims used, and exclusions, is available from http://www.ccwdata.org/cs/groups/public/documents/document/ccw_conditioncategories2011.pdf.

Table 4. Characteristics of Selected US Department of Health and Human Services Data Systems Used for Studying and Monitoring Chronic Conditions

Return

Characteristic	National Ambulatory Medical Care Survey (26,27)	National Health Interview Survey (NHIS) (24,25)	Medical Expenditure Panel Survey Household Component (28)	Nationwide Inpatient Sample (29–31)	Centers for Medicare and Medicaid Services Beneficiary Claims Data File (21)
Operator/owner	Centers for Disease Control and Prevention/National Center for Health Statistics	Centers for Disease Control and Prevention/National Center for Health Statistics	Agency for Healthcare Research and Quality	Agency for Healthcare Research and Quality	Centers for Medicare and Medicaid Services

Characteristic	National Ambulatory Medical Care Survey (26,27)	National Health Interview Survey (NHIS) (24,25)	Medical Expenditure Panel Survey Household Component (28)	Nationwide Inpatient Sample (29–31)	Centers for Medicare and Medicaid Services Beneficiary Claims Data File (21)
Sampling frame	Primary care providers	Noninstitutionalized civilian population	Households responding to NHIS	Nonfederal short-term stay hospitals	Medicare beneficiaries
Sampling design	Multistage probability of providers and systematic random sample of visits	Multistage probability selection of households with 1 eligible (age >17 y) respondent	Subsample of prior year households responding to NHIS with oversampling of selected population subgroups	Stratified random sample of hospitals in participating states, all hospitalizations included from sampled hospitals	NA
Unit of analysis	Outpatient visit	Individual	Individual	Hospitalization	Individual
Data source	Medical chart	Self-report	Household report of treated medical conditions	Discharge summary	Claims
Condition data	ICD code/chart notes	Self-report	ICD/CCS codes based on recorded responses	ICD/CCS	ICD
Other core data elements	Demographic characteristics, utilization, provider characteristics, economic	Demographic characteristics, health behaviors, disability, health insurance coverage, utilization	Economic, utilization	Economic, facility, demographic, payer	Demographic characteristics, utilization
Most recent year data available	2008	2011	2009	2009	2010

Abbreviations: NA, not applicable; ICD, International Classification of Diseases; CCS, Clinical Classification Software.

Appendix. Selected HHS Health Data Systems for Studying Chronic Conditions

Return

National Health Interview Survey (NHIS): Operated since 1957 and now maintained by the Centers for Disease Control and Prevention's (CDC's) National Center for Health Statistics, NHIS uses computer-assisted personal household interviews to collect data on a broad range of health topics (24,25). The NHIS is a cross-sectional household interview survey system that uses a multistage area probability sampling design. Eligible subjects are civilian noninstitutionalized persons residing in the United States at the time of the interview. Data collected include demographic characteristics, use of health services, health conditions and mobility limitations, self-reported health status, and behaviors (24,25).

National Ambulatory Medical Care Survey (NAMCS): Also operated and maintained by CDC's National Center for Health Statistics, NAMCS is designed to provide national-level data on the provision and use of ambulatory medical care services. The survey — a multistage probability design that involves probability samples of primary sampling units (PSUs), physician practices within PSUs, and patient visits within practices — collects data from a sample of physicians who provide primary patient care in nonfederal, office-based settings. For each sampled physician, a systematic random sample of visits during a 1-week period is selected for systematic abstraction; data collected include demographic characteristics, diagnoses (current and existing), procedures, and treatment plans (26,27).

Medical Expenditure Panel Survey Household Component (MEPS-HC): MEPS-HC is an ongoing federal survey sponsored by the Agency for Healthcare Research and Quality that can be used to produce national estimates for the US civilian noninstitutionalized population. The survey collects data from a nationally representative sample on health status, demographic characteristics, employment, healthcare access, healthcare use, medical expenditures, sources of payment, and insurance coverage. The MEPS-HC uses an overlapping panel design in which a new sample panel of households is selected each year from respondents to the previous year's NHIS, and data from 2 concurrent panels are combined to produce annual data. Five interviews are conducted with each household at approximately 5-month intervals to gather 2 years of longitudinal data per panel. Each interview is conducted in person with 1 representative from the household usually responding for all family members. Detailed data are collected from the household respondent on health care events and associated medical conditions and expenditures for all household members. Medical condition data are recorded verbatim by interviewers and professionally coded into International Classification of Diseases, 9th Revision, Clinical Modification codes by certified staff (28).

Nationwide Inpatient Sample (NIS): NIS is part of the Healthcare Cost and Utilization Project (HCUP) sponsored by the Agency for Healthcare Research and Quality. HCUP comprises a group of health care databases and related software tools that were developed through a partnership with private and public state-level data collection organizations. The NIS is the largest publicly available all-payer inpatient care database. For each year, the NIS is designed to approximate a 20%-stratified sample of community hospitals and contains discharge data for about 8 million hospital stays from more than 1,000 hospitals. Data elements in this system include diagnostic and procedure codes, payer information, patient and hospital characteristics, charges, and length of stay. The data are weighted to produce national and regional estimates of care in US community hospitals (29–31).

CMS Medicare administrative data: This data system, which is available through the Centers for Medicare and Medicaid Services Chronic Condition Data Warehouse, includes 100% Medicare files for fee-for-service institutional and noninstitutional claims, as well as enrollment and eligibility data. Information in this data system includes demographic characteristics, chronic conditions, claim payments, diagnostic codes, and procedure codes (21).

The RIS file format is a text file containing bibliographic citations. These files are best suited for import into bibliographic management applications such as EndNote , Reference Manager , and ProCite . A free trial download is available at each application's web site.

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Prevalence of Multiple Chronic Conditions Among US Adults: Estimates From the National Health Interview Survey, 2010

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Abstract

Preventing and ameliorating chronic conditions has long been a priority in the United States; however, the increasing recognition that people often have multiple chronic conditions (MCC) has added a layer of complexity with which to contend. The objective of this study was to present the prevalence of MCC and the most common MCC dyads/triads by selected demographic characteristics. We used respondent-reported data from the 2010 National Health Interview Survey (NHIS) to study the US adult civilian noninstitutionalized population aged 18 years or older (n = 27,157). We categorized adults as having 0 to 1, 2 to 3, or 4 or more of the following chronic conditions: hypertension, coronary heart disease, stroke, diabetes, cancer, arthritis, hepatitis, weak or failing kidneys, chronic obstructive pulmonary disease, or current asthma. We then generated descriptive estimates and tested for significant differences. Twenty-six percent of adults have MCC; the prevalence of MCC has increased from 21.8% in 2001 to 26.0% in 2010. The prevalence of MCC significantly increased with age, was significantly higher among women than men and among non-Hispanic white and non-Hispanic black adults than Hispanic adults. The most common dyad identified was arthritis and hypertension, and the combination of arthritis, hypertension, and diabetes was the most common triad. The findings of this study contribute information to the field of MCC research. The NHIS can be used to identify population subgroups most likely to have MCC and potentially lead to clinical guidelines for people with more common MCC combinations.

Introduction

Chronic conditions are an increasing concern in the United States, where they affect nearly half of the adult population and their prevalence has increased in recent years (1–3). These conditions result in numerous adverse health outcomes, increased health care needs, and subsequently higher medical costs (4–6). In the past, strategies have focused on preventing and ameliorating a single disease at a time; however, the large percentage of people with 2 or more conditions, or multiple chronic conditions (MCC), has added a layer of complexity to developing prevention and intervention strategies (7–10). As a result, the US Department of Health and Human Services (HHS) has developed a strategic framework to address MCC (11). Strategies of the framework include the stimulation of epidemiologic research to determine the most common MCC dyads and triads and to explain more clearly the differences in MCC and the opportunities for prevention and treatment among various sociodemographic groups (10,11).

Although numerous data sources are available to help meet these data-driven objectives, the National Health Interview Survey (NHIS) can be used to generate estimates of MCC that are representative of the noninstitutionalized, civilian adult population of the United States. The NHIS contains extensive sociodemographic and health data that can be studied with MCC. Furthermore, because it is conducted continuously, it can be used to monitor trends in MCC over time.

The main objective of this study was to use nationally representative data from the 2010 NHIS to examine the prevalence of MCC by select sociodemographic groups, and the prevalence of MCC dyads and triads among US adults. A secondary objective was to use earlier data from the NHIS to examine trends in MCC during 2001–2010.

Analysis

Data source

The NHIS is a multipurpose health survey that represents the US civilian, noninstitutionalized population (12,13). The NHIS is multistaged and is conducted continuously throughout each calendar year by using computer-assisted personal interviews. The survey has 3 main components: the Family Core, the Sample Adult Core, and the Sample Child Core. In the Family Core, an adult self-reports for himself or herself and as a proxy for the remainder of the family. From each family, 1 adult aged 18 years or older and 1 child (if the family includes a child) are randomly chosen for the Sample Adult Core and Sample Child Core questionnaires. The selected "sample adult" self-reports for the Sample Adult portion of the NHIS (unless a health condition requires a proxy respondent to answer for this adult) (12,13). All data for chronic conditions were taken from the Sample Adult Core, and data for sex, age, race/ethnicity, and health insurance coverage were taken from the Family Core. The 2010 NHIS Sample Adult Core contained 27,157 adults, had a conditional response rate (ie, the rate for those sample adults identified as eligible without taking into account household or family nonresponse) of 77.3%, and a final response rate of 60.8%. Descriptive estimates of select sociodemographic characteristics for the 2010 adult population are in Table 1. For the trend analysis using the NHIS for the years 2001 through 2010, the lowest Sample Adult Core sample size over the 10-year period was 21,781 (2008) and the highest was 33,326 (2001). The conditional response rate was lowest in 2008 (74.2%) and highest in 2003 (84.5%); the final response rate was lowest in 2008 (62.6%) and highest in 2002 (74.3%).

Definitions

The HHS Interagency Workgroup on MCC and Office of the Assistant Secretary for Health have generated a standardized approach to defining chronic conditions in the United States (14), which was used as a basis to generate a measure of MCC. The 2010 NHIS included questions on 10 of the 20 chronic conditions captured by the Workgroup's definition, including whether adults had ever been told by a doctor or other health professional that they had hypertension, coronary heart disease, stroke, diabetes, cancer, arthritis, hepatitis, or emphysema; had experienced weak or failing kidneys or chronic bronchitis during the past 12 months; or currently had asthma. Presence of emphysema or chronic bronchitis was combined in this analysis to form a single condition of chronic obstructive pulmonary disease (COPD). We counted the presence of each of these 10 conditions and combined them into 3 categories: 0 to 1 condition, 2 to 3 conditions, and 4 or more conditions. We also generated estimates for the 5 most common MCC dyad and triad combinations by sex and age group, and we estimated weighted prevalences for the 5 most common combinations. Within each combination, chronic conditions are listed alphabetically. These MCC dyad and triad combinations were not mutually exclusive; an adult could have more than 1 dyad or triad.

The NHIS questions on chronic conditions included in this article remained consistent for the 2001 through 2010 NHIS surveys, with 1 exception: in 2001 the NHIS asked sample adults if they had arthritis, with no reference to rheumatoid arthritis, gout, lupus, or fibromyalgia. From 2002 and onward, the question on arthritis included all 5 conditions (ie, arthritis, rheumatoid arthritis, gout, lupus, and fibromyalgia). The 10 conditions included in this HHS standardized approach (14) that were not measured by the NHIS for those years were congestive heart failure, cardiac arrhythmias, hyperlipidemia, autism spectrum disorder, dementia, depression, human immunodeficiency virus infection, osteoporosis, schizophrenia, and substance abuse disorders (a few of these conditions were measured by the NHIS in some years). The inability to capture these additional conditions, especially those related to mental health among the younger population (15), likely means percentages of MCC using the NHIS may be underestimates (16). Health insurance categories were based on a hierarchy of mutually exclusive categories (12,13), which included private coverage, public coverage (ie, Medicaid, Children's Health Insurance Program, or Medicare), other coverage (ie, state-sponsored health plans, other government programs, or military health plans), and uninsured.

Statistical analysis

To account for survey weights that allow for generalization to the US adult civilian noninstitutionalized population and the additional covariance resulting from the complex cluster sampling design used by the NHIS, we used SUDAAN version 10.0.1 (RTI International, Research Triangle Park, North Carolina) to generate all descriptive estimates and their corresponding confidence intervals. Two-tailed significance tests were used to test for significant differences in prevalence among population subgroups in 2010, and all differences noted in this article are significant ($P < .05$) unless otherwise noted. Estimates with a relative standard error greater than 30% were considered unreliable and were not discussed. Data from the 2001 through 2010 NHIS surveys were used to examine the trends of MCC by sex, age, and selected race/ethnicity subgroups with sufficient sample sizes to generate statistically reliable estimates. The JoinPoint Regression Program version 3.5.1 (National Cancer Institute, Washington, DC) was used to identify whether an increasing or decreasing trend was significant. This software also identified "joinpoints," which are points in time where a change in trend occurs (17).

Results

Prevalence of MCC by sex and age

In 2010, 49.1% of civilian, noninstitutionalized US adults had no chronic conditions, and 24.8% had only 1 chronic condition. One-quarter of US adults had MCC (Table 2); 21.1% had 2 to 3 MCC and 4.9% had 4 or more MCC. For both sexes, older adults had a higher prevalence of MCC than younger adults. Among adults aged 18 to 44 years, men were less likely to have 2 to 3 MCC compared with women (P = .003). For adults aged 18 to 44 years and 45 to 64 years, men were less likely than women to have 4 or more MCC. In contrast, among adults 65 years or older, men were more likely than women to have 4 or more MCC.

Prevalence of MCC by sex, age, and race/ethnicity

Significant differences in the prevalence of MCC were found when the analysis was further stratified by race/ethnicity (Table 2). For example, among non-Hispanic white adults aged 18 to 44 years, men were less likely than women to have 2 to 3 MCC (P = .005), yet men aged 65 years or older were more likely to have 4 or more MCC than women 65 years or older. Among non-Hispanic black and Hispanic adults aged 45 to 64 years, women were more likely than men to have 4 or more MCC.

Differences in the prevalence of MCC were also found among specific racial/ethnic categories for certain sex/age groups (Table 2). Non-Hispanic American Indian/Alaska Native men aged 45 to 64 years were more likely to have 2 to 3 MCC compared with men 45 to 64 years in all other racial/ethnic groups. Among the same sex and age group (men 45 to 64 years), non-Hispanic white and non-Hispanic black men were more likely to have 4 or more MCC compared with Hispanic men; however, there was no significant difference in the prevalence of 4 or more MCC between non-Hispanic white and non-Hispanic black men. No significant racial/ethnic differences in the prevalence of 4 or more MCC were found among men aged 65 years or older.

For all 3 age groups, non-Hispanic black women had a higher prevalence of 2 to 3 MCC compared with Hispanic women (Table 2). Among those aged 45 to 64 years, non-Hispanic black women had a higher prevalence of 2 to 3 MCC relative to non-Hispanic white women. Non-Hispanic Asian/Pacific Islander women had a lower prevalence of 2 to 3 MCC than non-Hispanic American Indian/Alaska Native, non-Hispanic black, non-Hispanic white, and Hispanic women.

Prevalence of MCC by sex, age, health insurance, and race/ethnicity

Table 3 further stratifies the estimates of MCC by health insurance coverage and shows that differences exist between different coverage statuses. Among men and women aged 18 to 44 years and 45 to 64 years, those with private coverage and those who were uninsured had a lower prevalence of 2 to 3 MCC than those with public coverage. Among women aged 45 to 64 years, the prevalence of 4 or more MCC was higher among those with public coverage than those with other coverage, without coverage, and private coverage. Prevalence of 4 or more MCC was significantly higher among men aged 45 to 64 years with public and other coverage than those with private coverage and without coverage.

Analysis of differences in racial/ethnic groups revealed additional patterns in the prevalence of MCC by health insurance coverage. Non-Hispanic white men aged 45 to 64 years who had public coverage had a higher prevalence of 2 to 3 MCC than those who had private coverage (P < .001) and other coverage (Table 3). The prevalence of 4 or more MCC was higher among non-Hispanic white men aged 45 to 64 years with either public coverage or other coverage than those with private coverage (both P < .001). Among men aged 65 years or older, non-Hispanic black men with public coverage were more likely to have 2 to 3 MCC than non-Hispanic black men with private coverage.

Among non-Hispanic white women aged 45 to 64 years, those with public coverage had a higher prevalence of 2 to 3 MCC (P = .002) and 4 or more MCC (P < .001) than those with private coverage and those who were uninsured (Table 3). These same significant differences in the prevalence of 2 to 3 MCC were also found among non-Hispanic black women aged 45 to 64 years. In addition, non-Hispanic black women aged 45 to 64 years with public coverage also had a higher prevalence of 4 or more MCC than those with private health insurance coverage (P < .001). For Hispanic women aged 45 to 64 years, no significant differences were found in the prevalence of 2 to 3 MCC among health insurance coverage types, but those with public coverage had a much higher prevalence of 4 or more MCC than those with private coverage (P < .001). Among non-Hispanic white women aged 65 years or older, those with public coverage had a higher prevalence of 4 or more MCC than those with private coverage.

Prevalence of MCC dyads and triads

To meet an additional objective of the HHS MCC framework — determination of the most common MCC dyads and triads (10,11) — we assessed the 5 most prevalent MCC dyad and triad combinations by sex and age group (Table 4). We list the individual chronic conditions within each dyad and triad alphabetically. For US men and women with at least 2 chronic conditions, for each age group, the MCC dyad with the highest prevalence was ever having had arthritis and ever having had hypertension. This MCC dyad was more prevalent among women aged 65 years or older compared

with men 65 years or older (P < .001). The second most prevalent dyad for men in each age group was ever having had diabetes and ever having had hypertension. This dyad was also the second most prevalent for women aged 45 to 64 years and 65 years or older, where women 45 to 64 years were less likely to have diabetes/hypertension compared with men aged 45 to 64 years (P < .001). For women aged 18 to 44 years the second most prevalent dyad was ever having had arthritis and currently having asthma.

Among US adults with at least 2 chronic conditions, the MCC dyad of ever having had arthritis and ever having had diabetes appeared across each of the various sex and age groups as 1 of the 5 most prevalent MCC dyads, with the exception of women aged 18 to 44 years (Table 4). Ever having had cancer and ever having had hypertension was 1 of the 5 most prevalent dyads among men aged 45 to 64 years and 65 years or older and women aged 65 years or older. Ever having had coronary heart disease and ever having had hypertension was 1 of the 5 most prevalent dyads among men aged 45 to 64 years and 65 years or older; however, this was not the case for women, regardless of age group.

As for the most prevalent MCC triads among US adults who had at least 3 chronic conditions (Table 5), for both men and women in most age groups the most prevalent triad was ever having had arthritis, ever having had diabetes, and ever having had hypertension. The one exception was for women 18 to 44 years, where the most common triad was ever having had arthritis, currently having asthma, and ever having had COPD. However, the arthritis/diabetes/hypertension triad was still one of the most prevalent among women aged 18 to 44 years with MCC.

Another common MCC triad was ever having had arthritis, currently having asthma, and ever having had hypertension, which was 1 of the 5 most prevalent triads for each sex and age group with the exception of men aged 65 years or older (Table 5). Ever having had arthritis, ever having had cancer, and ever having had hypertension was prevalent among both men and women aged 45 to 64 years and 65 years or older; this prevalence was higher for women aged 45 to 64 years than for men aged 45 to 64 years.

Trends in MCC

From 2001 through 2010, there was a slight (albeit significant) increasing trend among US adults for the prevalence of 2 to 3 MCC (P < .001) and 4 or more MCC (P < .001) (Figure 1). The same trend — slightly increasing and statistically significant — was also found when examining 2 to 3 MCC and 4 or more MCC separately for men and women.
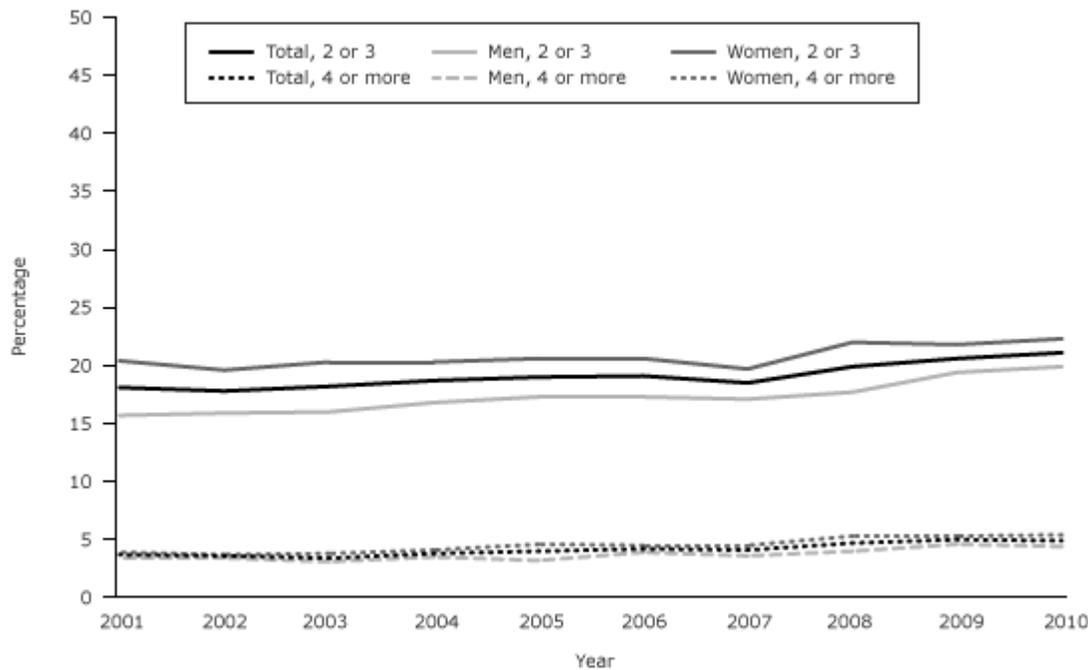
Figure 1. Prevalence of multiple chronic conditions among the total US adult population and separately, among US men and women, National Health Interview Survey for 2001 through 2010. [A tabular version of this figure is also available.]

Examination of the 2001–2010 NHIS data for MCC by age showed no significant increase in the prevalence of 2 to 3 MCC or 4 or more MCC for adults aged 18 to 44 years (Figure 2). For adults 65 years or older, there were slight significant increases from 2001 to 2010 in the prevalence of both 2 to 3 MCC (P = .005) and 4 or more MCC (P < .001). For adults aged 45 to 64 years with 2 to 3 MCC, the increasing trend was significant (P = .005) during 2007 through

2010. A significant increase in the prevalence of 4 or more MCC from 2001 through 2010 was found among adults aged 45 to 64 years.
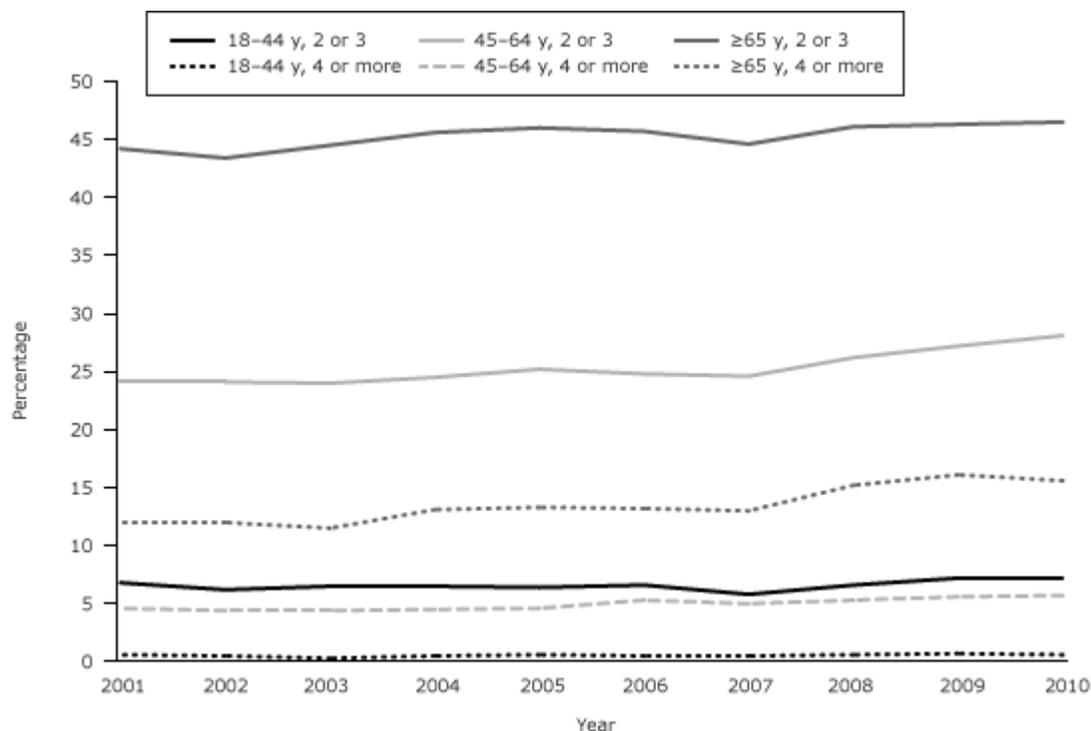
Figure 2. Prevalence of multiple chronic conditions among US adults aged 18 to 44 years, 45 to 64 years, and 65 years or older, National Health Interview Survey for 2001 through 2010. [A tabular version of this figure is also available.]

For the prevalence of MCC from 2001 through 2010 by race/ethnicity (Figure 3), a slight increase in 2 to 3 MCC was found among non-Hispanic white adults ($P < .001$). However, for non-Hispanic black adults ($P = .04$) and Hispanic adults ($P = .03$), the increasing trend was significant only during 2007 through 2010. Among non-Hispanic white and non-Hispanic black adults there was a slight, significant increase in the prevalence of 4 or more MCC over time. This trend in the prevalence of 4 or more MCC was not significant for Hispanic adults.

Figure 3. Prevalence of multiple chronic conditions among non-Hispanic white, non-Hispanic black, and Hispanic adults in the United States, National Health Interview Survey for 2001 through 2010. [A tabular version of this figure is also available.]

Summary

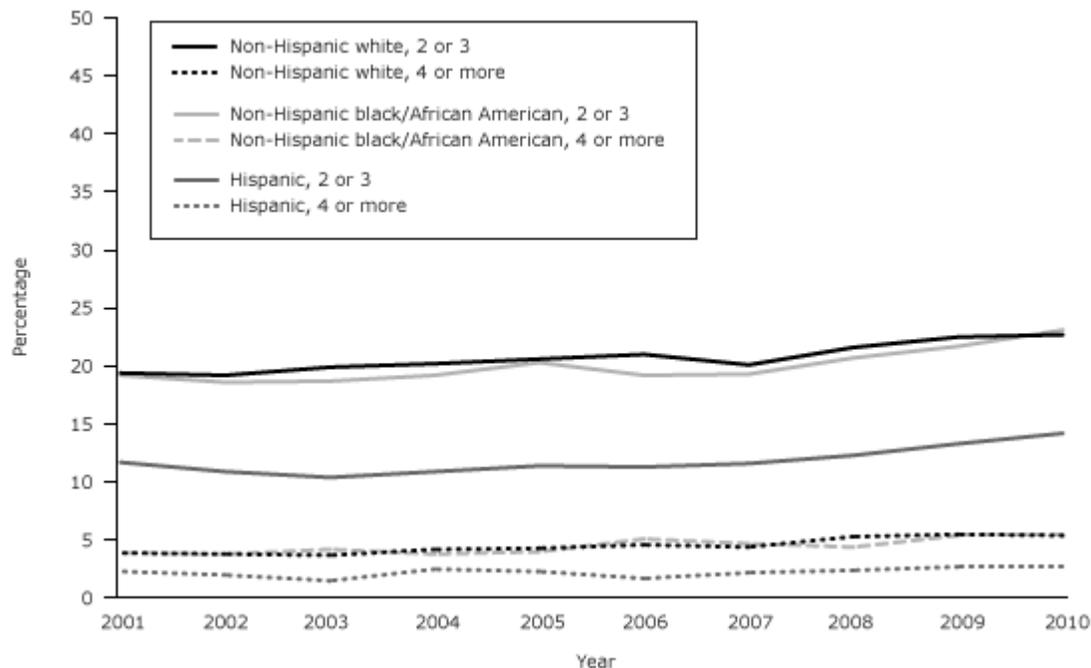The main objective of our study was to use the NHIS to examine the prevalence of MCC by select sociodemographic groups and the prevalence of MCC dyads and triads. The results showed that more than one-quarter of US adults have MCC. Among certain subgroups (such as women and older adults), the prevalence of MCC was generally higher, and for others (Hispanic adults and those with private insurance) the prevalence was generally lower. Not surprisingly (18), the prevalence rates of our study vary from those of others because of differing populations of interest and the specific definition of MCC used. However, some of the general patterns found in our study, such as higher prevalence among older adults, have also been found in past research (8,19). The arthritis/hypertension dyad and the arthritis/diabetes/hypertension triad were 2 of the most prevalent MCC combinations, differing from the most common MCC combinations found by other studies examining adults aged 65 or older (20,21). Our trend analyses showed significant increases in MCC for all adults since 2001.

Although MCC prevalences presented in this study are generalizable to the US adult noninstitutionalized civilian population, use of the NHIS has limitations. Only 10 conditions detailed in the HHS Interagency Workgroup definition (14) were able to be captured, leaving certain conditions unaccounted for (15,16). Of the conditions captured, their measurement using NHIS could potentially be further debated (eg, including all cancers as opposed to only noncurable cancers). The NHIS also captured only conditions that were confirmed by a doctor or health professional, potentially leading to the underreporting of conditions that remain undiagnosed or were not recalled by the respondent during the NHIS interview. Finally, this research was exploratory in nature and used multiple comparisons, which could increase the likelihood of type I error.

In spite of these limitations, examining the prevalence of MCC among subgroups of adults allows for the identification of MCC patterns in the US adult population. Our research serves as a platform from which additional research using the NHIS can build. It would be beneficial for future studies to seek to explain why differences in the prevalence of MCC among subgroups exist. This might entail examining topics such as how different health insurance types influence service use and the likelihood of being diagnosed with a chronic condition, how educational attainment may affect MCC, or what behavioral risk factors are most common among adults with MCC.

Our study shows that the increasing trend in the prevalence of MCC among US adults is a cause for concern, and the NHIS can be a useful data source for identifying patterns of MCC at the national level and assessing which population subgroups are most likely to have MCC. This information can be useful in helping clinicians develop prevention strategies tailored to population subgroups with greater prevalence of MCC and subgroups that are most at risk for complications resulting from specific dyads and triads, consequently reducing health care costs among these subgroups.

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Tables

Table 1. Prevalence of Selected Sociodemographic Characteristics of US Adults, National Health Interview Survey, 2010

Return

Variable	% (95% Confidence Interval)
Sex	
Men	48.3 (47.57–49.09)

Variable	% (95% Confidence Interval)
Women	51.7 (50.91–52.43)
Age, y	
18–44	48.2 (47.32–49.08)
45–64	34.9 (34.19–35.70)
≥65	16.9 (16.26–17.47)
Race/ethnicity	
Non-Hispanic white	68.0 (67.13–68.91)
Non-Hispanic black/African American	11.6 (11.03–12.26)
Hispanic	14.0 (13.38–14.61)
Non-Hispanic Asian/Pacific Islander	4.7 (4.38–5.05)
Non-Hispanic American Indian/Alaska Native	0.5 (0.39–0.67)
Non-Hispanic other race	1.1 (0.99–1.33)
Health insurance	
Public	16.0 (15.38–16.59)
Private	62.9 (62.03–63.79)
Other	3.1 (2.87–3.44)
Uninsured	18.0 (17.34–18.60)

Table 2. Prevalence of Chronic Conditions Among US Adults by Sex, Age, and Race/Ethnicity, National Health Interview Survey, 2010[a]

Sex, Age, and Race/Ethnicity	No. of Chronic Conditions		
	0–1, % (95% CI)	2–3, % (95% CI)	≥4, % (95% CI)
Total	74.0 (73.28–74.63)	21.1 (20.50–21.74)	4.9 (4.62–5.24)
Men			
18–44 y			
Total	93.3 (92.49–94.07)	6.3 (5.57–7.11)	0.4 (0.23–0.64)
Non-Hispanic white	93.6 (92.55–94.46)	6.1 (5.23–7.11)	0.3 (0.15–0.73)[b]
Non-Hispanic black/African American	91.2 (88.56–93.23)	8.0 (6.06–10.46)	0.8 (0.33–2.11)[b]
Hispanic	93.7 (91.76–95.21)	6.0 (4.53–7.93)	—[c]
Non-Hispanic Asian/Pacific Islander	96.5 (93.51–98.13)	3.4 (1.76–6.36)[b]	—[c]
Non-Hispanic American Indian/Alaska Native	86.7 (55.37–97.16)	—[c]	—[d]
Non-Hispanic other race	86.1 (73.41–93.26)	12.8 (5.89–25.64)[b]	—[c]
45–64 y			
Total	67.2 (65.44–68.91)	28.1 (26.50–29.79)	4.7 (3.99–5.49)
Non-Hispanic white	66.3 (64.12–68.44)	28.4 (26.49–30.48)	5.2 (4.36–6.29)
Non-Hispanic black/African American	61.6 (56.57–66.30)	33.7 (29.13–38.69)	4.7 (3.24–6.79)
Hispanic	76.6 (72.26–80.50)	21.4 (17.61–25.65)	2.0 (1.19–3.38)
Non-Hispanic Asian/Pacific Islander	78.6 (71.56–84.27)	19.5 (14.08–26.45)	—[c]
Non-Hispanic American Indian/Alaska Native	28.5 (10.28–58.20)[b]	66.8 (37.31–87.19)	—[c]

Sex, Age, and Race/Ethnicity	No. of Chronic Conditions		
	0–1, % (95% CI)	2–3, % (95% CI)	≥4, % (95% CI)
Non-Hispanic other race	62.6 (44.99–77.41)	32.9 (18.26–51.92)	—[c]
≥65 y			
Total	37.5 (35.17–39.85)	45.4 (42.92–47.88)	17.1 (15.31–19.13)
Non-Hispanic white	36.9 (34.24–39.62)	45.7 (42.91–48.60)	17.4 (15.29–19.68)
Non-Hispanic black/African American	32.3 (26.40–38.83)	48.6 (42.25–55.03)	19.1 (14.49–24.70)
Hispanic	47.5 (40.39–54.76)	40.1 (33.30–47.22)	12.4 (8.53–17.71)
Non-Hispanic Asian/Pacific Islander	39.4 (29.26–50.59)	45.1 (34.75–55.85)	15.5 (8.47–26.69)
Non-Hispanic American Indian/Alaska Native	—[d]	—[d]	100.0 (n/a)
Non-Hispanic other race	50.8 (29.75–71.58)	30.4 (13.70–54.70)[b]	—[c]
Women			
18–44 y			
Total	91.1 (90.26–91.95)	8.0 (7.26–8.91)	0.8 (0.59–1.11)
Non-Hispanic white	91.0 (89.81–92.12)	8.2 (7.20–9.42)	0.7 (0.45–1.17)
Non-Hispanic black/African American	88.3 (86.00–90.20)	10.3 (8.48–12.45)	1.4 (0.87–2.38)
Hispanic	92.9 (91.19–94.23)	6.8 (5.42–8.42)	0.4 (0.19–0.73)[b]
Non-Hispanic Asian/Pacific Islander	97.1 (94.40–98.51)	2.8 (1.38–5.46)[b]	—[c]
Non-Hispanic American Indian/Alaska Native	84.2 (63.87–94.17)	—[c]	—[c]
Non-Hispanic other race	83.2 (72.29–90.39)	12.9 (6.70–23.50)[b]	—[c]
45–64 y			
Total	65.2 (63.64–66.73)	28.1 (26.65–29.56)	6.7 (5.97–7.54)
Non-Hispanic white	66.8 (64.87–68.62)	27.3 (25.55–29.06)	6.0 (5.08–6.98)
Non-Hispanic black/African American	52.0 (47.92–56.14)	36.8 (33.05–40.62)	11.2 (8.96–13.91)
Hispanic	65.9 (61.82–69.75)	26.7 (23.21–30.52)	7.4 (5.63–9.67)
Non-Hispanic Asian/Pacific Islander	79.9 (73.37–85.16)	18.6 (13.52–25.10)	1.5 (0.67–3.20)[b]
Non-Hispanic American Indian/Alaska Native	52.6 (31.78–75.52)	42.8 (23.61–64.50)	—[c]
Non-Hispanic other race	48.5 (34.78–62.45)	27.7 (17.68–40.53)	23.8 (14.12–37.32)
≥65 y			
Total	38.2 (36.22–40.18)	47.4 (45.44–49.30)	14.5 (13.09–15.94)
Non-Hispanic white	38.2 (35.83–40.53)	47.4 (45.12–49.67)	14.5 (12.88–16.19)
Non-Hispanic black/African American	33.6 (28.98–38.45)	52.3 (47.29–57.18)	14.2 (11.13–17.93)
Hispanic	40.6 (34.82–46.75)	43.7 (38.03–49.50)	15.7 (11.48–21.04)
Non-Hispanic Asian/Pacific Islander	49.6 (40.80–58.43)	40.9 (32.76–49.54)	9.5 (5.33–16.42)
Non-Hispanic American Indian/Alaska Native	—[c]	56.3 (25.52–82.89)	—[c]
Non-Hispanic other race	—[c]	47.7 (27.04–69.20)	32.7 (12.96–61.29)[b]

Abbreviations: CI, confidence interval; n/a, not applicable.
[a] Adults identifying as multiple races were included in the "other race" category.
[b] Relative standard error (RSE) >30% and ≤50% and should be used with caution as they do not meet National Center for Health Statistics standards of reliability and precision.
[c] RSE >50% are not shown.
[d] Estimates with a quantity of zero.

Table 3. Prevalence of Chronic Conditions Among US Adults by Sex, Age, Health Insurance, and Race/Ethnicity, National Health Interview Survey, 2010[a]

Sex, Age, and Health Insurance, Race/Ethnicity	No. of Chronic Conditions		
	0–1, % (95% CI)	2–3, % (95% CI)	≥4, % (95% CI)
Men			
18–44 y			
Public, total	83.9 (79.44–87.53)	14.2 (10.78–18.47)	1.9 (0.89–4.06)[b]
Public, non-Hispanic white	81.9 (74.43–87.49)	16.2 (10.92–23.25)	—[c]
Public, non-Hispanic black/African American	81.2 (71.56–88.17)	17.6 (10.78–27.34)	—[c]
Public, Hispanic	89.7 (81.13–94.62)	8.1 (3.90–15.95)[b]	—[c]
Private, total	94.0 (92.88–94.91)	5.9 (4.96–6.97)	—[c]
Private, non-Hispanic white	94.6 (93.31–95.58)	5.4 (4.40–6.67)	—[d]
Private, non-Hispanic black/African American	93.5 (90.04–95.87)	5.4 (3.40–8.32)	—[c]
Private, Hispanic	91.6 (87.68–94.40)	8.2 (5.44–12.14)	—[c]
Other, total	86.3 (77.85–91.83)	11.2 (6.25–19.16)	—[c]
Other, non-Hispanic white	83.1 (69.69–91.33)	12.7 (5.88–25.45)[b]	—[c]
Other, non-Hispanic black/African American	86.0 (60.53–96.12)	—[c]	—[d]
Other, Hispanic	92.0 (79.29–97.16)	—[c]	—[d]
Uninsured, total	94.7 (93.29–95.86)	4.9 (3.85–6.31)	—[c]
Uninsured, non-Hispanic white	94.1 (91.62–95.91)	5.4 (3.70–7.69)	—[c]
Uninsured, non-Hispanic black/African American	93.2 (89.11–95.87)	6.3 (3.75–10.41)	—[c]
Uninsured, Hispanic	95.9 (93.68–97.33)	4.0 (2.58–6.20)	—[c]
45–64 y			
Public, total	38.4 (32.85–44.23)	44.7 (39.10–50.39)	16.9 (13.27–21.38)
Public, non-Hispanic white	33.9 (26.36–42.35)	44.7 (37.04–52.54)	21.4 (15.97–28.17)
Public, non-Hispanic black/African American	41.3 (31.48–51.86)	47.8 (37.31–58.52)	10.9 (6.09–18.70)
Public, Hispanic	51.2 (37.37–64.92)	39.5 (26.52–54.22)	9.2 (4.54–17.84)[b]
Private, total	69.3 (67.14–71.35)	27.3 (25.37–29.40)	3.4 (2.60–4.35)
Private, non-Hispanic white	68.9 (66.43–71.34)	27.3 (25.07–29.73)	3.7 (2.79–4.95)
Private, non-Hispanic black/African American	62.1 (55.54–68.30)	34.5 (28.59–41.04)	3.3 (1.67–6.47)[b]
Private, Hispanic	74.9 (68.02–80.68)	23.9 (18.24–30.74)	—[c]
Other, total	56.2 (48.84–63.28)	33.7 (27.13–40.96)	10.1 (6.92–14.54)
Other, non-Hispanic white	59.2 (49.57–68.17)	29.5 (21.52–38.94)	11.3 (7.12–17.53)
Other, non-Hispanic black/African American	42.3 (29.29–56.40)	48.7 (34.82–62.72)	9.1 (4.35–17.98)[b]
Other, Hispanic	59.3 (33.80–80.65)	38.5 (17.76–64.41)[b]	—[c]
Uninsured, total	76.8 (72.88–80.35)	21.2 (17.70–25.14)	2.0 (1.15–3.44)
Uninsured, non-Hispanic white	71.4 (65.88–76.42)	25.9 (21.08–31.31)	2.7 (1.39–5.16)[b]
Uninsured, non-Hispanic black/African American	83.3 (75.61–88.95)	15.3 (9.99–22.81)	—[c]

Sex, Age, and Health Insurance, Race/Ethnicity	No. of Chronic Conditions		
	0–1, % (95% CI)	2–3, % (95% CI)	≥4, % (95% CI)
Uninsured, Hispanic	88.6 (82.71–92.67)	10.3 (6.42–16.22)	—c
≥65 y			
Public, total	37.4 (34.17–40.77)	46.0 (42.47–49.49)	16.6 (14.13–19.46)
Public, non-Hispanic white	37.2 (33.15–41.39)	45.2 (40.88–49.58)	17.6 (14.49–21.27)
Public, non-Hispanic black/African American	29.0 (22.49–36.48)	55.0 (47.30–62.41)	16.0 (11.10–22.64)
Public, Hispanic	45.9 (37.71–54.35)	42.0 (33.84–50.66)	12.1 (8.10–17.59)
Private, total	36.6 (33.38–39.91)	45.5 (42.01–48.94)	18.0 (15.52–20.70)
Private, non-Hispanic white	36.2 (32.81–39.84)	46.3 (42.64–50.08)	17.4 (14.85–20.32)
Private, non-Hispanic black/African American	36.7 (25.22–49.85)	39.5 (28.98–51.01)	23.9 (14.56–36.58)
Private, Hispanic	46.0 (29.89–62.96)	36.0 (22.03–52.77)	18.0 (7.46–37.54)b
Other, total	56.3 (35.11–75.44)	28.2 (13.89–48.78)b	15.5 (6.19–33.88)b
Other, non-Hispanic white	68.0 (40.81–86.71)	21.5 (7.49–48.01)b	—c
Other, non-Hispanic black/African American	—c	—c	37.0 (12.28–71.11)b
Other, Hispanic	—d	100.0 (n/a)	—d
Uninsured, total	67.2 (39.81–86.43)	30.7 (11.95–59.19)b	—c
Uninsured, non-Hispanic white	48.1 (12.83–85.36)b	51.9 (14.64–87.17)b	—d
Uninsured, non-Hispanic black/African American	—c	—c	—c
Uninsured, Hispanic	82.8 (46.37–96.38)	—c	—d
Women			
18–44 y			
Public, total	84.5 (81.46–87.06)	12.9 (10.52–15.77)	2.6 (1.67–4.08)
Public, non-Hispanic white	79.4 (74.20–83.83)	17.2 (13.16–22.27)	3.3 (1.74–6.27)b
Public, non-Hispanic black/African American	84.7 (79.63–88.76)	11.9 (8.32–16.65)	3.4 (1.77–6.36)b
Public, Hispanic	92.5 (87.48–95.56)	7.0 (3.99–12.00)	—c
Private, total	92.5 (91.42–93.51)	7.0 (6.05–8.12)	0.4 (0.25–0.80)b
Private, non-Hispanic white	92.9 (91.56–94.06)	6.7 (5.60–8.04)	0.4 (0.17–0.85)b
Private, non-Hispanic black/African American	89.3 (85.52–92.12)	10.0 (7.23–13.71)	—c
Private, Hispanic	91.9 (88.95–94.09)	8.0 (5.78–10.91)	—c
Other, total	90.3 (85.59–93.57)	8.9 (5.76–13.39)	—c
Other, non-Hispanic white	89.9 (81.99–94.51)	8.8 (4.56–16.30)b	—c
Other, non-Hispanic black/African American	89.2 (72.85–96.24)	—c	—d
Other, Hispanic	91.8 (85.22–95.58)	7.6 (3.97–14.20)b	—c
Uninsured, total	91.7 (90.00–93.18)	7.6 (6.16–9.32)	0.7 (0.32–1.47)b
Uninsured, non-Hispanic white	90.9 (87.74–93.31)	8.6 (6.27–11.82)	—c
Uninsured, non-Hispanic black/African American	89.7 (85.53–92.76)	9.4 (6.48–13.36)	—c
Uninsured, Hispanic	94.2 (91.72–95.97)	5.3 (3.59–7.76)	0.5 (0.19–1.30)b

Sex, Age, and Health Insurance, Race/Ethnicity	No. of Chronic Conditions		
	0–1, % (95% CI)	2–3, % (95% CI)	≥4, % (95% CI)
45–64 y			
Public, total	33.0 (28.80–37.58)	42.4 (38.17–46.73)	24.6 (20.90–28.64)
Public, non-Hispanic white	33.5 (27.06–40.60)	40.7 (34.32–47.34)	25.8 (20.77–31.65)
Public, non-Hispanic black/African American	24.5 (18.52–31.71)	53.1 (45.20–60.79)	22.4 (16.29–30.00)
Public, Hispanic	42.9 (32.46–53.93)	33.1 (24.09–43.55)	24.0 (16.04–34.40)
Private, total	68.9 (67.00–70.69)	26.7 (24.96–28.56)	4.4 (3.71–5.21)
Private, non-Hispanic white	70.0 (67.80–72.04)	26.1 (24.12–28.27)	3.9 (3.16–4.81)
Private, non-Hispanic black/African American	56.7 (51.08–62.23)	35.1 (30.22–40.42)	8.1 (5.63–11.55)
Private, Hispanic	68.9 (63.13–74.12)	25.5 (20.87–30.67)	5.6 (3.71–8.51)
Other, total	61.4 (53.20–68.95)	29.2 (22.62–36.83)	9.4 (5.63–15.31)
Other, non-Hispanic white	64.1 (53.02–73.78)	28.1 (19.43–38.80)	7.8 (3.47–16.73)[b]
Other, non-Hispanic black/African American	58.9 (41.83–74.06)	29.1 (16.85–45.49)	12.0 (5.18–25.27)[b]
Other, Hispanic	56.5 (37.64–73.71)	32.9 (18.07–52.24)	—[c]
Uninsured, total	69.2 (65.15–73.06)	25.2 (21.66–29.17)	5.5 (3.84–7.89)
Uninsured, non-Hispanic white	67.1 (61.45–72.28)	26.4 (21.65–31.86)	6.5 (4.06–10.16)
Uninsured, non-Hispanic black/African American	68.8 (60.52–76.06)	24.1 (17.56–32.22)	7.0 (3.39–14.06)[b]
Uninsured, Hispanic	72.4 (64.16–79.31)	25.1 (18.53–33.05)	2.5 (0.96–6.50)[b]
≥65 y			
Public, total	36.9 (34.07–39.74)	47.2 (44.26–50.18)	15.9 (13.87–18.23)
Public, non-Hispanic white	37.4 (33.88–41.09)	46.0 (42.27–49.82)	16.6 (13.92–19.58)
Public, non-Hispanic black/African American	32.8 (26.91–39.19)	53.3 (46.84–59.66)	13.9 (10.58–18.14)
Public, Hispanic	36.9 (30.22–44.09)	48.4 (41.54–55.39)	14.7 (10.53–20.08)
Private, total	38.8 (36.01–41.65)	47.9 (45.15–50.72)	13.3 (11.52–15.27)
Private, non-Hispanic white	38.6 (35.57–41.76)	48.3 (45.25–51.38)	13.1 (11.19–15.21)
Private, non-Hispanic black/African American	33.6 (26.28–41.86)	52.5 (44.34–60.49)	13.9 (8.75–21.36)
Private, Hispanic	45.2 (31.56–59.62)	34.9 (23.78–48.00)	19.9 (10.35–34.76)[b]
Other, total	—[c]	73.2 (37.60–92.52)	—[c]
Other, non-Hispanic white	—[d]	100.0 (n/a)	—[d]
Other, non-Hispanic black/African American	—[c]	—[d]	—[c]
Other, Hispanic	—[d]	100.0 (n/a)	—[d]
Uninsured, total	69.4 (47.49–85.00)	17.4 (6.66–38.32)[b]	—[c]
Uninsured, non-Hispanic white	—[c]	51.1 (15.43–85.71)[b]	—[c]
Uninsured, non-Hispanic black/African American	60.3 (19.46–90.50)[b]	—[c]	—[c]
Uninsured, Hispanic	82.8 (48.96–96.04)	—[c]	—[c]

Abbreviations: CI, confidence interval; n/a, not applicable.
[b] Relative standard error (RSE) >30% and ≤50% and should be used with caution as they do not meet National Center for Health Statistics standards of reliability and precision.

Table 4. Five Most Prevalent Chronic Condition Dyads for US Adults With 2 or More Chronic Conditions, by Sex and Age, National Health Interview Survey, 2010[a]

Return

Sex, Age, and Dyad	% (95% Confidence Interval)
Men	
18–44 y	
Arthritis/hypertension	26.9 (22.01–32.43)
Diabetes/hypertension	21.1 (16.40–26.66)
Asthma/hypertension	18.6 (14.21–23.91)
COPD/hypertension	13.1 (9.12–18.36)
Arthritis/diabetes	9.2 (6.24–13.46)
45–64 y	
Arthritis/hypertension	46.9 (43.71–50.17)
Diabetes/hypertension	29.7 (27.02–32.50)
CHD/hypertension	16.4 (14.27–18.71)
Arthritis/diabetes	14.7 (12.70–17.05)
Cancer/hypertension	11.3 (9.50–13.43)
≥65 y	
Arthritis/hypertension	49.3 (46.29–52.32)
Diabetes/hypertension	29.5 (26.81–32.42)
Cancer/hypertension	27.6 (24.91–30.40)
CHD/hypertension	24.8 (22.05–27.84)
Arthritis/diabetes	21.2 (18.75–23.83)
Women	
18–44 y	
Arthritis/hypertension	24.6 (20.71–29.05)
Arthritis/asthma	20.5 (16.84–24.80)
Asthma/hypertension	19.5 (15.94–23.64)
Arthritis/COPD	16.7 (13.31–20.85)
Diabetes/hypertension	14.1 (11.12–17.74)
45–64 y	
Arthritis/hypertension	49.9 (47.24–52.55)
Diabetes/hypertension	23.6 (21.50–25.87)
Arthritis/diabetes	17.3 (15.38–19.37)
Asthma/hypertension	16.7 (14.72–18.89)
Arthritis/asthma	16.6 (14.79–18.63)
≥65 y	

Sex, Age, and Dyad	% (95% Confidence Interval)
Arthritis/hypertension	63.0 (60.46–65.51)
Diabetes/hypertension	25.4 (23.27–27.71)
Arthritis/diabetes	20.4 (18.39–22.50)
Cancer/hypertension	21.8 (19.78–24.02)
Arthritis/cancer	21.0 (19.05–23.07)

Abbreviations: COPD, chronic obstructive pulmonary disease; CHD, coronary heart disease.
[a] Within dyads, chronic conditions are listed in alphabetical order. Arthritis includes arthritis, rheumatoid arthritis, gout, lupus, and fibromyalgia.

Table 5. Five Most Prevalent Chronic Condition Triads for US Adults With 3 or More Chronic Conditions, by Sex and Age, National Health Interview Survey, 2010[a]

Sex, Age, and Triad	% (95 Confidence Interval)
Men	
18–44 y	
Arthritis/diabetes/hypertension	26.1 (16.70–38.45)
Asthma/diabetes/hypertension	15.5 (7.73–28.73)[b]
Arthritis/asthma/hypertension	14.6 (7.17–27.31)[b]
Arthritis/COPD/hypertension	12.2 (6.47–21.79)[b]
Arthritis/CHD/hypertension	7.3 (3.23–15.83)[b]
45–64 y	
Arthritis/diabetes/hypertension	28.3 (24.34–32.66)
Arthritis/CHD/hypertension	17.9 (14.52–21.86)
CHD/diabetes/hypertension	14.5 (11.37–18.22)
Arthritis/cancer/hypertension	11.2 (8.61–14.53)
Arthritis/asthma/hypertension	10.6 (8.03–13.91)
≥65 y	
Arthritis/diabetes/hypertension	28.2 (24.67–32.06)
Arthritis/cancer/hypertension	27.5 (23.97–31.31)
Arthritis/CHD/hypertension	27.2 (23.43–31.26)
CHD/diabetes/hypertension	17.8 (14.66–21.48)
Cancer/CHD/hypertension	14.6 (11.82–18.01)
Women	
18–44 y	
Arthritis/asthma/COPD	24.7 (17.68–33.50)
Arthritis/asthma/hypertension	21.3 (15.09–29.09)
Asthma/COPD/hypertension	19.8 (13.64–27.89)
Arthritis/COPD/hypertension	19.7 (13.82–27.32)
Arthritis/diabetes/hypertension	14.4 (9.65–21.03)

Sex, Age, and Triad	% (95 Confidence Interval)
45–64 y	
Arthritis/diabetes/hypertension	30.5 (27.24–34.02)
Arthritis/asthma/hypertension	22.0 (19.00–25.35)
Arthritis/COPD/hypertension	18.4 (15.59–21.52)
Arthritis/cancer/hypertension	16.7 (13.80–20.09)
Arthritis/asthma/COPD	14.4 (12.08–17.16)
≥65 y	
Arthritis/diabetes/hypertension	32.6 (29.36–35.95)
Arthritis/cancer/hypertension	26.9 (23.95–30.13)
Arthritis/CHD/hypertension	19.3 (16.44–22.41)
Arthritis/COPD/hypertension	16.8 (14.19–19.84)
Arthritis/asthma/hypertension	16.5 (13.95–19.38)

Abbreviations: COPD, chronic obstructive pulmonary disease; CHD, coronary heart disease.
[a] Within triads, chronic conditions are listed in alphabetical order. Arthritis includes arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia.
[b] Relative standard error (RSE) >30% and ≤50% and should be used with caution as they do not meet National Center for Health Statistics standards of reliability and precision.

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PREVENTING CHRONIC DISEASE
PUBLIC HEALTH RESEARCH, PRACTICE, AND POLICY

Multiple Chronic Conditions Among US Adults Who Visited Physician Offices: Data From the National Ambulatory Medical Care Survey, 2009

Jill Jacobsen Ashman, PhD; Vladislav Beresovsky, PhD

PEER REVIEWED

Abstract

Most research on adults with chronic conditions focuses on a single disease or condition, such as hypertension or diabetes, rather than on multiple chronic conditions (MCC). Our study's objective was to compare physician office visits by adults with MCC with visits by adults without MCC, by selected patient demographic characteristics. We also identified the most prevalent dyads and triads of chronic conditions among these patients. We used the National Ambulatory Medical Care Survey, a nationally representative survey of office visits to nonfederal physicians and used 13 of the 20 conditions defined by the National Strategic Framework on Multiple Chronic Conditions. Descriptive estimates were generated and significant differences were tested.

In 2009, an estimated 326 million physician office visits, were made by adults aged 18 years or older with MCC representing 37.6% of all medical office visits by adults. Hypertension was the most prevalent chronic condition that appeared in the top 5 MCC dyads and triads, by sex and age groups. The number of visits by patients with MCC increased with age and was greater for men than for women and for adults with public rather than private insurance. Physicians were more likely to prescribe medications at office visits made by patients with MCC. Physician office visits by adults with MCC were not evenly distributed by demographic characteristics.

Introduction

Most research on adults with chronic conditions focuses on a single disease or condition, such as hypertension or diabetes; little attention is focused on multiple chronic conditions (MCC) in 1 patient. This study compares, by selected demographic characteristics, physician office visits by adults with MCC with visits by adults without MCC. We also present findings on the most common MCC dyads and triads.

Analysis

Data source

The National Ambulatory Medical Care Survey (NAMCS) is a nationally representative annual survey of patient office visits to nonfederal physicians. The NAMCS sampling frame includes all physicians in the American Medical Association and American Osteopathic Association master files, excluding anesthesiologists, radiologists, and pathologists. The 2009 NAMCS (1) used a multistage probability design and included 1,293 physicians who completed patient record forms. The unweighted response rate was 62.1%, and the weighted response rate was 62.4% (1). This study included the 28,693 patient record forms that physicians completed for visits by patients 18 or older for NAMCS 2009. We excluded visits by patients under age 18. Patient information recorded during the visit was abstracted from medical records and entered onto the patient record forms.

Estimates are based on sample data weighted to produce national estimates and include standard errors. Estimates are not presented if they are based on fewer than 30 cases in the sample data. Estimates based on 30 or more cases include an explanation if the relative standard error of the estimate exceeds 30%.

Definitions

The US Department of Health and Human Services (HHS) Interagency Workgroup on Multiple Chronic Diseases (IWMCD) created a list of 20 chronic conditions common in the United States (2). NAMCS includes check boxes for 13 of these conditions: arthritis, asthma, cancer, chronic kidney disease, chronic obstructive pulmonary disease, congestive heart failure, coronary artery disease, depression, diabetes, hyperlipidemia, hypertension, osteoporosis, and stroke. A checked box for any of these conditions on NAMCS indicates that the medical record contains documentation that the patient was given a diagnosis of the condition at some point, not necessarily during the current visit. The remaining 7 conditions on the HHS-IWMCD list — autism spectrum disease, cardiac arrhythmias, dementia, HIV, hepatitis, schizophrenia, and substance abuse disorders — do not have check boxes on NAMCS. A separate NAMCS question collects the primary diagnosis (as well as 2 additional diagnoses) for the current visit. If 1 of the 7 conditions that are not on the checklist show up in the diagnosis question, we could have included that condition in the count of chronic conditions that we used for this study. However, if the same patient had visited the doctor for a condition or ailment unrelated to 1 of the 7 conditions without check boxes, we would have no way of identifying that chronic condition and could not include it in our count. Because we cannot accurately count the number of visits that patients with these 7 conditions made, we excluded those 7 conditions from our study. We focus exclusively on the 13 conditions with check boxes on NAMCS.

We summed conditions and grouped them into 3 categories (0 or 1, 2 or 3, and ≥4), with MCC defined as 2 or more chronic conditions per visit to a physician. We created dyads by summing yes responses for every combination of 2 chronic conditions. We identified the most common dyads by patients with at least 2 of the 13 chronic conditions (n = 9,871 unweighted visits). We created triads by summing yes responses for every combination of 3 chronic conditions. We identified the most common triads by patients with at least 3 of the 13 chronic conditions (n = 4,986 unweighted visits). In 2009, race data were missing from NAMCS for 24.4% of physician office visits, and ethnicity data were missing for 25.7%. NAMCS staff used model-based single imputation to create imputed race/ethnicity variables. Race/ethnicity imputation is restricted to 3 categories (white, black, and other) on the basis of research by a NAMCS internal work group that identified quality concerns with imputed estimates for race/ethnicity categories other than white and black. Extensive research was conducted on the imputation method and is described in more detail elsewhere (1). We combined the imputed NAMCS race and ethnicity variables to form 4 racial/ethnic groups: non-Hispanic white, non-Hispanic black, non-Hispanic other, and Hispanic persons of any race. "Non-Hispanic other" includes Asians, Native Hawaiian/Pacific Islanders, American Indian/Alaska Natives, and persons of more than 1 race.

NAMCS collects all expected sources of payment listed in the medical chart. We combined these variables into 4 mutually exclusive insurance groups: public insurance (all visits with Medicare or Medicaid/Children's Health Insurance Program [CHIP]) as the expected source(s) of payment); private insurance (all visits paid for by private insurance, provided the public insurance box was not also checked); and no insurance (visits with self-pay or "no charge/charity" checked, provided that public or private insurance was not also checked); and other (the remaining visits not classified into 1 of the first 3 groups, [visits paid for by Workers' Compensation and other types of insurance, and unknown: 2.4% of all visits]).

NAMCS collects up to 8 medications that are documented in the medical chart as having been prescribed or provided during the visit. NAMCS includes prescription medications, over-the-counter preparations, immunizations, and desensitizing agents, and medications can be new or continued. Because NAMCS limits the total number of medications that can be recorded per visit to 8, a record of 8 medications indicates that the patient has been prescribed at least 8, but the number could actually be higher. Only 9% of all physician office visits were made by patients with 8 medications, so limiting medications to 8 does not affect a large percentage of total visits (3).

Statistical analysis

Differences among subgroups were evaluated with 2-tailed t tests by using $P < .05$ as the level of significance. A weighted least squares regression analysis was used to evaluate the significance of trends. All comparisons reported in this article were statistically significant.

Results

Physician office visits by sociodemographic group

In 2009 adult patients made an estimated 867,783,000 physician office visits (Table 1). Patients with multiple chronic conditions made an estimated 326 million physician office visits representing 37.6% of all visits made by adults (data not shown). The majority of all visits were made by non-Hispanic white adults. Adult visits were distributed evenly by age. An estimated 61.7% of visits were made by women. Approximately half of all visits were made by patients with

private insurance and about a third was made by those with public insurance (Table 1). However, there was great variation in insurance status by age. Only 17% and 19% respectively of visits made by those aged 18 to 44 and aged 45 to 64 were made by patients with public insurance, whereas 80% of visits made by those aged 65 and older were made by patients with public insurance (data not shown). Private insurance showed the inverse, with 65% and 71% respectively of visits by those aged 18 to 44 and aged 45 to 64 being made by patients with private insurance, whereas only 17% of visits by those aged 65 or older were made by patients with private insurance (data not shown).

Physician office visits by patients with MCC by sex, age and race

In 2009, 29.2% of physician office visits were made by adult patients with 2 or 3 chronic conditions, and 8.4% of visits were made by patients with 4 or more MCC (Table 2). Visits made by younger patients were less likely to be made by patients with MCC (9.3% of visits by adults aged 18 to 44 years had 2 to 3 chronic conditions compared with 32.4% of visits by adults aged 45 to 64 and 44.4% of visits by patients aged 65 or older). This increasing trend by age for 2 or 3 chronic conditions was seen for visits by men and women and for visits by non-Hispanic white, non-Hispanic black and Hispanic patients. The increasing trend by age for patients with 4 or more chronic conditions was also seen for visits by both sexes and visits by all racial/ethnic groups for which we had reliable estimates.

Visits by men (32.6%) were more likely than visits by women (27.0%) to be made by patients with 2 or 3 chronic conditions, and this trend persisted for visits by non-Hispanic whites, non-Hispanic blacks, and Hispanics. For visits by patients younger than 65, visits by men were more likely than visits by women to be made by patients with 2 or 3 chronic conditions. This sex difference persisted for visits by non-Hispanic blacks and Hispanics aged 18 to 44, and for visits by non-Hispanic whites and Hispanics aged 45 to 64. Visits by men and women aged 65 or older were equally likely to be made by patients with MCC, regardless of race/ethnicity.

Physician office visits by patients with MCC by sex, age, and insurance

We found significant differences among visits made by patients with insurance (public, private, or other) and those with no insurance (Table 3). Visits by patients with private insurance (23.7%), other insurance (20.2%), or no insurance (16.0%) were less likely to be made by patients with 2 to 3 chronic conditions than were visits by patients with public insurance (39.5%). This difference by insurance status persisted for visits made by patients with 4 or more chronic conditions.

A greater proportion of visits by patients aged 65 and older with public rather than private insurance were made by patients with 2 to 3 MCC (45.5% and 39.5% respectively). At all ages, a greater proportion of visits by men with public rather than private insurance were made by patients with MCC. Visits made by women aged 45 or older with public rather than private insurance were more likely to be made by women with 2 or more chronic conditions.

Visits made by patients with no insurance were less likely to be made by patients with 2 or more chronic conditions (18.6%) than were visits made by patients with public insurance (54.2%). We saw this same pattern for all ages and for visits by both women and men.

Visits made by men with private insurance were more likely to be made by patients with 2 or 3 chronic conditions (28.7%) than visits made by women with private insurance (20.7%). This sex difference persisted for visits by those younger than 65. We did not find a statistically significant sex difference by private insurance-for visits made by patients aged 65 or older or for visits made by patients with 4 or more chronic conditions.

Visits by men aged 18 to 44 with public insurance were more likely (19.0%) than visits by women aged 18 to 44 (9.4%) with public insurance to be made by patients with 2 or 3 chronic conditions. We did not find a significant sex difference by public insurance for visits made by patients aged 45 or older or for visits made by patients with 4 or more chronic conditions.

Chronic condition dyads

Hypertension, the most frequently occurring chronic condition, appeared in 21 of the 29 chronic conditions dyads listed in Table 4. The most frequent dyad was hypertension and hyperlipidemia, and its incidence increased with age for women. About 16.6% of visits by women aged 18 to 44 with 2 or more chronic conditions were made by patients having both hypertension and hyperlipidemia. This number increased for visits by women aged 45 to 64 (31.9%) and 65 or older (40.6%). More visits by adult men than women aged 18 to 64 with 2 or more chronic conditions were made by patients with both hypertension and hyperlipidemia. Diabetes with hypertension and diabetes with hyperlipidemia were frequent dyads, appearing in the top 5 dyads for all age groups for visits by both men and women. Hypertension and arthritis was a frequently occurring dyad for visits by both men and women aged 45 or older, and frequency increased with age. Unlike other dyads, visits by women were more likely than visits by men to be made by patients with hypertension and arthritis.
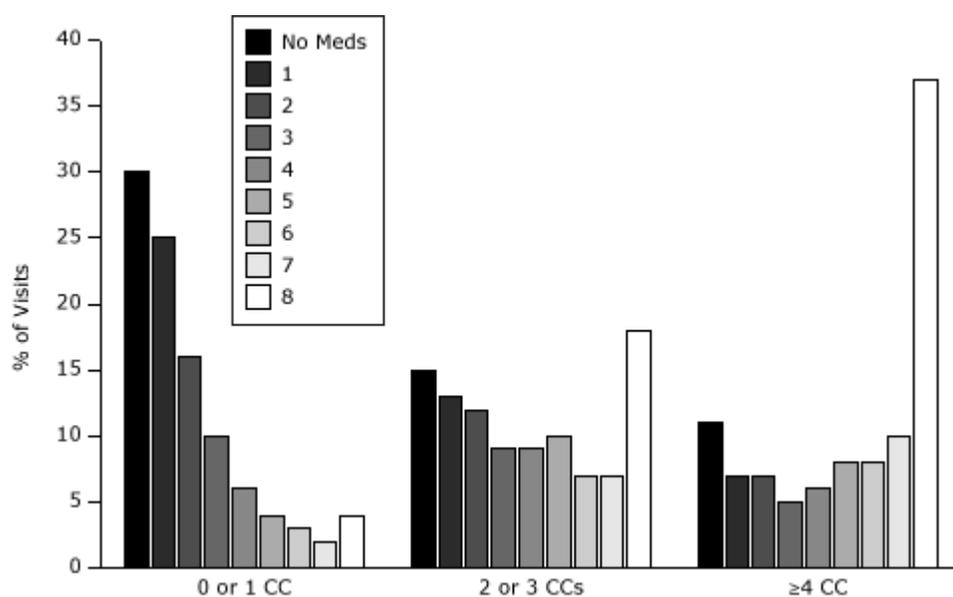
Chronic condition triads

An estimated 179,518,000 physician office visits were made by patients with 3 or more chronic conditions. Hypertension, the most frequently occurring chronic condition, appeared in every listed triad (Table 5). Hyperlipidemia, the second most frequent chronic condition, was absent from only 5 of the listed triads.

The most prevalent chronic condition triad was hypertension, hyperlipidemia, and diabetes. This was the only triad for which we could produce reliable estimates for men and women aged 18 to 44. More visits by men (48.9%) than women (19.9%) aged 18 to 44 with 3 or more chronic conditions and more visits by men (26.1%) than women (19.3%) aged 65 and older were made by patients with hypertension and hyperlipidemia and diabetes. There was not a significant sex difference for this triad for those aged 45 to 64. Another common chronic condition triad was hypertension, hyperlipidemia, and arthritis, and more visits by women than men aged 45 to 64 and 65 or older were made by patients with this triad. Hypertension/diabetes/arthritis was also a common triad for visits by patients aged 45 or older. Visits by women aged 45 to 64 (14.1%) were more likely than visits by men aged 45 to 64 (7.7%) to be made by patients with this chronic condition triad. There was not a significant sex difference for this triad for those aged 65 or older. Hypertension/hyperlipidemia/depression was another common chronic condition triad for visits by women aged 45 or older and visits by men aged 45 to 64. We found no difference by sex. Ischemic heart disease/hypertension/hyperlipidemia was a common triad for visits by men aged 45 or older.

Number of medications ordered or prescribed at visits for patients with MCC

Patients without MCC were more likely to make office visits during which no medications were ordered or prescribed (Figure). For 30% of visits by patients with 0 or 1 chronic condition, no medications were prescribed. This number decreased to about 15% of visits made by patients with 2 to 3 chronic conditions and 11% of visits made by patients with 4 or more chronic conditions. Patients without MCC took fewer medications than did patients with 4 or more. We found a decreasing trend by number of medications for visits by patients without MCC, and an increasing trend for visits by patients with 4 or more chronic conditions. The trend was not significant for visits by patients with 2 or 3 MCC. More medications were ordered or prescribed during visits for patients with MCC. For example, at least 8 medications were ordered or prescribed for 4% of visits made by patients with 0 or 1 chronic condition, but this number climbed to 18% of visits made by patients with 2 or 3 chronic conditions and to 37% of visits made by patients with 4 or more chronic conditions.

Figure. Physician office visits made by patients with or without chronic conditions, by number of medications ordered or prescribed. Shows percentage of office-based ambulatory care visits in which 0 through 8 or more medications were ordered or prescribed for each of 3 chronic condition groupings (0 or 1, 2 or 3 ≥4) (1). [A tabular version of this figure is also available.]

Summary

Our nationally representative study of office-based ambulatory care visits by adult patients with diagnoses of MCC contributes new information to the field. About 37.6% of adult visits were made by patients with MCC. Visits by patients with MCC were not evenly distributed by demographic characteristics. Visits by women comprised more than 60% of all visits. However, visits by men were more likely than visits by women to be made by patients with MCC.

Visits by patients with MCC increased with age and were more likely to be made by patients with public insurance. Hypertension was the most common chronic condition in both dyads and triads. Hypertension-hyperlipidemia was the most common dyad, and these 2 conditions were the most common combination in the top triads, appearing in 17 of the 22 listed triads for this study. The most frequently occurring dyads and triads that included arthritis occurred more often at visits by women than men. However, frequent dyads and triads of other conditions were more likely at visits by men than women. More medications were ordered or prescribed during visits by patients with MCC than by patients without MCC. Visits by patients without MCC were more likely to have no or fewer medications ordered or prescribed than visits by patients with 4 or more chronic conditions.

Our study has limitations. Because the unit of analysis for NAMCS 2009 is an ambulatory care visit to a physician in the United States, the number of visits rather than number of people are measured, so it is possible for the same person to be counted multiple times. In addition, anyone who did not visit a doctor in 2009 was excluded from NAMCS 2009, including Medicare beneficiaries who did not visit a doctor. Thus, our results are not directly comparable with results presented in the *Chronic Conditions Among Medicare Beneficiaries, Chart Book* (4). According to the chart book, about 16% of all Medicare beneficiaries did not visit a doctor in 2009, representing about 33% of beneficiaries without MCC and about 9% of beneficiaries with MCC (4). The National Health Interview Survey (5) estimates that about 92% of US residents aged 65 or older have Medicare (5). NAMCS 2009 estimated that 79% of visits by patients aged 65 or older were made by patients with Medicare. NAMCS has check boxes for 13 chronic conditions, whereas the chart book tracks 15 chronic conditions (4); therefore, our results may undercount Medicare beneficiaries with MCC. Despite these differences, we found that visits by patients with MCC were more likely to be made by patients with public rather than private insurance.

As a nationally representative survey of office-based medical care, our study provides information about ambulatory medical care received by patients with MCC by demographic characteristics and identified the most frequently occurring dyads and triads of chronic conditions.

Acknowledgments

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Tables

Table 1. Selected Demographics of Visits by Patients 18 or Older, National Ambulatory Medical Care Survey, 2009

Return

Selected Demographics	Weighted Number (SE), in 1000s	% (SE)
All patients	867,783 (39,012)	100
Race/ethnicity		
Non-Hispanic white	654,544 (33,353)	75.4 (1.3)
Non-Hispanic black	90,797 (6,779)	10.5 (0.6)
Non-Hispanic other[a]	35,273 (5,469)	4.1 (0.6)
Hispanic	87,169 (8,684)	10.0 (1.0)
Age, y		
18–44	267,057 (12,331)	30.8 (0.8)
45–64	320,375 (16,670)	36.9 (0.7)
≥65	280,351 (15,021)	32.3 (0.8)
Sex		
Women	535,675 (24,422)	61.7 (0.7)
Men	332,108 (16,311)	38.3 (0.7)
Expected source of payment		
Private insurance	448,470 (20,736)	51.7 (1.1)
Public insurance[b]	328,782 (19,232)	37.9 (1.1)
Other insurance[c]	53,237 (5,461)	6.1 (0.6)
No insurance[d]	37,294 (2,695)	4.3 (0.3)

[a] Non-Hispanic other includes Asians, Native Hawaiian/Pacific Islanders, American Indian/Alaska Natives, and persons of mixed race.
[b] Public insurance includes Medicare and Medicaid.
[c] Other insurance includes Workers' Compensation, other insurance, and unknown (2.4% of visits).
[d] No insurance includes self-pay, no charge, and charity.

Table 2. Physician Office Visits by Patients With Chronic Conditions by Sex, Age, and Race/Ethnicity, National Ambulatory Medical Care Survey, 2009

Return

Sex, Age, Race/Ethnicity	0–1 Chronic Conditions, % (SE)	2–3 Chronic Conditions, % (SE)	≥4 Chronic Conditions, % (SE)
Total			
All ≥18 y	62.5 (1.1)	29.2 (0.9)	8.4 (0.5)
Non-Hispanic white	61.4 (1.2)	29.8 (0.9)	8.8 (0.6)
Non-Hispanic black	62.6 (2.1)	30.3 (1.7)	7.1 (0.9)
Non-Hispanic other[a]	71.9 (4.5)	22.3 (3.8)	5.8 (1.3)
Hispanic	66.7 (2.5)	25.9 (1.9)	7.3 (1.6)
All 18–44 y	89.7 (0.7)	9.3 (0.6)	1.1 (0.2)
Non-Hispanic white	89.6 (0.7)	9.2 (0.6)	1.1 (0.2)

Sex, Age, Race/Ethnicity	0−1 Chronic Conditions, % (SE)	2−3 Chronic Conditions, % (SE)	≥4 Chronic Conditions, % (SE)
Non-Hispanic black	87.3 (2.2)	11.6 (2.0)	—b
Non-Hispanic other[a]	92.1 (2.2)	7.6 (2.2)	—b
Hispanic	91.2 (1.3)	7.8 (1.3)	—b
All 45−64 y	60.7 (1.1)	32.4 (0.9)	7.0 (0.5)
Non-Hispanic white	60.8 (1.2)	31.8 (1.0)	7.4 (0.7)
Non-Hispanic black	54.5 (2.3)	39.7 (2.1)	5.8 (0.8)
Non-Hispanic other[a]	73.3 (5.7)	22.0 (4.9)	—b
Hispanic	61.0 (3.5)	33.1 (3.4)	5.9 (1.7)
All ≥65 y	38.6 (1.3)	44.4 (1.2)	16.9 (1.0)
Non-Hispanic white	39.0 (1.5)	44.3 (1.3)	16.7 (1.0)
Non-Hispanic black	37.0 (3.4)	44.5 (3.1)	18.5 (2.3)
Non-Hispanic other[a]	45.0 (6.1)	41.0 (5.5)	14.0 (3.3)
Hispanic	34.4 (3.2)	46.5 (3.3)	19.2 (4.1)
Women			
All ≥18 y	65.0 (1.1)	27.0 (0.9)	8.0 (0.5)
Non-Hispanic white	63.5 (1.3)	28.0 (1.0)	8.5 (0.6)
Non-Hispanic black	65.4 (2.5)	27.4 (2.0)	7.1 (1.3)
Non-Hispanic other[a]	75.3 (3.9)	19.2 (3.3)	5.5 (1.5)
Hispanic	70.7 (2.6)	22.5 (2.0)	6.8 (1.6)
All 18−44 y	91.0 (0.6)	8.2 (0.6)	0.8 (0.2)
Non-Hispanic white	90.2 (0.7)	8.8 (0.6)	1.0 (0.3)
Non-Hispanic black	90.8 (1.7)	8.6 (1.7)	—b
Non-Hispanic other[a]	94.3 (2.2)	5.7 (2.4)[b]	—b
Hispanic	93.6 (1.3)	6.0 (1.3)	—b
All 45−64 y	62.9 (1.2)	30.1 (1.0)	7.1 (0.6)
Non-Hispanic white	62.8 (1.2)	30.0 (1.1)	7.2 (0.7)
Non-Hispanic black	56.4 (2.5)	37.4 (2.5)	6.2 (1.2)
Non-Hispanic other[a]	72.5 (6.1)	20.7 (4.8)	—b
Hispanic	67.1 (3.5)	26.2 (2.9)	6.7 (2.0)
All ≥65 y	37.7 (1.6)	44.9 (1.4)	17.4 (1.0)
Non-Hispanic white	38.6 (1.8)	44.4 (1.5)	17.0 (1.2)
Non-Hispanic black	32.7 (3.8)	46.8 (3.7)	20.5 (3.4)
Non-Hispanic other[a]	45.5 (5.8)	41.2 (5.5)	—b
Hispanic	31.6 (3.5)	49.6 (4.2)	18.8 (4.4)
Men			
All ≥18 y	58.4 (1.3)	32.6 (1.1)	9.0 (0.7)
Non-Hispanic white	58.0 (1.3)	32.6 (1.1)	9.4 (0.8)
Non-Hispanic black	57.1 (3.1)	35.8 (2.8)	7.1 (1.7)
Non-Hispanic other[a]	66.5 (6.7)	27.2 (5.7)	—b

Sex, Age, Race/Ethnicity	0–1 Chronic Conditions, % (SE)	2–3 Chronic Conditions, % (SE)	≥4 Chronic Conditions, % (SE)
Hispanic	59.4 (3.2)	32.2 (2.7)	8.4 (1.9)
All 18–44 y	86.6 (1.3)	11.6 (1.1)	1.8 (0.4)
Non-Hispanic white	88.4 (1.3)	10.1 (1.0)	—b
Non-Hispanic black	77.0 (6.9)	20.1 (5.5)	—b
Non-Hispanic other[a]	85.5 (4.9)	—b	—b
Hispanic	85.4 (2.3)	12.2 (2.2)	—b
All 45–64 y	57.5 (1.5)	35.6 (1.4)	6.8 (0.7)
Non-Hispanic white	58.0 (1.6)	34.5 (1.5)	7.5 (0.9)
Non-Hispanic black	51.8 (4.6)	43.0 (4.4)	5.2 (1.5)
Non-Hispanic other[a]	74.4 (6.5)	23.6 (6.1)	—b
Hispanic	51.5 (5.2)	43.9 (5.3)	—b
All ≥65 y	40.0 (1.6)	43.7 (1.5)	16.3 (1.4)
Non-Hispanic white	39.5 (1.7)	44.3 (1.7)	16.2 (1.6)
Non-Hispanic black	44.5 (5.8)	40.4 (6.1)	15.1 (4.3)
Non-Hispanic other[a]	44.4 (8.8)	40.7 (8.3)	—b
Hispanic	38.4 (5.1)	41.9 (4.4)	19.7 (4.5)

Abbreviation: SE, standard error.
[a] Non-Hispanic other includes Asians, Native Hawaiian/Pacific Islanders, American Indian/Alaska Natives, and persons of mixed race.
[b] Estimate does not meet standards of reliability or precision.

Table 3. Physician Office Visits by Patients With Chronic Conditions by Sex, Age, and Expected Source of Payment, National Ambulatory Medical Care Survey, 2009

Return

Sex, Age, Expected Source of Payment	0–1 Chronic Conditions, % (SE)	2–3 Chronic Conditions, % (SE)	≥4 Chronic Conditions, % (SE)
Total			
All ≥18 y			
All sources	62.5 (1.1)	29.2 (0.9)	8.4 (0.5)
Private insurance	71.6 (1.0	23.7 (0.9)	4.7 (0.4)
Public insurance[a]	45.8 (1.6)	39.5 (1.3)	14.7 (0.9)
Other insurance[b]	75.1 (2.6)	20.2 (2.1)	4.7 (0.8)
No insurance[c]	81.4 (2.0)	16.0 (1.7)	2.6 (0.6)
18–44 y			
All sources	89.7 (0.7)	9.3 (0.6)	1.1 (0.2)
Private insurance	90.1 (0.8)	9.2 (0.7)	—d
Public insurance [a]	85.4 (1.6)	11.6 (1.3)	3.0 (0.8)
Other insurance [b]	93.4 (1.6)	6.3 (1.6)	—d
No insurance[c]	92.5 (1.6)	7.0 (1.5)	—d
45–64 y			

Sex, Age, Expected Source of Payment	0−1 Chronic Conditions, % (SE)	2−3 Chronic Conditions, % (SE)	≥4 Chronic Conditions, % (SE)
All sources	60.7 (1.1)	32.4 (0.9)	7.0 (0.5)
Private insurance	63.0 (1.1)	31.5 (1.1)	5.6 (0.5)
Public insurance [a]	45.4 (2.8)	40.6 (2.1)	14.1 (1.5)
Other insurance [b]	67.2 (3.0)	26.6 (2.3)	6.2 (1.2)
No insurance [c]	69.2 (3.3)	26.5 (2.8)	4.3 (1.1)
≥65 y			
All sources	38.6 (1.3)	44.4 (1.2)	16.9 (1.0)
Private insurance	45.3 (2.3)	39.5 (1.8)	15.2 (1.6)
Public insurance [a]	37.1 (1.4)	45.5 (1.3)	17.4 (1.1)
Other insurance [b]	32.6 (5.3)	51.3 (5.7)	16.1 (3.9)
No insurance [c]	75.0 (6.3)	—[d]	—[d]
Women			
All ≥18 y			
All sources	65.0 (1.1)	27.0 (0.9)	8.0 (0.5)
Private insurance	75.1 (1.0)	20.7 (0.8)	4.3 (0.4)
Public insurance[a]	47.4 (1.9)	38.2 (1.5)	14.3 (1.0)
Other insurance[b]	77.8 (2.5)	17.9 (2.1)	4.5 (0.8)
No insurance[c]	82.0 (2.2)	16.0 (2.1)	2.0 (0.5)
18−44 y			
All sources	91.0 (0.6)	8.2 (0.5)	0.8 (0.2)
Private insurance	91.3 (0.7)	8.3 (0.7)	—[d]
Public insurance [a]	88.1 (1.6)	9.4 (1.3)	—[d]
Other insurance[b]	94.0 (1.4)	5.5 (1.3)	—[d]
No insurance[c]	92.9 (1.8)	7.1 (1.8)	—[d]
45−64 y			
All sources	62.9 (1.2)	30.1 (1.0)	7.0 (0.6)
Private insurance	66.1 (1.2)	28.5 (1.2)	5.4 (0.6)
Public insurance[a]	45.9 (2.8)	39.2 (2.3)	14.9 (2.0)
Other insurance[b]	67.6 (3.5)	25.7 (3.1)	6.7 (1.7)
No insurance [c]	69.4 (3.5)	26.6 (3.3)	3.9 (1.1)
≥65 y			
All sources	37.7 (1.6)	44.9 (1.4)	17.4 (1.0)
Private insurance	44.9 (3.4)	38.1 (2.4)	16.9 (2.2)
Public insurance[a]	36.0 (1.7)	46.3 (1.5)	17.6 (1.2)
Other insurance[b]	35.3 (6.5)	50.7 (6.4)	—[d]
No insurance[c]	79.2 (6.3)	—[d]	—[d]
Men			
All ≥18 y			
All sources	58.4 (1.3)	32.6 (1.1)	9.0 (0.7)

Sex, Age, Expected Source of Payment	0–1 Chronic Conditions, % (SE)	2–3 Chronic Conditions, % (SE)	≥4 Chronic Conditions, % (SE)
Private insurance	65.9 (1.4)	28.7 (1.2)	5.4 (0.6)
Public insurance [a]	43.1 (1.7)	41.7 (1.6)	15.2 (1.3)
Other insurance [b]	71.8 (3.4)	23.1 (3.0)	5.1 (1.4)
No insurance [c]	80.4 (2.5)	16.1 (2.1)	3.5 (1.2)
18–44 y			
All sources	86.6 (1.3)	11.6 (1.1)	1.8 (0.4)
Private insurance	87.2 (1.4)	11.3 (1.2)	—[d]
Public insurance [a]	76.3 (3.9)	19.0 (3.0)	—[d]
Other insurance [b]	92.4 (2.7)	7.6 (2.7)	—[d]
No insurance [c]	92.0 (2.0)	6.9 (1.9)	—[d]
45–64 y			
All sources	57.5 (1.5)	35.6 (1.4)	6.8 (0.7)
Private insurance	58.6 (1.6)	35.7 (1.6)	5.8 (0.7)
Public insurance[a]	44.5 (3.9)	42.7 (3.9)	12.8 (2.0)
Other insurance[b]	66.8 (3.5)	27.5 (3.1)	—[d]
No insurance[c]	68.8 (4.6)	26.4 (4.1)	—[d]
≥65 y			
All sources	40.0 (1.6)	43.7 (1.5)	16.3 (1.4)
Private insurance	45.9 (2.7)	41.1 (3.1)	13.0 (1.8)
Public insurance[a]	38.5 (1.7)	44.3 (1.5)	17.1 (1.5)
Other insurance[b]	30.4 (6.6)	51.9 (7.6)	—[d]
No insurance[c]	71.2 (11.5)	—[d]	—[d]

Abbreviation: SE, standard error.
[a] Public insurance includes Medicare and Medicaid.
[b] Other insurance includes Workers' Compensation, other insurance, and unknown (2.4% of visits).
[c] No insurance includes self-pay, no charge, and charity.
[d] Estimate does not meet standards of reliability or precision.

Table 4. Physician Office Visits by Patients With the 5 Most Prevalent Dyads of Chronic Conditions, by Sex and Age, National Ambulatory Medical Care Survey, 2009

Sex, Age, and Dyads	≥2 Chronic Conditions[a], % (SE)
Women	
18–44 y	
Hypertension/diabetes	18.1 (2.1)
Hypertension/hyperlipidemia	16.6 (2.0)
Depression/asthma	15.6 (2.1)
Hypertension/depression	14.9 (2.0)
Hyperlipidemia/diabetes	11.5 (1.8)
45–64 y	

Sex, Age, and Dyads	≥2 Chronic Conditions[a], % (SE)
Hypertension/hyperlipidemia	31.9 (1.6)
Hypertension/diabetes	26.1 (1.5)
Hypertension/arthritis	21.3 (1.4)
Hyperlipidemia/diabetes	17.4 (1.3)
Hypertension/depression	15.1 (1.2)
≥65 y	
Hypertension/hyperlipidemia	40.6 (1.8)
Hypertension/arthritis	28.6 (2.1)
Hypertension/diabetes	24.0 (1.4)
Hyperlipidemia/arthritis	16.6 (1.6)
Hyperlipidemia/diabetes	14.7 (1.2)
Men	
18–44 y [b]	
Hypertension/hyperlipidemia	32.7 (3.8)
Hypertension/diabetes	27.5 (3.4)
Hyperlipidemia/diabetes	22.7 (3.0)
Hypertension/depression	15.2 (2.5)
45–64 y	
Hypertension/hyperlipidemia	42.2 (2.1)
Hypertension/diabetes	27.6 (1.8)
Hyperlipidemia/diabetes	20.3 (1.9)
Hypertension/arthritis	15.2 (1.3)
Hypertension/depression	10.3 (1.4)
≥65 y	
Hypertension/hyperlipidemia	43.6 (1.8)
Hypertension/diabetes	29.0 (1.4)
Hypertension/arthritis	19.4 (1.6)
Hyperlipidemia/diabetes	19.1 (1.3)
Ischemic heart disease/hypertension	16.3 (1.2)

Abbreviation: SE, standard error.
[a] The denominator includes all visits by patients with 2 or more CC, (N=337,100,000 visits). The percentage of visits for each age group does not equal 100% because patients may be included in multiple dyads, and data for only the 5 most frequent dyads for each age group are displayed.
[b] The remaining most frequent dyad estimate for visits by men aged 18–44 y does not meet standards of reliability or precision.

Table 5. Physician Office Visits by Patients With the 5 Most Prevalent Triads of Chronic Conditions, by Sex and Age, National Ambulatory Medical Care Survey, 2009

Sex, Age, Triad	≥3 Chronic Conditions[a], % (SE) [a]
Women	

Sex, Age, Triad	≥3 Chronic Conditions[a], % (SE) [a]
18–44 y[b]	
Hypertension/hyperlipidemia/diabetes	19.9 (5.0)
45–64 y	
Hypertension/hyperlipidemia/diabetes	27.4 (2.5)
Hypertension/hyperlipidemia/arthritis	17.5 (2.1)
Hypertension/diabetes/arthritis	14.1 (2.1)
Hypertension/hyperlipidemia/depression	12.2 (1.4)
Hypertension/depression/arthritis	10.8 (1.2)
≥65 y	
Hypertension/hyperlipidemia/arthritis	21.8 (2.2)
Hypertension/hyperlipidemia/diabetes	19.3 (1.7)
Osteoporosis/hypertension/hyperlipidemia	11.3 (1.3)
Hypertension/diabetes/arthritis	11.0 (1.1)
Hypertension/hyperlipidemia/depression	10.7 (1.1)
Men	
18–44 y [b]	
Hypertension/hyperlipidemia/diabetes	48.9 (6.7)
45–64 y	
Hypertension/hyperlipidemia/diabetes	31.5 (2.8)
Ischemic heart disease/hypertension/hyperlipidemia	14.1 (1.6)
Hypertension/hyperlipidemia/depression	10.8 (1.8)
Hypertension/hyperlipidemia/arthritis	9.4 (1.4)
Hypertension/diabetes/arthritis	7.7 (1.3)
≥65 y	
Hypertension/hyperlipidemia/diabetes	26.1 (2.0)
Ischemic heart disease/hypertension/hyperlipidemia	17.6 (1.8)
Hypertension/hyperlipidemia/arthritis	15.0 (1.9)
Hypertension/diabetes/arthritis	9.9 (1.3)
Hypertension/hyperlipidemia/cancer	9.3 (1.3)

Abbreviation: SE, standard error.
[a] The denominator includes all visits by patients with 3 or more chronic conditions, (N=179,518,000 visits). The percentage of visits for each age group does not equal 100% because patients may be included in multiple triads, and data for only the 5 most frequent triads for each age group are displayed.
[b] The remaining most frequent triad estimates for visits by patients aged 18–44 do not meet standards of reliability or precision.

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Health Care Expenditures for Adults With Multiple Treated Chronic Conditions: Estimates From the Medical Expenditure Panel Survey, 2009

Steven R. Machlin, MS; Anita Soni, PhD

Abstract

The objective of this article is to illustrate the usefulness of Medical Expenditure Panel Survey (MEPS) data for examining variations in medical expenditures for people with multiple chronic conditions (MCC). We analyzed 2009 MEPS data to produce estimates of treated prevalence for MCC and associated medical expenditures for adults in the US civilian noninstitutionalized population (sample = 24,870). We also identified the most common dyad and triad combinations of treated conditions. Approximately one-quarter of civilian US adults were treated for MCCs in 2009; 18.3% were treated for 2 to 3 conditions and 7% were treated for 4 or more conditions. The proportion of adults treated for MCC increased with age. White non-Hispanic adults were most likely and Hispanic and Asian adults were least likely to be treated for MCC. Health care expenditures increased as the number of chronic conditions treated increased. Regardless of age or sex, hypertension and hyperlipidemia was the most common dyad among adults treated for MCC; diabetes in conjunction with these 2 conditions was a common triad. MEPS has the capacity to produce national estimates of health care expenditures associated with MCC. MEPS data in conjunction with data from other US Department of Health and Human Services sources provide information that can inform policies addressing the complex issue of MCC.

Introduction

Chronic conditions are broadly defined as those expected to last at least 1 year and result in limitations of self-care, independent living, and social interactions or the need for ongoing medical intervention (1,2). In 2009, the top 5 most costly medical conditions in terms of health care expenditures (heart disease, trauma-related disorders, cancer, mental disorders, and chronic obstructive pulmonary disease/asthma) (3) were primarily chronic in nature. Because of factors such as the aging of the population (4) and high obesity rates (5,6), the proportion of the population with multiple chronic conditions (MCC) is likely to rise. This trend will exacerbate public policy concerns related to prevention, treatment, and costs of care for people with MCC.

The Medical Expenditure Panel Survey (MEPS) is a federal survey that has the capacity to produce nationally representative estimates of health care expenditures associated with medical conditions for the US civilian noninstitutionalized population. Previous research has used MEPS for estimates of expenditures on chronic conditions (7-9) but has not examined variations by number of chronic conditions or presented common dyads and triads of conditions. The objective of this article is to provide descriptive estimates that illustrate the usefulness of MEPS data for examining variations in medical expenditures for people with MCC. Estimates are provided according to number of MCC and selected characteristics of the adult population aged 18 years or older; the most common dyad and triad combinations of treated conditions are also identified.

Analysis

The MEPS Household Component (MEPS-HC) is a nationally representative survey of the US civilian noninstitutionalized population that has been conducted since 1996 (10). It provides data that can be used to produce

annual estimates as well as behavioral and economic analyses of health care use, expenditures, insurance coverage, sources of payment, access to care, and health care quality. The MEPS-HC uses an overlapping panel design in which a new sample panel of households is selected each year from respondents to the prior year's National Health Interview Survey (11). Data are collected in 5 rounds of computer-assisted personal interviews that cumulatively cover a 2-year period. Typically, 1 representative from the household responds for all family members. The 2009 MEPS-HC comprises a sample of approximately 14,000 households across 2 consecutive panels with a combined overall response rate of approximately 60%. MEPS data collection and analyses are covered under the auspices of human research protocols that have institutional review board approval (12).

The set of conditions considered to be chronic in this article was developed by the US Department of Health and Human Services (DHHS) Interagency Workgroup on MCC and the Office of the Assistant Secretary of Health (13). It consists of the following conditions: arthritis, asthma, autism spectrum disorder, cancer, cardiac arrhythmias, chronic kidney disease, chronic obstructive pulmonary disease, congestive heart failure, coronary artery disease, dementia, depression, diabetes, hepatitis, HIV infection, hyperlipidemia, hypertension, osteoporosis, schizophrenia, stroke, and substance abuse disorders. DHHS used a deliberative process to select these conditions that required not only meeting the definition of chronic but also being prevalent in the population and having the potential for public health or clinical interventions.

Estimates in this report are derived on the basis of data for adults aged 18 or older in the 2009 MEPS (N = 24,870) classified according to the number of chronic conditions for which they were treated during the year (0 to 1, 2 to 3, 4 or more). The condition data used for this analysis were derived on the basis of verbatim text responses to open-ended questions about conditions reported to be associated with health care events. These reported conditions are coded according to the *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM). Treatment of these conditions may have been received through ambulatory visits to office or hospital outpatient settings, emergency departments, hospital inpatient stays, home health services, or prescribed medicines. Expenditures in MEPS for these types of services are defined as total payments from all sources for the care provided including payments from patients (ie, out of pocket), private insurance, Medicare, Medicaid, workers' compensation, and other sources. Data on expenditures are derived from information collected in both the MEPS-HC and the MEPS Medical Provider Component (MEPS-MPC). In the MEPS-MPC, data are collected from a sample of medical providers identified as providing care to people in the MEPS-HC (14).

We compared participants' demographic characteristics, health care use, and expenditures between people treated for MCC (defined as 2 or more) and those treated for only 1 or no chronic conditions (ie, people not treated for 2 or more MCC). Variations in common dyad and triad combinations of treated conditions were also examined by age and sex. Less than 6% of the sample aged 18 to 44 years was treated for dyads or triads; their data are not presented. The "treated prevalence" estimates in this report should not be misconstrued as equivalent to actual chronic condition prevalence because some people may not receive treatment in a given year for a particular chronic condition or some respondents may not be aware that they (or their family member) have the condition.

All estimates were produced by using SAS version 9.2 (SAS Institute Inc, Cary, North Carolina) and SUDAAN version 10.0.1 (RTI International, Research Triangle Park, North Carolina) and were weighted to represent 231.8 million adults in the US civilian noninstitutionalized population in 2009. Standard errors of estimates were computed by using the Taylor series method (15), which takes into account the MEPS complex survey design. Differences noted in the text are significant at .05.

Results

Approximately 25% of civilian US noninstitutionalized adults aged 18 or older were treated for MCC in 2009. A total of 18.3% were treated for 2 to 3 conditions, and 7% were treated for 4 or more conditions (Table 1).

The proportion of adults treated for MCC increased with age. In 2009, 67% of people aged 65 or older were treated for 2 or more chronic conditions and 24.6% were treated for 4 or more conditions. In contrast, 31.3% of adults aged 45 to 64 were treated for MCC and 7.0% were treated for 4 or more conditions. An estimated 5.8% of people aged 18 to 44 were treated for MCC.

Adult women were slightly more likely to be treated for MCC than adult men (27.4% vs 23.2%). Among adults aged 45 to 64, a slightly higher proportion of women than men were treated for 4 or more chronic conditions (8.1% vs 5.9%).

White non-Hispanic adults (28.5%) were most likely to be treated for MCC; Hispanic (14.4%) and Asian adults (16.2%) were least likely. Among adults aged 18 to 64, 33.1% of those with public insurance were treated for 2 or more chronic conditions compared with 16.3% of those with private insurance and 8.2% who were uninsured. Among adults aged 65 or older, 65.2% of those with only Medicare coverage and 67.6% of those with Medicare and supplemental private insurance were treated for MCC compared with 74.8% of those with Medicare and other public insurance (primarily Medicaid).

Health care use and expenditures for MCC

The likelihood of having at least 1 hospital stay in 2009 varied from 5.3% among adults not treated for MCC to 27.7% among those treated for 4 or more chronic conditions. Comparing these same groups, the proportion with at least 1 emergency department visit varied from 11.1% to 29.7% (Table 2). Virtually all adults treated for 2 or more chronic conditions had prescribed medicine purchases and nearly all had ambulatory medical care in offices or hospital outpatient departments. In contrast, 65.5% of adults not treated for MCC had ambulatory medical visits and just over half (56.2%) had prescribed medicine purchases. Moreover, the average numbers of ambulatory visits and prescribed medicine purchases increased substantially with the number of treated chronic conditions. These patterns were similar across all age groups.

Average expenditures for all medical care in 2009 were $8,478 among participants treated for 2 to 3 chronic conditions and $16,257 among those treated for 4 or more chronic conditions (Table 3). When restricted to treatment of chronic conditions only, these averages were $3,693 and $8,935, respectively. In contrast, the average expenditure for all conditions among adults who were not treated for MCC was $2,367.

Average medical expenses generally increased with age among those not treated for MCC. However, no significant variation was seen in either total expenses or expenses for chronic conditions between younger (18–44), middle-aged (45–64), and older adults (65 or older) with MCC.

Treated prevalence of MCC dyads and triads

Among adults treated for MCC, hypertension and hyperlipidemia was the most common dyad combination regardless of age or sex. Among 4 groups examined by sex and age (45-64, 65 or older), the proportion treated for both conditions ranged from 42.2% for women aged 45 to 64 to 60.8% for men 65 or older. The combinations of diabetes with hypertension or hyperlipidemia were also common among all sex and age groups (ranging from 21.0% for women aged 65 or older to 28.3% for men aged 65 or older). Additional common dyads for people aged 65 or older were coronary artery disease and hyperlipidemia (32.4%) and coronary artery disease and hypertension (31.4%) for men and hypertension and arthritis for women (22.1%). Depression and hypertension or hyperlipidemia were also among the top 5 dyads for women aged 45 to 64 (19.1% and 15.6%, respectively).

Among adults treated for at least 3 chronic conditions, the combination of hypertension, hyperlipidemia, and diabetes was a common triad regardless of age or sex (ranging from 27.7% for women aged 65 or older to 37.5% for men aged 45-64). In addition, hypertension, hyperlipidemia, and coronary artery disease was the most common triad of treated conditions for men aged 65 or older (38.0%) and was prevalent among men aged 45 to 64 (24.4%) and women aged 65 or older (20.4%). Other triad combinations with prevalence of at least one-fifth of those treated for 3 or more chronic conditions were hypertension, hyperlipidemia, and cancer (22.5%) for men aged 65 or older, and hypertension, hyperlipidemia, and arthritis for women aged 65 or older (22%).

Summary

National estimates of treated prevalence and health care expenditures associated with MCC for the civilian noninstitutionalized population can be derived from MEPS data. According to 2009 MEPS data, 31.3% of adults aged 45 to 64 and 67.1% of those aged 65 or older in the US civilian noninstitutionalized population were treated for MCC identified as prevalent and potentially amenable to public health or clinical interventions. MEPS estimates for treated prevalence and expenditures vary among population subgroups and may grow appreciably in the near future because of such factors as the aging of the population (4) and high obesity rates (5,6). This trend would exacerbate public policy concerns related to prevention, treatment, and the cost of care for people with MCC.

The data in this article show that expenditures increase substantially with number of MCC treated; in 2009, the average expense among people with 4 or more chronic conditions was almost double that for people with 2 to 3 conditions and approximately 7 times greater than for people treated for no chronic conditions or only 1 chronic condition. Consequently, reducing the number of chronic conditions among people with such conditions may generate substantial medical care savings. Another finding with potential policy implications is that no significant variation was found in medical expenditures between younger, middle-aged, and older adults with 2 or more treated chronic conditions. This lack of variation by age suggests that a strategy to reduce the prevalence of MCC among younger adults, who generally have lower health expenses and are at lower risk of chronic conditions than adults aged 65 or older, is an area that may have implications for controlling health care costs.

Although MEPS is a unique source of nationally representative information on treated prevalence and health care expenditures, the survey has strengths and limitations for examining issues related to MCC. For example, MEPS is well suited for estimating treated prevalence because conditions are ascertained in conjunction with comprehensive data collection on medical events. However, evidence suggests that MEPS-HC respondents underreport medical events (16) and are best able to accurately identify salient or broadly classified medical conditions (17). Nonetheless, in conjunction

with data from other DHHS sources, MEPS data provide relevant information for policy makers seeking to address the complex issues related to treatment of people with MCC.

Acknowledgments

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Tables

Table 1. Number of Treated Chronic Conditions[a,b] by Demographic Characteristics, Medical Expenditure Panel Survey, 2009

Return

Demographic Variable	Population (in millions)	No. of Treated Chronic Conditions, % (95% CI)		
		0 to 1	2 to 3	4 or more
≥18 y	231.8	74.7 (73.8–75.6)	18.3 (17.5–19.1)	7.0 (6.6–7.4)
Age group				
18–44 y	111.1	94.2 (93.6–94.8)	5.2 (4.7–5.7)	0.6 (0.4–0.8)
45–64 y	80.3	68.8 (67.5–70.1)	24.3 (23.1–25.5)	7.0 (6.3–7.7)
≥65 y	40.3	32.9 (30.9–34.9)	42.5 (40.4–44.6)	24.6 (23.0–26.2)
Sex				
Male	112.3	76.9 (75.8–78.0)	17.1 (16.2–18.0)	6.1 (5.5–6.7)
Female	119.5	72.7 (71.6–73.8)	19.5 (18.5–20.5)	7.9 (7.3–8.5)
Sex, age (y)				
Male, 18–44	55.7	95.2 (94.5–95.9)	4.3 (3.7–4.9)	0.5 (0.3–0.7)
Male, 45–64	39.2	69.6 (67.8–71.4)	24.5 (22.8–26.2)	5.9 (5.0–6.8)
Male, ≥65	17.5	34.6 (31.7–37.5)	41.1 (38.2–44.0)	24.4 (21.8–27.0)
Female, 18–44	55.5	93.2 (92.2–94.2)	6.1 (5.2–7.0)	0.7 (0.4–1.0)
Female, 45–64	41.2	67.9 (66.3–69.5)	24.0 (22.5–25.5)	8.1 (7.1–9.1)
Female, ≥65	22.9	31.6 (29.3–33.9)	43.7 (41.1–46.3)	24.8 (22.8–26.8)
Race				
Hispanic	32.0	85.6 (84.4–86.8)	10.7 (9.7–11.7)	3.7 (3.2–4.2)
White, non-Hispanic	158.0	71.5 (70.4–72.6)	20.4 (19.4–21.4)	8.1 (7.5–8.7)
Black, non-Hispanic	26.5	77.6 (76.0–79.2)	16.7 (15.3–18.1)	5.7 (4.9–6.5)
Asian, non-Hispanic	10.7	83.9 (81.0–86.8)	13.4 (10.9–15.9)	2.8 (1.9–3.7)
Other race, non-Hispanic	4.6	71.7 (67.0–76.4)	18.0 (14.2–21.8)	10.3 (7.0–13.6)
Insurance status, 18–64 y				
Any private insurance	135.5	83.6 (82.8–84.4)	13.7 (12.9–14.5)	2.6 (2.3–2.9)
Public insurance only	19.4	66.9 (64.9–68.9)	21.7 (19.9–23.5)	11.4 (10.1–12.7)
Uninsured	36.7	91.9 (90.9–92.9)	6.7 (5.8–7.6)	1.5 (1.0–2.0)
Insurance status, ≥65 y[c]				
Medicare only	15.6	34.8 (31.8–37.8)	43.3 (40.1–46.5)	21.9 (19.3–24.5)
Medicare and private	20.3	32.4 (29.7–35.1)	43.2 (40.4–46.0)	24.4 (22.0–26.8)

Demographic Variable	Population (in millions)	No. of Treated Chronic Conditions, % (95% CI)		
		0 to 1	2 to 3	4 or more
Medicare and other public	4.0	25.2 (20.6–29.8)	36.8 (31.8–41.8)	38.0 (32.3–43.7)

Abbreviation: CI, confidence interval.
a Percentages may not add to 100 because of rounding.
b As defined by the US Department of Health and Human Services workgroup on multiple chronic conditions.
c The small number of people who did not fit into any of these categories were excluded.

Table 2. Health Care Use by Age Group and Number of Treated Chronic Conditions,a Medical Expenditure Panel Survey, 2009

Type of Health Care	No. of Treated Chronic Conditions, Estimate (95% CI)		
	0 to 1	2 to 3	4 or more
≥18 y			
Ambulatory visits			
Percentage with ≥1 visit	65.5 (64.4–66.6)	96.0 (95.2–96.8)	98.4 (97.5–99.3)
Average no. of visits for those with ≥1 visit	6.2 (6.0–6.4)	11.4 (10.7–12.1)	17.0 (15.9–18.1)
Emergency department visits			
Percentage with ≥1 visit	11.1 (10.4–11.8)	17.1 (15.5–18.7)	29.7 (27.1–32.3)
Average no. of visits for those with ≥1 visit	1.3 (1.3–1.3)	1.5 (1.4–1.6)	1.6 (1.5–1.7)
Inpatient stays			
Percentage with ≥1 stay	5.3 (4.9–5.7)	13.8 (12.5–15.1)	27.7 (25.3–30.1)
Average no. of stays for those with ≥1 stay	1.2 (1.2–1.2)	1.4 (1.3–1.5)	1.5 (1.4–1.6)
Prescribed medicine purchases			
Percentage with ≥1 purchase	56.2 (55.1–57.3)	99.2 (98.9–99.5)	100.0
Average no. of purchases for those with ≥1 purchase	9.1 (8.8–9.5)	28.6 (27.7–29.5)	56.8 (54.2–59.4)
18–44 y			
Ambulatory visits			
Percentage with ≥1 visit	61.0 (59.7–62.3)	95.0 (92.5–97.5)	96.5 (89.7–103.3)
Average no. of visits for those with ≥1 visit	5.6 (5.4–5.9)	12.5 (10.8–14.2)	15.7 (11.7–19.7)
Emergency department visits			
Percentage with ≥1 visit	12.4 (11.5–13.3)	26.2 (21.4–31.0)	40.5 (27.9–53.1)
Average no. of visits for those with ≥1 visit	1.3 (1.3–1.3)	1.9 (1.6–2.2)	2.2 (1.7–2.7)
Inpatient stays			
Percentage with ≥1 stay	5.5 (5.0–6.0)	11.9 (8.7–15.1)	27.4 (14.3–40.5)
Average no. of stays for those with ≥1 stay	1.2 (1.2–1.2)	2.7 (2.4–3.0)	1.7 (1.3–2.1)
Prescribed medicine purchases			
Percentage with ≥1 purchase	50.7 (49.3–52.1)	98.3 (96.9–99.7)	100.0
Average no. of purchases for those with ≥1 purchase	7.3 (6.9–7.7)	27.5 (25.3–29.8)	63.9 (52.5–75.4)
45–64 y			
Ambulatory visits			
Percentage with ≥1 visit	70.7 (69.2–72.2)	95.8 (94.8–96.8)	99.2 (98.3–100.1)

Type of Health Care	No. of Treated Chronic Conditions, Estimate (95% CI)		
	0 to 1	2 to 3	4 or more
Average no. of visits for those with ≥1 visit	6.7 (6.3–7.1)	10.4 (9.5–11.3)	16.9 (15.0–18.8)
Emergency department visits			
Percentage with ≥1 visit	8.9 (8.0–9.8)	15.3 (13.1–17.5)	32.7 (28.5–36.9)
Average no. of visits for those with ≥1 visit	1.2 (1.1–1.3)	1.4 (1.3–1.5)	1.6 (1.4–1.8)
Inpatient stays			
Percentage with ≥1 stay	3.7 (3.0–4.4)	11.3 (9.6–13.0)	23.6 (19.9–27.3)
Average no. of stays for those with ≥1 stay	1.2 (1.1–1.3)	1.4 (1.3–1.5)	1.6 (1.5–1.7)
Prescribed medicine purchases			
Percentage with ≥1 purchase	62.1 (60.5–63.7)	99.5 (99.1–99.9)	100.0
Average no. of purchases for those with ≥1 purchase	10.7 (10.2–11.3)	28.1 (26.8–29.4)	63.0 (58.8–67.2)
≥65 y			
Ambulatory visits			
Percentage with ≥1 visit	79.0 (76.1–81.9)	96.6 (95.5–97.7)	98.0 (96.6–99.4)
Average no. of visits for those with ≥1 visit	8.6 (7.8–9.4)	12.0 (10.9–13.1)	17.1 (15.7–18.6)
Emergency department visits			
Percentage with ≥1 visit	10.5 (8.6–12.4)	16.0 (13.9–18.1)	27.3 (23.3–31.3)
Average no. of visits for those with ≥1 visit	1.2 (1.1–1.3)	1.4 (1.3–1.5)	1.6 (1.4–1.8)
Inpatient stays			
Percentage with ≥1 stay	10.7 (8.6–12.8)	17.4 (15.2–19.6)	30.0 (26.5–33.5)
Average no. of stays for those with ≥1 stay	1.4 (1.3–1.5)	1.4 (1.3–1.5)	1.5 (1.4–1.6)
Prescribed medicine purchases			
Percentage with ≥1 purchase	74.3 (71.5–77.1)	99.3 (98.8–99.8)	100.0
Average no. of purchases for those with ≥1 purchase	12.5 (11.5–13.5)	29.5 (28.1–31.0)	52.9 (49.6–56.3)

Abbreviation: CI, confidence interval.
a As defined by the US Department of Health and Human Services workgroup on multiple chronic conditions. Estimates expressed as percentages, unless otherwise indicated.

Table 3. Health Care Expenditures[a] by Age Group and Number of Treated Chronic Conditions,[b] Medical Expenditure Panel Survey, 2009

Return

Age, y/Expenditure	No. of Treated Chronic Conditions, Estimate (95% CI)		
	0 to 1	2 to 3	4 or more
≥18			
Percentage with expenditures >0	72.4 (71.4–73.4)	100.0	100.0
Average expenditures, $	2,367 (2,245–2,489)	8,478 (7,884–9,072)	16,257 (14,954–17,560)
Average expenditures for treated chronic conditions, $	408 (349–467)	3,693 (3,350–4,036)	8,935 (8,002–9,868)
18–44			
Percentage with expenditures >0	67.9 (66.6–69.2)	100.0	100.0

Age, y/Expenditure	No. of Treated Chronic Conditions, Estimate (95% CI)		
	0 to 1	2 to 3	4 or more
Average expenditures, $	1,862 (1,740–1,984)	8,165 (6,707–9,623)	14,746 (10,222–19,270)
Average expenditures for treated chronic conditions, $	251 (188–314)	4,004 (2,840–5,168)	8,733 (5,624–11,842)
45–64			
Percentage with expenditures >0	77.5 (76.1–78.9)	100.0	100.0
Average expenditures, $	2,721 (2,492–2,950)	8,129 (7,223–9,035)	17,685 (15,168–20,202)
Average expenditures for treated chronic conditions, $	462 (366–558)	3,786 (3,292–4,280)	8,914 (7,232–10,596)
≥65			
Percentage with expenditures >0	86.9 (84.5–89.3)	100.0	100.0
Average expenditures, $	4,878 (4,092–5,664)	8,979 (8,093–9,865)	15,553 (13,946–17,160)
Average expenditures for treated chronic conditions, $	1,420 (1,052–1,788)	3,483 (3,034–3,932)	8,961 (7,769–10,153)

Abbreviation: CI, confidence interval.
[a] Excludes Medical Expenditure Panel Survey expenditures not tied to specific conditions (ie, dental and other medical expenditures).
[b] As defined by the US Department of Health and Human Services workgroup on multiple chronic conditions.

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Hospital Utilization, Costs, and Mortality for Adults With Multiple Chronic Conditions, Nationwide Inpatient Sample, 2009

Claudia A. Steiner, MD, MPH; Bernard Friedman, PhD

Abstract

Objective
Our objective was to provide a national estimate across all payers of the distribution and cost of selected chronic conditions for hospitalized adults in 2009, stratified by demographic characteristics.

Analysis
We analyzed the Nationwide Inpatient Sample (NIS), the largest all-payer inpatient database in the United States. Use, cost, and mortality estimates across payer, age, sex, and race/ethnicity are produced for grouped or multiple chronic conditions (MCC). The 5 most common dyads and triads were determined.

Results
In 2009, there were approximately 28 million adult discharges other than those related to pregnancy and maternity, from US hospitals; 39% had 2 to 3 MCC, and 33% had 4 or more. A higher number of MCC was associated with higher mortality, use of services, and average cost. The percentages of Medicaid, privately insured patients, and race groups with 4 or more MCC were highly sensitive to age.

Summary
This descriptive analysis of multipayer inpatient data provides a robust national view of the substantial use and costs among adults hospitalized with MCC.

Introduction

The prevalence of adults with more than 1 coexisting chronic condition, often referred to as multiple chronic conditions (MCC), is large and growing in the United States. As the US population ages, the Partnership for Solutions projects that by 2020, one-quarter of Americans will live with MCC (1). Consequences of multiple chronic conditions include impacts on health, quality, delivery of care, and cost. Nationwide, expenses for hospital inpatient care remain the largest component of total health care expenditures. A previous study of hospitalizations using a national all-payer database demonstrated that the number of chronic conditions independently influences hospital costs. Patients with complex illness, defined as 3 or more chronic conditions, were found to have a disproportionately large association with hospital cost per year (2) Another study using hospitalizations from statewide databases that support readmission analyses demonstrated that the likelihood of a readmission was related to the complexity of chronic illness as measured by the number of different chronic conditions (3).

The primary objective of this study is to describe the distribution of multiple chronic conditions among patients hospitalized in US community hospitals in 2009. The study includes all payers, including private, public, and uninsured. We also describe hospitalizations subclassified by patient's payer or by race/ethnicity, within age groups and by sex. In addition, we describe the most common dyads and triads of chronic conditions by demographic characteristics.

Analysis

The data source for this study is the Nationwide Inpatient Sample (NIS) of the Healthcare Cost and Utilization Project (HCUP), the largest all-payer inpatient database in the United States (4). The NIS is designed to approximate a 20% sample of US community hospitals, defined by the American Hospital Association as "all nonfederal, short-term, general, and other specialty hospitals, excluding hospital units of institutions." The NIS hospital sample is drawn from states participating in HCUP. For 2009, these 44 states comprise more than 95% of the US population. This universe of US community hospitals is divided into strata by 5 hospital characteristics: ownership/control, number of beds, teaching status, urban/rural location, and US region. The NIS is a stratified probability sample of hospitals; sampling probabilities are proportional to the number of US community hospitals in each stratum. The 2009 NIS includes all discharge data from 1,050 hospitals that were selected for the sample, a total of 7,810,762 unweighted discharges. Sample weights are provided to produce national estimates.

The study population is restricted to adult patients aged 18 or older admitted for diagnoses other than pregnancy and maternity. The expected payers are defined hierarchically by using primary and secondary expected payer as Medicare, then Medicaid, privately insured, and uninsured. Some "other" categories that include private insurers and public funding are not uniformly reported, so they are included in the privately insured group. The age groups are 18 to 44 years, 45 to 64 years, and 65 or older. Race and ethnicity are defined as white, black, Hispanic, Asian/Pacific Islander, and Native American.

Enhancement of hospital sample for race/ethnicity coding

Some states and hospitals do not provide patient race or ethnicity on each discharge record. Therefore, an internal Agency for Healthcare Research and Quality (AHRQ)-enhanced version of the NIS was created to produce robust national estimates stratified by race and ethnicity. For hospitals that do not provide race/ethnicity, the enhanced database randomly selected additional hospitals in the same stratum without replacement or duplication, attempting to reach the 20% target of hospitals in the stratum. This method of preparing data are used in the National Hospital Disparities Report (5,6).

Calculation of the number of chronic conditions

We used the set of chronic conditions developed by the Department of Health and Human Services (HHS) Interagency Workgroup on MCC and the Office of the Assistant Secretary of Health (7). Highly related diagnoses of the same condition were grouped together using an established Clinical Classification System (CCS) (8). The CCS categories were matched to the established set of chronic conditions; an exception was made for Autism Spectrum Disorder, for which individual ICD-9-CM codes were used. Steps were taken to avoid overcounting the number of 15 conditions reported on a single discharge summary. No one CCS category was counted more than once. In addition, we grouped clusters of CCS categories for highly related conditions (eg, 2 CCS categories for diabetes are clustered together). No cluster is counted more than once. The criteria used to identify the 15 chronic conditions are provided in an Appendix. Chronic conditions on each discharge record were counted and grouped into 3 categories (0-1, 2–3, and 4 or more). Multiple chronic conditions (MCC) are defined as 2 or more chronic conditions.

Cost and mortality

Cost is an estimate of resources used in production of service and includes direct hospital costs without physician fees. All-payer, inpatient cost-to-charge ratios are constructed from the hospital's accounting data for 2009 as reported to the Centers for Medicare and Medicaid Services (CMS). For 10% to 15% of hospitals, cost-to-charge ratios are estimated by imputation within state by hospital characteristics (9). Mortality rates represent only deaths in the hospital.

Results

We calculated a national estimate of the overall distribution of multiple chronic conditions for adult discharges by age group, expected primary payer, and sex (Table 1). Each column shows several use and cost items for the number of chronic conditions (0-1, 2–3, 4 or more), including the mortality rate and mean length of stay, and cost. Roughly one-third of discharges were in the highest MCC grouping (4 or more). The mortality rate was higher for adults discharged with 4 or more MCC compared with that of adults with 0–1 chronic conditions (3.1% vs 1.9%); there was a longer length of stay and a 9% higher cost per discharge.

Medicare covers 53.7% of all the discharges and has a higher share of the discharges with 4 or more MCC (74.8%). Fewer than half (46%) of Medicare discharges had 4 or more chronic conditions. For privately insured patients, only 16.7% had 4 or more chronic conditions. Men and women both had about one-third of discharges with 4 or more chronic conditions. The differences by age are striking. Only 6.5% of discharges aged 18 to 44 years had 4 or more chronic conditions, whereas adults aged 65 or older had rates similar to those of the entire Medicare population (47.5% with 4 or more chronic conditions). We found small differences in the distribution of chronic conditions by

racial/ethnic groups. The proportion of adults discharged with 4 or more chronic conditions was lowest for Hispanics (26.3%) and highest for whites (33.7%). Asian/Pacific Islanders had the highest mortality regardless of number of chronic conditions, and the highest costs per case ($14,000) compared with $11,000 for all groups combined.

The distribution of discharges for different payer categories were nested within age and sex (Table 2). In this context, substantial differences can be seen in the Medicaid-covered population by age group. Younger adults covered by Medicaid have a relatively low percentage of adults with 4 or more MCC (9% for men, 7.7% for women). The percentage for each sex rises to about 32% for adults aged 45 through 64 and then to 42% for adults aged aged 65 or older. Uninsured adults and adults with private payers had a lower percentage of discharges with 4 or more MCC across all age groups and each sex.

We analyzed differences in distribution and outcome by racial/ethnic groups nested within age groups and sex (Table 3). In younger age groups, a higher proportion of black men discharged have 4 or more MCC than do any other racial/ethnic group. This same was true of black women aged 18 through 44. Differences among adults by race and ethnicity are hidden when ages are combined.

We identified the most common pairs of conditions nested within age and sex for adults discharged with 2 or more conditions (Table 4). For example, an estimated 1,044,459 adult men aged 18 through 44 have 2 or more chronic conditions on their discharge abstract. Of those, approximately 24% have the dyad of depression and substance abuse. Clearly, hypertension is found in most of these combinations. After age 44, two-way combinations of coronary artery disease, diabetes, hyperlipidemia, and hypertension are the most prominent dyads.

Triads of chronic conditions reveal a few additional conditions beyond those demonstrated within the most common dyads. (Table 5) We determined the 5 most common triads of the 15 chronic condition groups, nested within age and sex. Chronic kidney disease and then, after age 44, cardiac arrhythmia make their way into the most frequent triads.

Summary

An estimated 20 million adult discharges from community hospitals in the United States have 2 or more chronic conditions noted on their hospital record. These discharges include nearly 66% of all adult discharges from US hospitals. More than 9 million adult discharges (almost a third of all discharges) are estimated to have 4 or more chronic conditions. These data demonstrate compelling findings to support the fourth goal of the HHS Multiple Chronic Conditions Strategic Framework by providing the detailed distribution of multiple chronic conditions among adult discharges from community hospitals. The data suggest that payer group and racial/ethnic groups are associated with the number of chronic conditions listed in a hospital discharge summary, as are cost per stay, mortality rate, stays per year, and cost per year. Although the causal underpinnings of the associations are not explored here, the differences in cost, length of stay, and mortality, for patients with 4 or more chronic conditions are substantial compared with those for adults with 1 chronic condition or none . Given that hospital costs remain the largest component of health care spending, the concentration of use and cost among patients with MCC demonstrates the need for a sustained effort to identify and treat MCC. Many factors could influence the incidence and management of chronic illness that are confounded with demographic and payer categories or operate differently in different groups.

Although the HCUP NIS is a singular source for national estimates of all-payer hospital-based use, outcomes, and cost, this database has strengths and limitations for examining MCCs. For example, while the HCUP NIS includes use and cost for private, public, and uninsured patients, it is limited to the experience of hospitalized adults. The data do not include outpatient costs or physician costs associated with MCC treatment. In addition, the data are not at the patient level but at the discharge level; so that use of frequently readmitted patients to the hospital is included in the database.

An increased number of these 15 chronic conditions for any hospitalized adult is associated with higher cost per stay and higher mortality. The well-known association between increasing age and number of chronic conditions is demonstrated in our study as well. However, nesting payer or racial/ethnic groups within age and sex, highlights important associations by age and sex. These findings may help public health agencies and private health plans to identify subpopulations that will have higher costs and poorer outcomes. This information might be used in designing and targeting new services, patient education, or financial incentives to support effective management of complex chronic illness. Once implemented, these data can also help evaluate the impact of new clinical or delievery system strategies on hospital use,, outcomes, or cost.

Acknowledgments

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Tables

Table 1. Adult Hospital Discharges, by Number of Chronic Conditions Across Payer, Sex, Age, Race/Ethnicity, Nationwide Inpatient Sample, 2009

Discharge Characteristic	No. of Chronic Conditions			
	0 or 1	2 or 3	≥4	All
All Adult Discharges				
Discharges, n (%)a	8,167,314 (28.81)	10,929,300 (38.56)	9,252,415 (32.64)	28,349,029 (100.00)
Mortality rate	0.02	0.03	0.03	0.03
Mean length of stay, d	4.46	5.21	5.42	5.06
Mean charge, $	35,385.98	37,602.67	38,672.55	37,311.28
Mean cost, $	10,544.91	11,180.93	11,480.79	11,095.01
Payer				
Medicare				
n (%)	2,204,737 (14.54)	6,033,738 (39.80)	6,922,039 (45.66)	15,160,515 (100.00)
Mortality rate	0.04	0.03	0.03	0.03
Mean length of stay, d	5.62	5.50	5.51	5.52
Mean charge, $	39653.15	38123.91	37786.48	38193.47
Mean cost, $	11,922.59	11,394.49	11,284.88	11,421.66
Medicaid				
n (%)	1,181,760 (37.01)	1,280,715 (40.11)	730,609 (22.88)	3,193,083 (100.00)
Mortality rate	0.02	0.02	0.02	0.02
Mean length of stay, d	5.26	5.95	5.89	5.68
Mean charge, $	37,242.88	36,467.74	39,491.62	37,445.82
Mean cost, $	10,634.06	10,398.02	11,244.41	10,678.85
Private				
n (%)	3,875,344 (47.10)	2,977,623 (36.19)	1,374,750 (16.71)	8,227,717 (100.00)
Mortality rate	0.01	0.02	0.02	0.02
Mean length of stay, d	3.72	4.45	4.82	4.17
Mean charge, $	34,257.60	38,879.88	43,095.20	37,397.61
Mean cost, $	10,277.17	11,626.10	12,693.26	11,166.47
Self-pay				
n (%)	905,473 (51.22)	637,224 (36.05)	225,017 (12.73)	1,767,713 (100.00)
Mortality rate	0.01	0.02	0.02	0.01
Mean length of stay, d	3.75	4.49	4.97	4.17
Mean charge, $	27,386	29,088.97	36,492.51	29,160.09
Mean cost, $	8,218.75	8,691.24	10,945.66	8,736.48
Sex				
Men				
n (%)	3,582,447 (27.41)	5,072,042 (38.80)	4,417,230 (33.79)	13,071,719 (100.00)

Discharge Characteristic	No. of Chronic Conditions			
	0 or 1	2 or 3	≥4	All
Mortality rate	0.02	0.02	0.03	0.02
Mean length of stay, d	4.19	5.13	5.45	4.95
Mean charge, $	38,860.38	40,070.49	41,303.33	40,153.68
Mean cost, $	11,524.23	11,873.24	12,207.98	11,890.22
Women				
n (%)	4,569,669 (29.89)	5,871,812 (38.41)	4,844,323 (31.69)	15,285,805 (100.00)
Mortality rate	0.02	0.02	0.03	0.02
Mean length of stay, d	4.19	5.13	5.45	4.95
Mean charge, $	32,646.41	35,449.35	36,266.74	34,868.34
Mean cost, $	9,790.54	10,583.73	10,820.74	10,421.11
Age				
18–44 y				
n (%)	3,419,009 (63.36)	1,624,350 (30.10)	352,970.50 (6.54)	5,396,330 (100.00)
Mortality rate	0.01	0.01	0.01	0.01
Mean length of stay, d	3.91	5.03	5.20	4.33
Mean charge, $	30,804.92	30,364.65	34,111.91	30,910.92
Mean cost, $	9,142.41	9,025.33	10,080.57	9,168.51
45–64 y				
n (%)	2,992,037 (31.60)	3,987,333 (42.11)	2,488,444 (26.28)	9,467,814 (100.00)
Mortality rate	0.02	0.02	0.02	0.02
Mean length of stay, d	4.50	5.05	5.26	4.93
Mean charge, $	37,773.66	39,377.85	40,983.65	39,292.56
Mean cost, $	11,299.41	11,710.14	12,107.17	11,684.60
≥65 y				
Discharges, n (%)	1,774,032 (13.11)	5,334,250 (39.43)	6,420,323 (47.46)	13,528,605 (100.00)
Mortality rate	0.05	0.04	0.04	0.04
Mean length of stay, d	5.44	5.38	5.50	5.44
Mean charge, $	40,068.53	38,467.4	38,022.14	38,467.45
Mean cost, $	11,974.46	11,444.67	11,317.35	11,454.16
Race/Ethnicity				
White				
n (%)	5,666,925 (27.62)	7,942,189 (38.70)	6,911,652 (33.68)	20,520,766 (100.00)
Mortality rate	0.02	0.03	0.03	0.03
Mean length of stay, d	4.37	5.06	5.30	4.95
Mean charge, $	34,050.26	35,737.8	36,542.4	35,541.02
Mean cost, $	10,576.29	11,075.09	11,266.23	11,001.25
Black				
n (%)	1,045,058 (27.01)	1,546,737 (39.98)	1,277,201 (33.01)	3,868,996 (100.00)

Discharge Characteristic	No. of Chronic Conditions			
	0 or 1	2 or 3	≥4	All
Mortality rate	0.02	0.02	0.02	0.02
Mean length of stay, d	4.99	5.74	5.81	5.56
Mean charge, $	35,929.6	38,679.35	39,139.03	38,087.77
Mean cost, $	10,114.23	10,877.67	11,276.55	10,802.81
Hispanic				
n (%)	890,011 (37.49)	859,422 (36.20)	624,850 (26.32)	2,374,283 (100.00)
Mortality rate	0.02	0.02	0.03	0.02
Mean length of stay, d	4.37	5.37	5.74	5.10
Mean charge, $	39,520.76	45,699.29	51,147.17	44,807.28
Mean cost, $	10,241.91	11,319.79	12,467.65	11,215.95
Asian/Pacific Islander				
n (%)	162,048 (31.36)	196,067 (37.94)	158,688 (30.71)	516,804 (100.00)
Mortality rate	0.03	0.04	0.04	0.03
Mean length of stay, d	4.80	5.68	5.92	5.48
Mean charge, $	47,747.97	57,105.99	64,097.02	56,257.44
Mean cost, $	12,455.85	14,280.97	15,380.64	14,035.66
Native American				
n (%)	61,241.47 (31.16)	76,597.34 (38.97)	58,721.93 (29.87)	196,560.7 (100.00)
Mortality rate	0.02	0.02	0.03	0.02
Mean length of stay, d	4.35	5.05	5.03	4.83
Mean charge, $	30,114.33	32,991.89	37,077.33	33,314.41
Mean cost, $	10,368.74	11,160.54	11,499.38	11,014.92

[a] The number of all discharges within the columns of each detailed breakdown section of the table may not add precisely to all discharges in the first line of the table because of missing data on national estimates within each section. For more information on sampling variation and missing data for particular variables, consult www.hcupnet.ahrq.gov.

Table 2. Adults Discharged From US Hospitals by Payer Within Age and Sex, Nationwide Inpatient Sample, 2009

Return

Discharge Characteristic	No. of Chronic Conditions			
	0 to 1	2 to 3	≥4	All
Men aged 18–44 y				
Medicare				
n (%)	108,888 (34.78)	145,761 (46.56)	58,433 (18.66)	313,082 (100.00)
Mortality rate	0.01	0.01	0.01	0.01
Mean length of stay, d	6.31	6.30	5.79	6.21
Mean charge, $	36,282.56	33,043.79	34,346.26	34,413.36
Mean cost, $	10,765.5	9,784.298	10,156.62	10,195.06
Medicaid				

Discharge Characteristic	No. of Chronic Conditions			
	0 to 1	2 to 3	≥4	All
n (%)	312,401 (51.81)	236,287 (39.18)	54,321 (9.01)	603,009 (100.00)
Mortality rate	0.01	0.01	0.01	0.01
Mean length of stay, d	3.78	4.49	4.52	4.01
Mean charge, $	34,158.33	32,689.01	38,973.72	33,976.47
Mean cost, $	10,066.80	9,690.28	11,398.59	10,024.63
Private				
n (%)	758,767 (68.21)	303,074 (27.25)	50,517 (4.54)	1,112,358 (100.00)
Mortality rate	0.01	0.01	0.01	0.01
Mean length of stay, d	3.78	4.49	4.52	4.01
Mean charge, $	34,158.33	32,689.01	38,973.72	33,976.47
Mean cost, $	10066.80	9690.28	11398.59	10024.63
Self-pay				
n (%)	351,196 (64.58)	166,152 (30.55)	26,455 (4.86)	543,804 (100.00)
Mortality rate	0.01	0.01	0.01	0.01
Mean length of stay, d	3.65	4.37	4.39	3.91
Mean charge, $	25,756.81	23,822.86	30,858.46	25,414.02
Mean cost, $	7,793.37	7,160.63	9,027.34	7,660.02
Men aged 45–64 y				
Medicare				
n (%)	203,301 (17.84)	467,741 (41.04)	468,674 (41.12)	1,139,716 (100.00)
Mortality rate	0.03	0.02	0.02	0.02
Mean length of stay, d	6.55	6.09	5.56	5.95
Mean charge, $	44,284.56	40,537.61	39,541.04	40,796.60
Mean cost, $	13,245.30	11,960.11	11,666.46	12,068.74
Medicaid				
n (%)	182,430 (23.77)	343,745 (44.80)	241,169 (31.43)	767,344 (100.00)
Mortality rate	0.03	0.02	0.02	0.02
Mean length of stay, d	6.75	6.41	5.95	6.35
Mean charge, $	45,922.70	40,771.91	40,881.27	42,030.43
Mean cost, $	13,085.48	11,751.80	11,711.18	12,056.01
Private				
n (%)	813767 (33.87)	1051276 (43.76)	537256 (22.36)	2402299 (100.00)
Mortality rate	0.02	0.02	0.01	0.02
Mean length of stay, d	4.24	4.35	4.64	4.38
Mean charge, $	40,495.69	42,715.50	46,321.88	42,767.70
Mean cost, $	12,150.26	12,752.72	13,698.33	12,759.49
Self-pay				
n (%)	166,307 (35.49)	205,565 (43.87)	96,733 (20.64)	468,605 (100.00)

Discharge Characteristic	No. of Chronic Conditions			
	0 to 1	2 to 3	≥4	All
Mortality rate	0.02	0.02	0.02	0.02
Mean length of stay, d	4.56	4.78	5.01	4.75
Mean charge, $	31,775.72	33,344.77	39,030.38	33,961.61
Mean cost, $	9,579.73	9,992.05	11,507.92	10,158.64
Men aged ≥65 y				
Medicare				
n (%)	665,135 (12.62)	2,014,678 (38.24)	2,588,693 (49.14)	5,268,507 (100.00)
Mortality rate	0.05	0.04	0.04	0.04
Mean length of stay, d	5.81	5.48	5.43	5.50
Mean charge, $	43,426.57	41,082.58	39,831.74	40,765.79
Mean cost, $	13,121.63	12,303.19	11,882.03	12,200.22
Medicaid				
n (%)	14,603 (16.51)	37,212 (42.07)	36,630 (41.42)	88,445 (100.00)
Mortality rate	0.06	0.05	0.04	0.05
Mean length of stay, d	7.20	7.07	7.21	7.15
Mean charge, $	52,644.60	48,780.02	48,914.96	49,474.11
Mean cost, $	14,215.67	13,230.12	13,480.00	13,496.22
Private				
Discharges, n (%)	76,922 (16.40)	189,141 (40.31)	203,115 (43.29)	469,177 (100.00)
Mortality rate	0.08	0.06	0.05	0.06
Mean length of stay, d	5.30	5.13	5.21	5.19
Mean charge, $	45,328.43	44,083.07	43,782.92	44,158.40
Mean cost, $	13,026.96	12,629.63	12,440.45	12,613.35
Self-pay				
n (%)	7,836 (21.69)	14,798 (40.95)	13,501 (37.36)	36,136 (100.00)
Mortality rate	0.108	0.06	0.06	0.07
Mean length of stay, d	5.58	5.54	6.17	5.79
Mean charge, $	36,910.76	39,488.91	39,595.57	38,970.75
Mean cost, $	11,220.25	12,522.91	12,651.25	12,288.72
Women aged 18−44 y				
Medicare				
n (%)	119,666 (38.58)	140,524 (45.31)	49,967 (16.11)	310,157 (100.00)
Mortality rate	0.01	0.01	0.01	0.01
Mean length of stay, d	5.49	5.90	5.54	5.69
Mean charge, $	32,332.45	33,295.78	33,724.04	32,992.90
Mean cost, $	9,748.48	9,783.22	9,955.79	9,797.59
Medicaid				
n (%)	4,492,580 (58.93)	278,647 (33.34)	64,634 (7.73)	835,860 (100.00)

Discharge Characteristic	No. of Chronic Conditions			
	0 to 1	2 to 3	≥4	All
Mortality rate	0.01	0.01	0.01	0.01
Mean length of stay, d	4.24	5.31	5.32	4.68
Mean charge, $	28,398.89	27,609.89	30,565.52	28,303.17
Mean cost, $	8,376.36	8,193.98	9,117.12	8,372.78
Private				
n (%)	1,048,248 (75.45)	303,657 (21.86)	37,472 (2.70)	1,389,376 (100.00)
Mortality rate	0.00	0.01	0.01	0.00
Mean length of stay, d	3.21	4.24	4.47	3.47
Mean charge, $	27,901.65	29,707.63	34,695.92	28,478.33
Mean cost, $	8,312.62	8,834.00	10,243.32	8,478.28
Self-pay				
n (%)	248,365 (69.35)	96,378 (26.91)	13,406 (2.70)	358,149 (100.00)
Mortality rate	0.00	0.01	0.01	0.01
Mean length of stay, d	3.27	4.10	4.40	3.54
Mean charge, $	22,693.59	22,365.63	29,013.77	22,842.02
Mean cost, $	6,926.04	6,738.00	8,623.15	6,938.96
Women aged 45–64 y				
Medicare				
n (%)	224,202 (20.00)	474,563 (42.34)	422,019 (37.65)	1,120,783 (100.00)
Mortality rate	0.02	0.02	0.02	0.02
Mean length of stay, d	6.00	5.84	5.54	5.76
Mean charge, $	39,567.05	37,455.52	37,136.58	37,758.12
Mean cost, $	11,987.25	11,229.84	11,025.40	11,304.51
Medicaid				
n (%)	210,734 (24.40)	373,959 (43.30)	278,978 (32.30)	863,671 (100.00)
Mortality rate	0.02	0.02	0.01	0.02
Mean length of stay, d	5.75	5.85	5.70	5.78
Mean charge, $	39,336.88	37,011.21	36,886.57	37,538.15
Mean cost, $	11,395.97	10,680.02	10,791.38	10,890.61
Private				
n (%)	1,080,447 (44.02)	988,812 (40.29)	385,165 (15.69)	2,454,423 (100.00)
Mortality rate	0.01	0.01	0.01	0.01
Mean length of stay, d	3.73	4.31	4.63	4.11
Mean charge, $	34,117.03	37,245.12	39,641.79	36,240.15
Mean cost, $	10,300.35	11,264.37	11,941.66	10,945.07
Self-pay				
n (%)	143,013 (39.43)	154,460 (42.59)	65,219 (17.98)	362,692 (100.00)
Mortality rate	0.02	0.01	0.02	0.02

Discharge Characteristic	No. of Chronic Conditions			
	0 to 1	2 to 3	≥4	All
Mean length of stay, d	3.97	4.49	4.73	4.33
Mean charge, $	27,568.26	29,511.21	33,909.31	29,536.17
Mean cost, $	8,578.13	9,032.98	10,415.54	9,102.30
Women aged ≥65				
Medicare				
n (%)	936,232 (13.35)	2,873,933 (40.97)	3,205,064 (45.69)	7,015,230 (100.00)
Mortality rate	0.04	0.03	0.03	0.03
Mean length of stay, d	5.45	5.30	5.46	5.39
Mean charge, $	37,312.62	34,902.96	34,767.87	35,163.93
Mean cost, $	11,430.65	10,588.52	10,490.42	10,656.53
Medicaid				
n (%)	21,863 (14.60)	62,869 (41.97)	65,057 (43.43)	149,789 (100.00)
Mortality rate	0.05	0.04	0.03	0.04
Mean length of stay, d	6.36	6.38	6.99	6.65
Mean charge, $	42,907.69	40,707.18	42,918.38	41,988.29
Mean cost, $	11,977.38	11,338.54	11,972.17	11,706.85
Private				
n (%)	83,905 (18.33)	197,581 (43.17)	176,220 (38.50)	457,706 (100.00)
Mortality rate	0.07	0.05	0.05	0.06
Mean length of stay, d	4.94	5.01	5.19	5.06
Mean charge, $	36,988.99	37,399.27	37,110.41	37,212.95
Mean cost, $	10,922.90	10,808.53	10,692.03	10,784.93
Self-pay				
n (%)	9,699 (23.06)	18,097 (43.03)	14,260 (33.91)	42,056 (100.00)
Mortality rate	0.07	0.06	0.05	0.06
Mean length of stay, d	6.40	5.48	6.20	5.94
Mean charge, $	31,791.20	32,658.91	34,218.72	32,988.01
Mean cost, $	10,023.66	10,349.79	11,124.45	10,537.39

Table 3. Adults Discharged From US Hospitals, by Race/Ethnicity Within Age Groups and Sex, Nationwide Inpatient Sample, 2009

Return

Discharge Characteristics	No. of Chronic Conditions			
	0 to 1	2 to 3	≥4	All
Men aged 18–44 y				
White				
n (%)	917,075 (60.83)	492,730 (32.68)	97,880 (6.49)	1,507,685 (100.00)
Mortality rate	0.01	0.01	0.01	0.01
Mean length of stay, d	4.10	4.94	5.06	4.44

Discharge Characteristics	No. of Chronic Conditions			
	0 to 1	2 to 3	≥4	All
Mean charge, $	32,308.69	28,636.78	33,143.72	31,161.70
Mean cost, $	9,937.46	89,10.26	10,198.32	9,618.37
Black				
n (%)	238,958 (49.93)	181,964 (38.02)	57,708 (12.06)	478,630 (100.00)
Mortality rate	0.01	0.01	0.01	0.01
Mean length of stay, d	5.03	5.65	5.51	5.33
Mean charge, $	34,340.21	31,673.97	34,212.79	33,310.18
Mean cost, $	9,709.54	9,155.93	10,078.22	9,543.23
Hispanic				
n (%)	22,8901 (65.46)	99,352 (28.41)	21,411 (6.12)	349,664 (100.00)
Mortality rate	0.01	0.01	0.01	0.01
Mean length of stay, d	4.56	5.59	5.33	4.90
Mean charge, $	40,675.98	40,163.08	43,418.28	40,697.90
Mean cost, $	10,928.28	10,542.99	11,013.78	10,824.10
Asian/Pacific Islander				
n (%)	26,604 (65.46)	11,263 (27.71)	2,777 (6.83)	40,644 (100.00)
Mortality rate	0.01	0.02	0.01	0.01
Mean length of stay, d	4.94	5.96	5.49	5.26
Mean charge, $	46,928.06	51,705.31	55,389.21	48,806.68
Mean cost, $	12,290.35	13,744.53	13,736.64	12,786.57
Native American				
n (%)	12,665 (56.31)	8,040 (35.75)	1,785 (7.94)	22,490 (100.00)
Mortality rate	0.01	0.01	0.02	0.01
Mean length of stay, d	4.24	4.99	4.72	4.55
Mean charge, $	29,490.33	26,213.56	33,706.71	28,648.17
Mean cost, $	9,733.02	8,618.44	10,976.53	9,431.61
Men aged 45–64 y				
White				
n (%)	964,565 (29.61)	1,398,301 (42.92)	895,219 (27.48)	3,258,085 (100.00)
Mortality rate	0.02	0.02	0.02	0.02
Mean length of stay, d	4.70	4.90	5.07	4.89
Mean charge, $	39,740.38	40,268.24	41,721.88	40,511.04
Mean cost, $	12,290.35	12,403.48	12,768.23	12,470.13
Black				
n (%)	156,756 (20.67)	339,238 (44.73)	262,498 (34.61)	758,492 (100.00)
Mortality rate	0.02	0.02	0.02	0.02
Mean length of stay, d	5.74	5.74	5.62	5.70
Mean charge, $	42,500.38	39,497.04	40,095.68	40,324.30

Discharge Characteristics	No. of Chronic Conditions			
	0 to 1	2 to 3	≥4	All
Mean cost, $	11,874.92	11,212.07	11,508.44	11,451.44
Hispanic				
n (%)	124,063 (30.99)	168,557 (42.10)	107,739 (26.91)	400,359 (100.00)
Mortality rate	0.02	0.02	0.02	0.02
Mean length of stay, d	5.10	5.48	5.58	5.39
Mean charge, $	46,103.51	48,804.00	52,895.88	49,065.06
Mean cost, $	11,925.25	12,216.00	13,132.87	12,372.10
Asian/Pacific Islander				
n (%)	23,944 (30.84)	32,410 (41.75)	21,279 (27.41)	77,633 (100.00)
Mortality rate	0.03	0.03	0.02	0.03
Mean length of stay, d	5.32	5.58	5.84	5.57
Mean charge, $	56,263.83	62,086.23	71,098.07	62,681.37
Mean cost, $	14,496.26	15,730.86	17,496.28	15,817.94
Native American				
n (%)	9,690 (26.63)	15,708 (43.18)	10,983 (30.19)	36,381 (100.00)
Mortality rate	0.03	0.02	0.01	0.02
Mean length of stay, d	5.09	4.92	4.79	4.93
Mean charge, $	36,101.52	35,412.00	39,829.43	36,931.24
Mean cost, $	12,672.81	11,841.69	12,230.61	12,179.48
Men aged ≥65 y				
White				
n (%)	594,416 (12.67)	1,767,324 (37.66)	2,331,641 (49.68)	4,693,381 (100.00)
Mortality rate	0.05	0.04	0.04	0.04
Mean length of stay, d	5.45	5.32	5.35	5.35
Mean charge, $	41,150.03	39,783.78	38,603.28	39,372.19
Mean cost, $	12,690.98	12,229.29	11,821.99	12,086.05
Black				
n (%)	52,675 (10.77)	187,401 (38.31)	249,085 (50.92)	489,161 (100.00)
Mortality rate	0.07	0.04	0.04	0.04
Mean length of stay, d	7.27	6.45	6.14	6.38
Mean charge, $	52,723.93	46,092.80	41,837.77	44,645.21
Mean cost, $	14,513.92	12,679.25	12,011.12	12,537.51
Hispanic				
n (%)	54,561 (14.78)	144,823 (39.23)	169,737 (45.98)	369,121 (100.00)
Mortality rate	0.05	0.04	0.04	0.04
Mean length of stay, d	5.76	5.82	6.03	5.91
Mean charge, $	52,214.78	53,118.44	56,508.38	54,535.47
Mean cost, $	12,531.53	12,715.68	13,583.41	13,085.42

Discharge Characteristics	No. of Chronic Conditions			
	0 to 1	2 to 3	≥4	All
Asian/Pacific Islander				
n (%)	16,563 (14.09)	47,631 (40.53)	53,322 (45.37)	11,7517 (100.00)
Mortality rate	0.06	0.05	0.05	0.05
Mean length of stay, d	6.14	6.13	6.08	6.11
Mean charge, $	62,512.13	64,955.69	68,702.57	66,278.41
Mean cost, $	15,711.12	15,857.96	16,61.18	16,016.96
Native American				
n (%)	4,597 (14.04)	12,286 (37.53)	15,855 (48.43)	32,738 (100.00)
Mortality rate	0.05	0.04	0.03	0.04
Mean length of stay, d	5.22	5.41	5.00	5.18
Mean charge, $	38,101.53	39,401.45	41,222.76	40,099.73
Mean cost, $	12,964.16	13,579.89	12,647.02	13,041.83
Women aged 18–44 y				
White				
n (%)	1,173,549 (66.97)	491,581 (28.05)	87,176 (4.97)	1,752,306 (100.00)
Mortality rate	0.00	0.01	0.01	0.00
Mean length of stay, d	3.45	4.63	4.88	3.85
Mean charge, $	26,383.05	26,096.09	30,033.49	26,483.96
Mean cost, $	8,282.15	8,209.02	9,332.88	8,313.86
Black				
n (%)	329,648 (57.58)	187,273 (32.71)	55,613 (9.71)	572,533 (100.00)
Mortality rate	0.00	0.01	0.01	0.01
Mean length of stay, d	4.02	5.17	5.43	4.53
Mean charge, $	28,225.17	32,018.64	33,067.90	29,937.95
Mean cost, $	8,090.41	9,097.29	9,832.92	8,589.50
Hispanic				
n (%)	262,448 (73.93)	77,565 (21.85)	14,985 (4.22)	354,998 (100.00)
Mortality rate	0.00	0.01	0.01	0.01
Mean length of stay, d	3.54	5.02	5.36	3.94
Mean charge, $	32,328.97	38,678.41	43,519.81	34,183.84
Mean cost, $	8,518.59	9,898.87	10,984.73	8,923.22
Asian/Pacific Islander				
n (%)	38,944 (75.83)	10,754 (20.94)	1,660 (3.23)	51,358 (100.00)
Mortality rate	0.01	0.01	0.01	0.01
Mean length of stay, d	3.84	5.93	6.40	4.36
Mean charge, $	36,230.32	51,448.43	55,025.04	39,983.62
Mean cost, $	9,762.20	13,694.84	14,330.96	10,723.20
Native American				

Discharge Characteristics	No. of Chronic Conditions			
	0 to 1	2 to 3	≥4	All
n (%)	16,149 (62.46)	7,869 (30.43)	1,838 (7.11)	25,856 (100.00)
Mortality rate	0.01	0.01	0.01	0.01
Mean length of stay, d	3.60	5.34	5.05	4.23
Mean charge, $	24,601.77	28,011.90	28,250.57	25,901.55
Mean cost, $	8,381.63	9,448.44	9,081.64	8,756.74
Women aged 45–64 y				
White				
n (%)	1,186,996 (36.45)	1,335,870 (41.03)	733,201 (22.52)	3,256,067 (100.00)
Mortality rate	0.01	0.01	0.01	0.01
Mean length of stay, d	4.13	4.84	5.12	4.65
Mean charge, $	33,859.10	35,445.57	36,614.66	35,129.71
Mean cost, $	10,554.25	11,064.03	11,351.18	10,942.63
Black				
n (%)	198,781 (24.01)	359,803 (43.45)	269,462 (32.54)	828,046 (100.00)
Mortality rate	0.02	0.02	0.02	0.02
Mean length of stay, d	4.79	5.43	5.60	5.33
Mean charge, $	36,747.47	38,743.52	38,706.02	38,252.29
Mean cost, $	10,416.47	10,908.23	11,161.01	10,872.44
Hispanic				
n (%)	150,184 (36.90)	162,767 (39.99)	94,051 (23.11)	407,002 (100.00)
Mortality rate	0.01	0.01	0.02	0.01
Mean length of stay, d	4.08	4.94	5.37	4.72
Mean charge, $	38,043.64	43,204.39	46,865.87	42,145.14
Mean cost, $	9,747.41	10,866.26	11,670.82	10,639.10
Asian/Pacific Islander				
n (%)	34,958 (42.26)	32,206 (38.93)	15,562 (18.81)	82,725 (100.00)
Mortality rate	0.02	0.02	0.02	0.02
Mean length of stay, d	4.25	5.23	5.60	4.88
Mean charge, $	44,425.20	52,586.01	59,232.48	50,306.06
Mean cost, $	11,829.17	13,621.52	15,001.78	13,106.22
Native American				
n (%)	11,639 (30.74)	15,921 (42.06)	10,298 (27.20)	37,858 (100.00)
Mortality rate	0.02	0.01	0.02	0.01
Mean length of stay, d	4.19	4.80	5.00	4.66
Mean charge, $	30,139.27	32,174.50	34,456.78	32,167.51
Mean cost, $	10,441.54	10,864.81	10,912.14	10,747.29
Women aged ≥65 y				
White				

Discharge Characteristics	No. of Chronic Conditions			
	0 to 1	2 to 3	≥4	All
n (%)	829,817 (13.71)	2,456,096 (40.58)	2,766,399 (45.71)	6,052,312 (100.00)
Mortality rate	0.04	0.03	0.04	0.04
Mean length of stay, d	5.18	5.19	5.41	5.29
Mean charge, $	35,414.11	33,773.19	33,429.61	33,842.53
Mean cost, $	11,057.53	10,506.00	10,386.20	10,527.33
Black				
n (%)	68,195 (9.19)	291,036 (39.22)	382,811 (51.59)	742,042 (100.00)
Mortality rate	0.06	0.04	0.03	0.04
Mean length of stay, d	6.71	6.10	5.98	6.10
Mean charge, $	48,248.46	41,551.23	38,663.57	40,683.88
Mean cost, $	12,980.58	11,515.06	11,113.04	11,443.54
Hispanic				
n (%)	69,704 (14.14)	206,336 (41.86)	216,909 (44.00)	492,949 (100.00)
Mortality rate	0.04	0.03	0.03	0.03
Mean length of stay, d	5.14	5.35	5.83	5.53
Mean charge, $	44,228.99	45,217.73	49,240.79	46,840.52
Mean cost, $	10,717.20	10,871.76	11,856.34	11,281.33
Asian/Pacific Islander				
n (%)	21,015 (14.31)	61,799 (42.07)	64,088 (43.63)	146,902 (100.00)
Mortality rate	0.05	0.04	0.04	0.04
Mean length of stay, d	5.70	5.53	5.89	5.71
Mean charge, $	54,013.97	52,729.35	59,779.75	55,956.26
Mean cost, $	13,741.25	12,850.96	14,155.06	13,542.71
Native American				
n (%)	6,502 (15.77)	16,773 (40.67)	17,962 (43.56)	41,236 (100.00)
Mortality rate	0.05	0.03	0.03	0.03
Mean length of stay, d	4.95	5.06	5.25	5.13
Mean charge, $	30,440.56	32,409.60	34,475.43	32,996.89
Mean cost, $	11,157.61	11,059.78	10,675.72	10,908.19

Table 4. Five Most Prevalent Chronic Condition Dyads for US Adults With 2 or More Chronic Conditions, by Sex and Age, Nationwide Inpatient Sample, 2009

Sex, Age, and Dyad	%[a]
Men	
18−44 y (n = 1,044,459)	
Depression/substance abuse	23.9
Hypertension/diabetes	17.8

Sex, Age, and Dyad	%[a]
Hyperlipidemia/hypertension	15.1
Hypertension/substance abuse	13.6
Hypertension/depression	11.9
45–64 y (n = 3,420,573)	
Hypertension/hyperlipidemia	31.8
Hypertension/diabetes	29.5
Hypertension/coronary artery disease	26.1
Hyperlipidemia/coronary artery disease	19.5
Diabetes/hyperlipidemia	16.6
≥65 y (n = 5,103,409)	
Hypertension/coronary artery disease	37.1
Hypertension/hyperlipidemia	34.2
Hypertension/cardiac arrhythmia	28.8
Hypertension/diabetes	27.9
Hyperlipidemia/coronary artery disease	24.9
Women	
18–44 y (n = 987,310)	
Depression/substance abuse	22.0
Hypertension/diabetes	18.6
Hypertension/depression	15.7
Depression/asthma	12.5
Hyperlipidemia/hypertension	11.3
45–64 y (n = 3,150,679)	
Hypertension/diabetes	31.3
Hyperlipidemia/hypertension	28.3
Hypertension/depression	18.0
Hyperlipidemia/diabetes	16.7
Hypertension/coronary artery disease	16.0
≥65 y (n = 6,618,736)	
Hypertension/hyperlipidemia	32.6
Hypertension/coronary artery disease	26.9
Hypertension/diabetes	26.7
Hypertension/cardiac arrhythmia	25.9
Hypertension/congestive heart failure	19.2

[a] Percentage does not total 100% because the list presents only the top-ranked disease groupings.

Return

Table 5. Five Most Prevalent Chronic Condition Triads for US Adults With 3 or More Chronic Conditions, by Sex and Age, Nationwide Inpatient Sample, 2009

Sex, Age, and Triad	%[a]
Men	
18–44 y (n = 481,305)	
Diabetes/hyperlipidemia/hypertension	14.3
Hypertension/depression/substance abuse	10.7
Diabetes/hyperlipidemia/chronic kidney disease	10.0
Hypertension/hyperlipidemia/coronary artery disease	9.2
Diabetes/hypertension/depression	6.8
45–64 y (n = 2,359,061)	
Hypertension/hyperlipidemia/coronary artery disease	22.7
Diabetes/hyperlipidemia/hypertension	20.1
Diabetes/hypertension/coronary artery disease	16.7
Hyperlipidemia/coronary artery disease/diabetes	11.7
Diabetes/hypertension/chronic kidney disease	11.0
≥65 y (n = 4,123,675)	
Hypertension/hyperlipidemia/coronary artery disease	25.1
Hypertension/coronary artery disease/cardiac arrhythmia	20.3
Diabetes/hypertension/coronary artery disease	18.2
Diabetes/hyperlipidemia/hypertension	16.7
Hyperlipidemia/hypertension/cardiac arrhythmia	16.2
Women	
18–44 y (n = 429,490)	
Diabetes/hyperlipidemia/hypertension	13.6
Diabetes/hyperlipidemia/hypertension	11.5
Diabetes/hypertension/depression	9.9
Diabetes/hypertension/chronic kidney disease	7.9
Hypertension/hyperlipidemia/depression	7.7
45–64 y (n = 2,075,306)	
Diabetes/hyperlipidemia/hypertension	22.7
Hypertension/hyperlipidemia/coronary artery disease	21.0
Diabetes/hypertension/coronary artery disease	13.6
Hypertension/hyperlipidemia/depression	13.2
Diabetes/hypertension/chronic kidney disease	10.4
≥65 y (n = 5,208,808)	
Hypertension/hyperlipidemia/coronary artery disease	16.9
Diabetes/hyperlipidemia/hypertension	15.2
Hypertension/coronary artery disease/cardiac arrhythmia	13.5
Diabetes/hypertension/coronary artery disease	13.2

Sex, Age, and Triad	%[a]
Hyperlipidemia/hypertension/cardiac arrhythmia	13.0

[a] Percentage does not total 100% because the list presents only the top-ranked disease groupings.

Appendix. Coding for Selected Chronic Conditions

Condition	CCS Category or Cluster
Hypertension	98, 99
Hyperlipidemia	53
Congestive heart failure	108
Coronary artery disease (CAD) (includes acute myocardial infarction, which indicates chronic underlying CAD)	100, 101
Diabetes	49, 50
Stroke (includes acute stroke but indicates underlying cerebrovascular disease)	109–112
Cardiac arrhythmias	105, 106
Arthritis	202, 203
Cancer	11–43
Depression	657
Dementia (includes Alzheimer's and other senile dementias)	653
Substance abuse disorders	660, 661
Chronic obstructive pulmonary disease	127
Asthma	128
Chronic kidney disease	156, 158
HIV	5
Hepatitis	6
Autism spectrum disorder	ICD-9-CM 29900, 29901
Schizophrenia	659
Osteoporosis	206

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PREVENTING CHRONIC DISEASE
PUBLIC HEALTH RESEARCH, PRACTICE, AND POLICY

Prevalence of Multiple Chronic Conditions Among Medicare Beneficiaries, United States, 2010

Kimberly A. Lochner, ScD; Christine S. Cox, MA

PEER REVIEWED

Abstract

Introduction
The increase in chronic health conditions among Medicare beneficiaries has implications for the Medicare system. The objective of this study was to use the US Department of Health and Human Services Strategic Framework on multiple chronic conditions as a basis to examine the prevalence of multiple chronic conditions among Medicare beneficiaries.

Analysis
We analyzed Centers for Medicare and Medicaid Services administrative claims data for Medicare beneficiaries enrolled in the fee-for-service program in 2010. We included approximately 31 million Medicare beneficiaries and examined 15 chronic conditions. A beneficiary was considered to have a chronic condition if a Medicare claim indicated that the beneficiary received a service or treatment for the condition. We defined the prevalence of multiple chronic conditions as having 2 or more chronic conditions.

Results
Overall, 68.4% of Medicare beneficiaries had 2 or more chronic conditions and 36.4% had 4 or more chronic conditions. The prevalence of multiple chronic conditions increased with age and was more prevalent among women than men across all age groups. Non-Hispanic black and Hispanic women had the highest prevalence of 4 or more chronic conditions, whereas Asian or Pacific Islander men and women, in general, had the lowest.

Summary
The prevalence of multiple chronic conditions among the Medicare fee-for-service population varies across demographic groups. Multiple chronic conditions appear to be more prevalent among women, particularly non-Hispanic black and Hispanic women, and among beneficiaries eligible for both Medicare and Medicaid benefits. Our findings can help public health researchers target prevention and management strategies to improve care and reduce costs for people with multiple chronic conditions.

Introduction

The increase in chronic health conditions among Medicare beneficiaries has far-reaching implications for the Medicare system (1,2). Among Medicare beneficiaries, not only are hypertension, high cholesterol, heart disease, and diabetes highly prevalent, but most beneficiaries have multiple chronic conditions. Medicare beneficiaries with multiple chronic conditions are the heaviest users of health care services, including such high-cost services as hospitalizations and emergency department visits, which translates into increased Medicare spending. For example, the two-thirds of beneficiaries with 2 more chronic conditions accounted for 93% of Medicare spending, and the one-third with 4 or more chronic conditions accounted for almost three-fourths of Medicare spending (3).

Although research has focused on chronic conditions such as hypertension, diabetes, and heart conditions (1), the US Department of Health and Human Services (HHS) Initiative on multiple chronic conditions calls for the need to enhance the understanding of chronic condition comorbidities. The HHS Initiative's strategic framework on multiple chronic conditions offers an organizing structure to address multiple chronic conditions through research,

interventions, and health care management and indicates the need to increase the evidence base on the epidemiology of multiple chronic conditions (4,5).

The objective of this study was to use the HHS Strategic Framework on multiple chronic conditions as a basis to examine the prevalence of multiple chronic conditions among Medicare beneficiaries. In combination with the other articles in this issue of *Preventing Chronic Disease* that address multiple chronic conditions, this study begins to fill the gaps and improve our understanding of the prevalence of multiple chronic conditions across different populations using different data sources.

Analysis

Medicare is the US federal health insurance program for people aged 65 or older, people younger than 65 with certain disabilities, and people of any age with end-stage renal disease. We examined Centers for Medicare and Medicaid Services (CMS) administrative enrollment and claims data for Medicare beneficiaries enrolled in the fee-for-service program for 2010. These CMS data are available from the CMS Chronic Condition Data Warehouse (CCW), a research database with 100% of Medicare enrollment and fee-for-service claims data that is designed to make CMS data more readily available to support research. (6).

In 2010, there were more than 50 million Medicare beneficiaries. The study population included only those Medicare beneficiaries continuously enrolled in Medicare fee-for-service parts A and B, also known as original or traditional Medicare, for 2010. To obtain a study population of beneficiaries continuously enrolled in fee-for-service Medicare for the entire year, we excluded beneficiaries with any Medicare Advantage enrollment during the year, approximately 17 million beneficiaries, and beneficiaries who first became eligible for Medicare after January of the calendar year. We included beneficiaries who died during the year up to their date of death if they met other inclusion criteria. Our 2010 Medicare fee-for-service study population comprised approximately 31 million beneficiaries and represented approximately 66% of the total Medicare population in 2010.

We included the following 15 chronic conditions in our examination of multiple chronic conditions: Alzheimer's disease and related dementia, arthritis, asthma, atrial fibrillation, cancer (breast, colorectal, lung, prostate), chronic kidney disease, chronic obstructive pulmonary disease, depression, diabetes, heart failure, hyperlipidemia, hypertension, ischemic heart disease, osteoporosis, and stroke. We considered Medicare beneficiaries to have a chronic condition if the CMS administrative data had a claim indicating that beneficiaries received a service or treatment for the condition. For example, to identify a beneficiary with hyperlipidemia during 2010, at least 1 inpatient, skilled nursing facility, or home health claim or 2 outpatient or carrier claims had to include any of the following diagnosis codes from the *International Classification of Diseases, 9th Revision, Clinical Modification*: 272.0, 272.1, 272.2, 272.3, 272.4. Detailed information on the identification of chronic conditions in the CCW is available elsewhere (6). Chronic conditions were counted and grouped into 3 categories (0 or 1, 2 or 3, and 4 or more); multiple chronic conditions were defined as having 2 or more chronic conditions. We also identified the most common dyads of chronic conditions among beneficiaries with at least 2 chronic conditions, as well as the most common triads among beneficiaries with at least 3 chronic conditions.

We examined the treated prevalence of multiple chronic conditions by select Medicare beneficiary characteristics: sex, age in years (<65, 65–74, 75–84, and ≥85), dual Medicaid enrollment, also known as "dual eligible," and race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Asian or Pacific Islander, American Indian or Alaska Native, and non-Hispanic other race.). Because of known limitations in Medicare enrollment data for the classification of a beneficiary's race/ethnicity, we used the race/ethnicity variable available in the CCW that is based on a validated algorithm that improves the accuracy of race/ethnicity classification (7).

Results

Among our population of fee-for-service Medicare beneficiaries, 17.1% percent were younger than 65, who receive Medicare primarily as a result of having a disability, and 82.9% were aged 65 or older (Table 1). Female beneficiaries were older than male beneficiaries, particularly in the group aged 85 or older (17.8% of women compared with 10.7% of men). Our study population was 81.2% non-Hispanic white, 9.6% non-Hispanic black, 5.7% Hispanic, and 2.2% Asian or Pacific Islander. Race/ethnicity did not vary greatly between men and women. Approximately one-fifth (21.6%) of Medicare beneficiaries were also eligible for Medicaid; more female beneficiaries were dual-eligible than men.

Overall, 68.4% of Medicare beneficiaries had 2 or more chronic conditions and 36.4% had 4 or more chronic conditions (Table 2). The prevalence of multiple chronic conditions (≥2) increased with age and was higher for women than men across all age groups. Among beneficiaries younger than 65, 48.7% of men had multiple chronic conditions compared with 58.8% of women. In this age group for both men and women, the prevalence of multiple chronic conditions was highest for non-Hispanic blacks and Hispanics (approximately 50% for men and 60%–64% for women) and lowest for Asian/Pacific Islanders (46.8% for men and 50.3% for women). Among beneficiaries 65 and older,

69.1% of men had multiple chronic conditions compared with 73.4% of women. Among men 65 or older, the highest prevalence of multiple chronic conditions was among non-Hispanic whites (69.6%) and the lowest among Hispanics (63.1%), but among women in this age group, the highest prevalence was among non-Hispanic blacks (79.6%) and the lowest among Asian/Pacific Islanders and non-Hispanic whites. When we compared the prevalence of 4 or more chronic conditions with the prevalence of 2 or more, the patterns were similar for beneficiaries younger than 65 but varied for beneficiaries 65 or older (Table 2).

The prevalence of multiple chronic conditions, in particular 4 or more chronic conditions, increased with age (Table 3). Non-Hispanic black men had the highest prevalence of 4 or more chronic conditions among men aged 65 to 74 and 75 to 84 (34.2% and 46.9%, respectively). For men 85 or older, non-Hispanic whites, non-Hispanic blacks and Hispanics had similar rates of 4 or more chronic conditions (54.6%). For women across all older age groups, non-Hispanic black and Hispanic women had the highest prevalence of 4 or more chronic conditions.

In general, dual-eligible beneficiaries had a higher prevalence of multiple chronic conditions than nondual beneficiaries, and female dual-eligible beneficiaries had a higher prevalence than male dual-eligible beneficiaries at every age (Table 4). Among female dual-eligible beneficiaries, the prevalence of multiple chronic conditions was 81.2% for those aged 65 to 74, 88.0% for those aged 75 to 84, and 91.7% for those aged 85 or older. The prevalence of 4 or more chronic conditions was high for this vulnerable population; approximately two-thirds of beneficiaries that were dual-eligible and aged 85 or older (both men and women) had 4 or more chronic conditions.

Among beneficiaries with 2 or more chronic conditions, the most prevalent dyads included hypertension, hyperlipidemia, diabetes, and ischemic heart disease (Table 5). The most common dyad across all sex and age groups was hypertension and hyperlipidemia; however, among beneficiaries younger than 65, the diabetes and hyperlipidemia was also highly prevalent. Women differed from men in that depression and arthritis were present in the most common dyads. We examined triads of chronic conditions only for beneficiaries who had at least 3 chronic conditions. For beneficiaries younger than 65, the most common triad of chronic conditions was diabetes, hypertension, and hyperlipidemia; 35.4% of men and 32.0% of women had these 3 conditions (Table 6). Among beneficiaries 65 years or older, ischemic heart disease, hypertension, and hyperlipidemia was a common triad; 42.6% of men and 29.4% of women had these 3 conditions.

Summary

The magnitude of CMS data allowed us to examine multiple chronic conditions by relevant sociodemographic characteristics to identify the Medicare beneficiaries who may benefit most from targeted interventions and health care management strategies aimed at delivering health care in a more effective and efficient manner. More than 21 million Medicare fee-for-service beneficiaries had 2 or more chronic conditions in 2010, and more than 11 million had 4 or more. Our findings support the goals and objectives of the HHS Strategic Framework on multiple chronic conditions, specifically the fourth goal that addresses the need for research to fill knowledge gaps about the epidemiology of multiple chronic conditions (4). Our findings also demonstrate the variation in multiple chronic conditions across demographic groups. Because the number of multiple chronic conditions increases with age and because women generally live longer than men do, the prevalence of multiple chronic conditions is expected to be higher for women. We found that female beneficiaries had a higher prevalence of multiple chronic conditions than male beneficiaries across all age groups. We also found that the prevalence of multiple chronic conditions varied by race/ethnicity. Non-Hispanic black and Hispanic women often had the highest prevalence of multiple chronic conditions. Multiple chronic conditions were more prevalent among the vulnerable population of dual-eligible beneficiaries, who tend to have low incomes or disabilities and be aged 85 or older.

Other studies may have included a larger number and broader set of chronic conditions to estimate the prevalence of multiple chronic conditions (1,2,8). Our estimates were determined on the basis of guidelines established by the HHS Strategic Framework, which defines multiple chronic conditions as having 2 or more chronic conditions and identifies a proposed set of 20 common chronic conditions (9). Our study included 15 of the 20 proposed HHS conditions but excluded several behavioral and other illnesses that are included in the HHS Framework (ie, autism spectrum disorder, schizophrenia, substance abuse [drug and alcohol disorders], HIV, and hepatitis, as well as conditions considered chronic by other sources) (10).

Our study has limitations. We identified chronic conditions through administrative claims in which discrepancies in physician coding could have introduced errors or lack of treatment for a condition could have resulted in misclassification., Also, our findings are applicable to the Medicare fee-for-service population. The CCW does not contain managed care claims or encounter data; therefore, examining multiple chronic conditions among Medicare beneficiaries enrolled in Medicare Advantage plans was not possible. However, our study did include more than 31 million Medicare beneficiaries, including disabled beneficiaries and those dually eligible for Medicaid.

Multiple chronic conditions lead to poor health outcomes, the use of high-cost health services, and increased Medicare spending. Our findings should provide health policy makers and the public health research community a better understanding of the burden of chronic conditions among the Medicare fee-for-service population and provide preliminary insights into developing prevention and management strategies that will improve care and reduce costs for people with chronic conditions.

Acknowledgments

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Tables

Table 1. Study Population Characteristics for Medicare Fee-for-Service Beneficiaries, 2010

Characteristic	Total, % (N = 31,313,331)	Men, % (n = 13,845,487)	Women, % (n = 17,467,844)
Age, y			
<65	17.1	20.4	14.6

Characteristic	Total, % (N = 31,313,331)	Men, % (n = 13,845,487)	Women, % (n = 17,467,844)
≥65	82.9	79.7	85.4
65–74	39.3	41.3	37.6
75–84	29.0	27.7	30.0
≥85	14.6	10.7	17.8
Sex			
Male	44.2	NA	NA
Female	55.8	NA	NA
Race/ethnicity			
Non-Hispanic white	81.2	81.0	81.3
Non-Hispanic black	9.6	9.4	9.8
Hispanic	5.7	6.0	5.5
Non-Hispanic Asian/Pacific Islander	2.2	2.1	2.2
Non-Hispanic American Indian/Alaska Native	0.5	0.5	0.5
Non-Hispanic other race	0.9	1.0	0.8
Dual-eligibility [a]			
Yes	21.6	19.1	23.7
No	78.4	80.9	76.3

Abbreviation: NA, not applicable.
[a] Refers to Medicare beneficiaries who also were eligible for Medicaid.

Table 2. Percentage of Medicare Fee-for-Service Beneficiaries With Chronic Conditions, by Sex, Age, and Race/Ethnicity, 2010

Return

Characteristic	No. of Chronic Conditions		
	0 or 1	**2 or 3**	**≥4**
Total (N = 31,313,331)	31.5	32.0	36.4
Men			
Aged <65 (n = 2,817,692)	51.3	26.0	22.7
Non-Hispanic white	51.9	26.3	21.9
Non-Hispanic black	50.1	25.2	24.8
Hispanic	49.4	25.6	25.0
Non-Hispanic Asian/Pacific Islander	53.2	25.4	21.4
Non-Hispanic American Indian/Alaska Native	52.2	25.7	22.1
Non-Hispanic other race	51.0	26.3	22.7
Aged ≥65 (n = 11,027,795)	30.9	31.2	37.9
Non-Hispanic white	30.4	31.7	37.9
Non-Hispanic black	31.5	28.3	40.2
Hispanic	36.9	26.0	37.1
Non-Hispanic Asian/Pacific Islander	32.1	33.0	34.9

Characteristic	No. of Chronic Conditions		
	0 or 1	2 or 3	≥4
Non-Hispanic American Indian/Alaska Native	33.1	29.8	37.1
Non-Hispanic other race	37.8	30.9	31.3
Women			
Aged <65 (n = 2,548,598)	41.2	30.3	28.5
Non-Hispanic white	42.7	30.5	26.9
Non-Hispanic black	36.0	30.2	33.8
Hispanic	39.8	29.1	31.0
Non-Hispanic Asian/Pacific Islander	49.6	28.7	21.6
Non-Hispanic American Indian/Alaska Native	41.5	30.2	28.3
Non-Hispanic other race	46.8	29.4	23.8
Aged ≥65 (n = 14,919,246)	26.6	34.1	39.3
Non-Hispanic white	27.2	34.5	38.3
Non-Hispanic black	20.5	32.9	46.7
Hispanic	24.8	28.9	46.4
Non-Hispanic Asian/Pacific Islander	27.8	35.3	36.9
Non-Hispanic American Indian/Alaska Native	27.6	33.0	39.4
Non-Hispanic other race	34.3	33.1	32.6

Table 3. Percentage of Medicare Fee-for-Service Beneficiaries Aged ≥65 With Chronic Conditions, by Sex, Expanded Age, and Race/Ethnicity, 2010

Return

Characteristic	No. of Chronic Conditions		
	0 or 1	2 or 3	≥4
Total (n = 25,947,041)	28.4	32.9	38.7
Men			
Aged 65–74 (n = 5,719,126)	38.4	32.5	29.0
Non-Hispanic white	38.2	33.2	28.6
Non-Hispanic black	36.3	29.5	34.2
Hispanic	43.4	27.0	29.6
Non-Hispanic Asian/Pacific Islander	40.2	34.0	25.8
Non-Hispanic American Indian/Alaska Native	37.7	30.3	32.0
Non-Hispanic other race	42.0	31.7	26.3
Aged 75–84 (n = 3,830,486)	24.4	30.8	44.8
Non-Hispanic white	24.0	31.3	44.7
Non-Hispanic black	25.6	27.4	46.9
Hispanic	29.9	25.4	44.7
Non-Hispanic Asian/Pacific Islander	24.7	33.4	42.0
Non-Hispanic American Indian/Alaska Native	27.3	29.5	43.2
Non-Hispanic other race	28.0	30.2	41.8

Characteristic	No. of Chronic Conditions		
	0 or 1	2 or 3	≥4
Aged ≥85 (n = 1,478,183)	18.6	27.0	54.5
Non-Hispanic white	18.1	27.4	54.6
Non-Hispanic black	21.4	24.0	54.6
Hispanic	23.5	21.9	54.6
Non-Hispanic Asian/Pacific Islander	20.4	28.3	51.3
Non-Hispanic American Indian/Alaska Native	23.8	27.5	48.7
Non-Hispanic other race	27.1	23.5	49.4
Women			
Aged 65–74 (n = 6,571,342)	35.5	35.8	28.7
Non-Hispanic white	36.8	36.1	27.1
Non-Hispanic black	25.8	35.4	38.8
Hispanic	31.4	31.4	37.3
Non-Hispanic Asian/Pacific Islander	35.7	37.2	27.1
Non-Hispanic American Indian/Alaska Native	33.0	33.8	33.2
Non-Hispanic other race	40.5	34.7	24.8
Aged 75–84 (n = 5,247,284)	21.5	34.5	44.0
Non-Hispanic white	22.1	35.1	42.8
Non-Hispanic black	16.2	32.0	51.7
Hispanic	19.0	27.5	53.5
Non-Hispanic Asian/Pacific Islander	21.5	34.8	43.7
Non-Hispanic American Indian/Alaska Native	22.9	32.7	44.4
Non-Hispanic other race	26.5	33.4	40.2
Aged ≥85 (n = 3,100,620)	16.3	30.0	53.7
Non-Hispanic white	16.4	30.5	53.1
Non-Hispanic black	13.7	27.6	58.7
Hispanic	15.7	23.5	60.8
Non-Hispanic Asian/Pacific Islander	18.7	30.7	50.6
Non-Hispanic American Indian/Alaska Native	18.9	30.5	50.7
Non-Hispanic other race	26.5	25.9	47.6

Table 4. Percentage of Medicare Fee-for-Service Beneficiaries With Chronic Conditions by Sex, Age, and Dual-Eligibility Status[a] (N = 31,313,331), 2010

Return

Characteristic	No. of Chronic Conditions		
	0 or 1	2 or 3	≥ 4
Men			
Aged <65	51.3	26.0	22.7
Dual	49.2	27.1	23.7
Nondual	53.6	24.8	21.6

Characteristic	No. of Chronic Conditions		
	0 or 1	2 or 3	≥ 4
Men			
Aged 65–74	38.4	32.5	29.0
Dual	26.9	27.3	45.8
Nondual	39.8	33.1	27.1
Aged 75–84	24.4	30.8	44.8
Dual	18.2	24.0	57.8
Nondual	25.2	31.6	43.2
Aged ≥85	18.6	27.0	54.5
Dual	11.5	21.1	67.4
Nondual	19.6	27.8	52.6
Women			
Aged <65	41.2	30.3	28.5
Dual	38.3	30.4	31.3
Nondual	45.4	30.0	24.5
Aged 65–74	35.5	35.8	28.7
Dual	18.7	30.0	51.2
Nondual	38.4	36.8	24.8
Aged 75–84	21.5	34.5	44.0
Dual	12.0	25.9	62.1
Nondual	23.6	36.3	40.2
Aged ≥85	16.3	30.0	53.7
Dual	8.3	24.1	67.6
Nondual	18.9	32.0	49.2

[a] Dual eligibility refers to beneficiaries that are eligible to receive benefits under both the Medicare and Medicaid programs.

Table 5. Five Most Prevalent Chronic Condition Dyads Among Medicare Fee-for-Service Beneficiaries, by Sex and Age Group (N = 21,437,857), 2010[a]

Return

Dyad by Sex and Age Group	Prevalence, %
Men	
<65	
Hypertension and hyperlipidemia	45.2
Diabetes and hyperlipidemia	37.9
Ischemic heart disease and hyperlipidemia	31.0
Diabetes and hypertension	29.6
Ischemic heart disease and hypertension	24.6
≥65	
Hypertension and hyperlipidemia	56.0

Dyad by Sex and Age Group	Prevalence, %
Ischemic heart disease and Hyperlipidemia	44.6
Ischemic heart disease and hypertension	39.0
Diabetes and hyperlipidemia	33.9
Diabetes and hypertension	28.6
Women	
<65	
Hypertension and hyperlipidemia	39.9
Diabetes and hyperlipidemia	35.0
Depression and hyperlipidemia	29.7
Arthritis and hyperlipidemia	29.4
Diabetes and hypertension	27.5
≥65	
Hypertension and hyperlipidemia	53.5
Arthritis and hyperlipidemia	36.8
Ischemic heart disease and hyperlipidemia	32.9
Diabetes and hyperlipidemia	30.0
Arthritis and hypertension	26.7

a Medicare beneficiaries had to have at least 2 of the chronic conditions listed.

Table 6. Five Most Prevalent Chronic Condition Triads Among Medicare Fee-for-Service Beneficiaries, by Sex and Age Group (N = 16,481,558), 2010[a]

Return

Triad by Sex and Age Group	Prevalence, %
Men	
<65	
Diabetes, hypertension, and hyperlipidemia	35.4
Ischemic heart disease, hypertension, and hyperlipidemia	30.1
Diabetes, ischemic heart disease, and hyperlipidemia	25.3
Diabetes, ischemic heart disease, and hypertension	20.1
Diabetes, chronic kidney disease, and hyperlipidemia	18.8
≥65	
Ischemic heart disease, hypertension, and hyperlipidemia	42.6
Diabetes, hypertension, and hyperlipidemia	32.1
Diabetes, ischemic heart disease, and hyperlipidemia	25.9
Diabetes, ischemic heart disease, and hypertension	22.3
Arthritis, hypertension, and hyperlipidemia	21.8
Women	
<65	
Diabetes, hypertension, and hyperlipidemia	32.0

Triad by Sex and Age Group	Prevalence, %
Arthritis, hypertension, and hyperlipidemia	23.5
Depression, hypertension, and hyperlipidemia	23.1
Ischemic heart disease, hypertension, and hyperlipidemia	21.9
Diabetes, arthritis, and hyperlipidemia	19.9
≥65	
Arthritis, hypertension, and hyperlipidemia	29.6
Ischemic heart disease, hypertension, and hyperlipidemia	29.4
Diabetes, hypertension, and hyperlipidemia	27.6
Ischemic heart disease, arthritis, and hyperlipidemia	20.8
Diabetes, ischemic heart disease, and hyperlipidemia	18.3

[a] Medicare beneficiaries had to have at least 3 of the chronic conditions listed.

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PREVENTING CHRONIC DISEASE
PUBLIC HEALTH RESEARCH, PRACTICE, AND POLICY

Co-Occurrence of Leading Lifestyle-Related Chronic Conditions Among Adults in the United States, 2002-2009

Earl S. Ford, MD, MPH; Janet B. Croft, PhD; Samuel F. Posner, PhD; Richard A. Goodman, MD, MPH; Wayne H. Giles, MD, MSc

PEER REVIEWED

Abstract

Introduction
Public health and clinical strategies for meeting the emerging challenges of multiple chronic conditions must address the high prevalence of lifestyle-related causes. Our objective was to assess prevalence and trends in the chronic conditions that are leading causes of disease and death among adults in the United States that are amenable to preventive lifestyle interventions.

Methods
We used self-reported data from 196,240 adults aged 25 years or older who participated in the National Health Interview Surveys from 2002 to 2009. We included data on cardiovascular disease (coronary heart disease, angina pectoris, heart attack, and stroke), cancer, chronic obstructive pulmonary disease (emphysema and chronic bronchitis), diabetes, and arthritis.

Results
In 2002, an unadjusted 63.6% of participants did not have any of the 5 chronic conditions we assessed; 23.9% had 1, 9.0% had 2, 2.9% had 3, and 0.7% had 4 or 5. By 2009, the distribution of co-occurrence of the 5 chronic conditions had shifted subtly but significantly. From 2002 to 2009, the age-adjusted percentage with 2 or more chronic conditions increased from 12.7% to 14.7% (*P* < .001), and the number of adults with 2 or more conditions increased from approximately 23.4 million to 30.9 million.

Conclusion
The prevalence of having 1 or more or 2 or more of the leading lifestyle-related chronic conditions increased steadily from 2002 to 2009. If these increases continue, particularly among younger adults, managing patients with multiple chronic conditions in the aging population will continue to challenge public health and clinical practice.

Introduction

More than 70.0% of deaths in the United States and about 75.0% of health care spending costs are attributable to chronic diseases (1). The 5 leading causes of death — heart disease, cancer, chronic lower respiratory disease, cerebrovascular disease, and diabetes — accounted for more than half of all deaths in 2009 and represent a high percentage of the nation's health care costs. Other chronic conditions exact a heavy toll in terms of disease, disability, quality of life, and economic costs (1).

Although much is known about the descriptive epidemiology of these 5 leading causes of disease and death, less is known about how commonly these conditions occur together (2–6). Such data could inform clinicians, public health professionals, policy makers, and health insurers. In recognition of the challenges to public health and the health care system posed by people with multiple chronic conditions, the US Department of Health and Human Services (HHS)

developed a strategic framework for multiple chronic conditions (7,8). This framework outlines goals, objectives, and strategies to address clinical and public health system changes to improve health: maximize use of self-care and related services; provide information to public health, social services, and clinical care providers; and promote research to address gaps in knowledge.

Because the roots of the chronic conditions that are the leading causes of morbidity and mortality can be traced to lifestyle factors — principally smoking, diet, and physical activity — it is likely that, despite significant reductions in the prevalence of smoking, the continuing erosion of a low-risk lifestyle profile (9) could result in an increase in the incidence, prevalence, and co-occurrence of lifestyle-related chronic conditions. In response to the HHS strategic framework's recommendations for research to address the epidemiology of multiple chronic conditions (7,8), our study's main objectives were to assess the prevalence of co-occurrence of leading lifestyle-related chronic conditions and to examine trends in the prevalence of these conditions from 2002 to 2009.

Methods

We used data from the National Health Interview Survey (NHIS) for the years 2002 through 2009 (10). For each year, NHIS used a complex sampling design to select a sample representing the noninstitutionalized civilian population in the United States. Interviewers visited participants in their homes and conducted computer-assisted personal interviews. The response rates for participants in the sample adult component of the NHIS in consecutive years from 2002 through 2009 were: 2002, 74.3%; 2003, 74.2%; 2004, 72.5%; 2005, 69.0%; 2006, 70.8%; 2007, 67.8%; 2008, 62.6%; and 2009, 65.4%. Because this study involved the use of publicly available data sets, approval by an institutional review board was not required.

We included the following diagnosed conditions in our analyses: coronary heart disease, angina pectoris, heart attack, stroke, cancer, emphysema, chronic bronchitis, diabetes, and arthritis. These chronic conditions were selected on the basis of the following considerations: 1) these conditions are among the leading causes of death and disability, and 2) modifiable lifestyle factors are important determinants of these conditions. We used a set of NHIS questions to identify participants with chronic conditions (Appendix). Although the question about arthritic conditions includes some forms of arthritis that are unlikely to be heavily influenced by lifestyle-related behaviors, the predominant constituent of this disease is likely to be osteoarthritis, which does have a strong lifestyle-related component. We combined coronary heart disease, angina pectoris, heart attack, and stroke into a single category of cardiovascular disease. We also combined emphysema and chronic bronchitis into a single category of chronic obstructive pulmonary disease. For the question about diabetes, we considered participants who responded that they had borderline diabetes as not having diabetes. Participants who responded "do not know" to any question were classified as not having that condition. The analyses began with 2002 data because the question about arthritis was first included in the NHIS in that year.

Covariates were age, sex, race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, and non-Hispanic other), and educational status (did not graduate from high school, high school graduate or equivalent, education beyond high school). These covariates were selected because the prevalence of chronic conditions shows a strong age-related gradient and differs by sex, race/ethnicity, and educational status.

Analyses were restricted to adults aged 25 years or older because educational attainment is more stable in this age group than in younger age groups. Additionally, the prevalence of the selected conditions is lower among people under age 25. Age adjustment was performed by using the direct method and the distribution of 3 age groups from the projected year 2000 population (25–44 y, 45–64 y, and ≥65 y). Comparisons of estimates were made by using t tests for dichotomous variables and by using χ^2 tests for categorical variables with more than 2 levels. Estimates of the number of adults aged 25 years or older with 1 or more chronic conditions were calculated by multiplying the unadjusted proportion by intercensal estimates of the resident population of the United States. Tests for trend were conducted by using orthogonal linear contrasts and by using log-binomial regression models that included age, sex, race/ethnicity, and educational status as covariates. Data management was performed in SAS 9.3 (SAS Institute Inc, Cary, NC), and prevalence estimates and P values were calculated by using SUDAAN version 11.0.0 (Research Triangle Institute, Research Triangle Park, North Carolina). Sampling weights were used to produce estimates and conduct statistical tests.

Results

From a total of 198,710 participants aged 25 years or older in the 8 years (2002–2009), we included 196,240 participants in the analyses, after excluding participants with missing values for education (n = 2,290), cancer (n = 110), diabetes (n = 90), chronic obstructive pulmonary disease (n = 142), and arthritis (n = 138). During the period studied, mean age increased from 48.8 years to 49.8 years ($P < .001$); the percentage of non-Hispanic whites decreased from 74.5% to 70.0% ($P < .001$), and the percentage of participants who had completed high school or its equivalent increased from 83.9% to 85.6% ($P < .001$). The sex distribution remained relatively stable.

Of the 5 chronic conditions, the age-adjusted prevalence of cancer, diabetes, and arthritis increased significantly from 2002 to 2009 (Table 1). The prevalence of cardiovascular disease changed little in that same period, especially between 2004 and 2009. The prevalence of chronic obstructive pulmonary disease remained unchanged. The prevalence of having 1 or more, 2 or more, and 3 or more conditions increased significantly.

In 2002, an unadjusted 63.6% of participants did not have any of the 5 leading chronic conditions; 23.9% had 1, 9.0% had 2, 2.9% had 3, and 0.7% had 4 or more (Table 2). By 2009, the distribution of the number of chronic conditions had shifted subtly but significantly for the total study population ($P < .001$) and in the 2 oldest age groups. Although significant, the absolute change was small. The age-adjusted percentage of participants who had at least 2 chronic conditions increased significantly, from 12.7% in 2002 to 14.7% in 2009 ($P < .001$) (Table 1). After adjusting for age, sex, race/ethnicity, and educational status, the increase remained significant (prevalence ratio per year, 1.03; 95% confidence interval, 1.02–1.03).The prevalence increased in all other sociodemographic groups except among Non-Hispanic other participants. The largest relative increases occurred among participants aged 25 to 44 years and those who had graduated from high school or received an equivalent degree.

The unadjusted percentage of participants who had at least 1 chronic condition increased from 36.4% in 2002 to 40.1% in 2009. The estimated number of US adults with 1 or more self-reported chronic conditions increased from approximately 67.9 million in 2002 to 81.3 million in 2009 (Figure). Of the 13.4 million increase, about 6.9 million was due to the increase in prevalence and 6.4 million to population growth. Furthermore, the number with 2 or more self-reported chronic conditions increased from approximately 23.4 million in 2002 to 30.9 million in 2009, and the number with 3 or more self-reported chronic conditions increased from approximately 6.7 million in 2002 to 9.3 million in 2009.
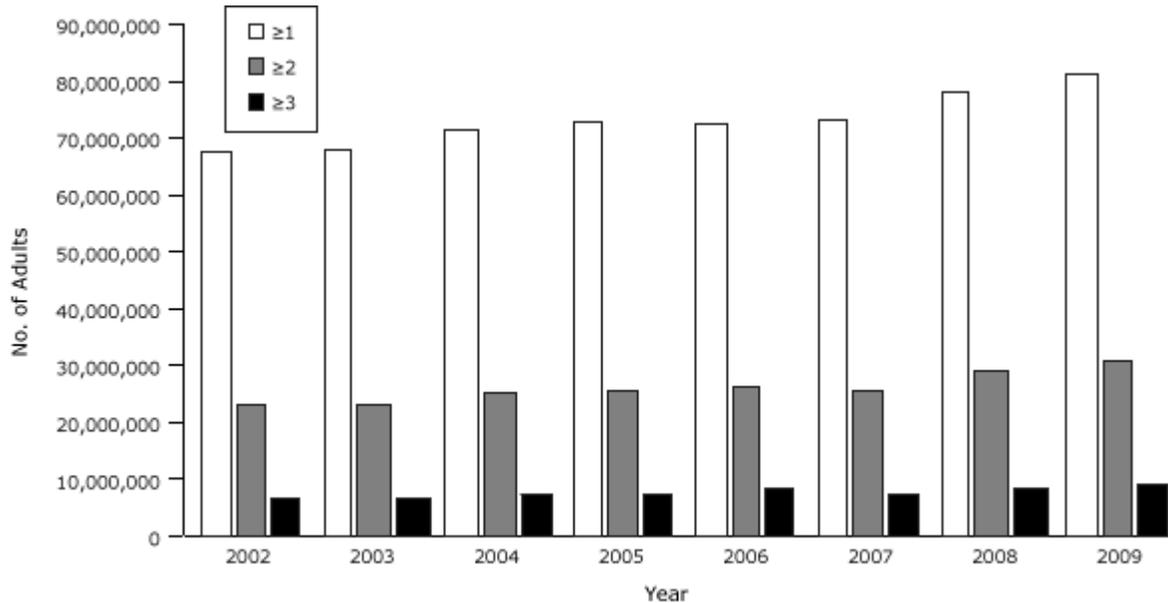
Figure. Estimated numbers of US adults aged 25 years or older with self-reported, co-occurring major lifestyle-related chronic conditions, National Health Interview Survey, 2002-2009 (10). [A tabular version of this figure is also available.]

The 5 leading chronic conditions form 32 possible mutually exclusive combinations. After age-adjustment, the most common single condition was arthritis (13.3% in 2002 and 13.0% in 2009). The most common combinations of 2 conditions were cancer and arthritis (2.1% in 2002 and 2.2% in 2009), cardiovascular disease and arthritis (2.0% in 2002 and 2.2% in 2009), and diabetes and arthritis (1.5% in 2002 and 2.2% in 2009). The most common combination of 3 conditions was cardiovascular disease, diabetes, and arthritis (0.9% in 2002 and 1.0% in 2009).

Large percentages of adults who had 1 of the 5 chronic conditions also reported having 1 or more additional chronic conditions (Table 3). For participants who reported having cardiovascular disease, chronic obstructive pulmonary disease, or arthritis, the age-adjusted percentage of adults reporting at least 1 additional chronic condition increased significantly from 2002 to 2009 (Table 3). For participants who reported having either cancer or diabetes with at least 1 additional condition, no such trend was evident.

Discussion

Unhealthy lifestyle behaviors are responsible for much of the disease and death from the leading chronic diseases (11,12). Our analysis of recent national data, which shows that about 1 in 7 adults had at least 2 of 5 chronic conditions

associated with disease and death, helps to address a gap in the existing knowledge base. On the basis of our analysis, an estimated 30.9 million adults had 2 or more major lifestyle behavior-related chronic conditions in 2009. Furthermore, the prevalence of having at least 2 such chronic conditions increased by an average 0.26% per year from 2002 to 2009 (P = .011), with significant increases in cancer (P < .001), diabetes (P < .001), and arthritis (P = .021) likely contributing to the increase.

Because certain lifestyle behaviors are risk factors for many chronic conditions, including the 5 leading chronic diseases included in this study, improving the behavioral risk factor profile of the population could lower the prevalence of these conditions and decrease their co-occurrence. For example, enormous progress has been made in reducing the prevalence of smoking in the United States (13), and the stable prevalence estimates for chronic obstructive pulmonary disease are likely a reflection of this. However, chronic obstructive pulmonary disease remains the only major chronic disease that has not experienced a large decline in mortality since 1999 (14).

The heavy toll exacted by the co-occurrence of multiple chronic conditions is demonstrated by its effect on death, quality of life, hospitalizations, outpatient visits, health care costs, and other health care metrics (2,4–6,15–17). We found that the largest relative increase in the percentage of adults with 2 or more chronic conditions occurred in the youngest group, albeit over a small baseline. If sustained, this increase would have implications for the health of the nation in future decades.

Not only does the number of chronic conditions have serious implications for disease, death, and health care costs, but specific combinations of chronic conditions may also negatively or positively influence health and economic outcomes. Specific combinations of chronic conditions may affect quality of life (18,19), functional recovery (20), disability (21), health care use (22), health care costs (17,23), and polypharmacy (the use of multiple medications by a patient) (24). Furthermore, combinations of comorbidity may also affect survival after serious conditions such as heart failure (25). For example, the combination of chronic kidney disease and dementia was associated with greatly reduced survival among hospitalized patients with heart failure. A previous analysis of NHIS data that included 9 chronic conditions found that the combinations of hypertension and diabetes, hypertension and heart disease, and hypertension and cancer were the most common 2-condition combinations (26). An analysis of German insurance claims data showed that the most common combination of 3 conditions among 46 chronic conditions included in the study was hypertension, lipid disorder, and chronic low back pain (27). In comparison, we found that the combination of cardiovascular disease and arthritis was the most common 2-condition combination, and the combination of cardiovascular disease, diabetes, and arthritis was the most common 3-condition combination.

Our study has limitations. First, the self-reported nature of the data likely led to an underestimate of the true prevalence of the chronic conditions. For example, the prevalence of self-reported diabetes underestimates the gold standard prevalence estimated from self-reported data and blood measurements of glucose by about a third to a half (28). Recent national data about the trends of cardiovascular disease, cancer, chronic obstructive pulmonary disease, and arthritis based on information other than self-report are not available. Therefore, our results require confirmation with other data based on more rigorous assessments of chronic conditions. Second, we were not able to measure undiagnosed disease; therefore, an alternative explanation of the increase in the percentage of adults having 1 or more chronic conditions is that awareness of these conditions may have improved in the face of a stable prevalence of conditions, thus contributing to the apparent trend. However, the increase in the prevalence of diabetes noted in our study is consistent with data from the National Health and Nutrition Examination Survey in which questionnaires were complemented with measurements of plasma glucose (28).

Another possible limitation is that the decrease in response rates during the study period raises the possibility that the results may have been subject to a bias. If participants who increasingly refused to participate were healthier than participants who opted to participate, a trend showing an increase in multiple chronic conditions may have represented an artifact. However, the lack of information about the health of adults who refused to participate precludes a thorough exploration of this possibility.

The reports of other investigators continue to shape and strengthen our knowledge base characterizing the prevalence and heterogeneity of multiple chronic conditions. Various studies provide estimates of the prevalence of multiple chronic conditions (Table 4). A recent NHIS analysis of data on 9 chronic conditions showed that 21.0% of adults aged 45 to 64 years and 45.3% of adults aged 65 years or older had 2 or more chronic conditions (26). That study examined only adults aged 45 or older. In comparison, we found that 14.7% of adults had 2 or more lifestyle-related chronic conditions in 2009, and 4.5% had 3 or more. Many of these analyses used different sets of chronic conditions in establishing their indices. Prevalence estimates of multiple chronic conditions are clearly influenced by the number of conditions that are considered: the more conditions that are included in a study, the higher the estimates will be. Thus, because we restricted our analyses to 5 chronic conditions that are leading sources of disease and death and that are strongly related to lifestyle factors, the estimates of the noninstitutionalized US population generated in our study are lower than those found elsewhere. Consequently, our analyses yield a complementary perspective on a subset of multiple chronic conditions that had not been previously considered.

Our results provide a new dimension in understanding the increasing burden of chronic diseases in the United States. An increasing percentage of adults are living with 2 or more chronic conditions, and more young people are reporting multiple chronic conditions. These trends, if unabated, could increase the nation's future health care costs and required health care resources. In particular, several researchers report that increases in the rate of hospitalizations and medical expenditures are related to increases in the number of co-occurring chronic conditions (2,5,6).

The high, increasing prevalence of lifestyle-related multiple chronic conditions provides yet another reason to aggressively promote population-based actions to improve lifestyle behaviors. In many parts of the country, efforts are under way to implement systems and environmental change in schools, communities, and workplaces. A prominent example of such efforts is the Community Transformation Grants program that seeks to build healthier communities and lifestyles through evidence-based approaches to reduce chronic diseases (29).

Although clinicians routinely manage patients who have more than 1 chronic condition, the growing prevalence of patients with multiple chronic conditions may pose additional challenges. First, the large numbers of prescriptions that may be required by such patients may affect a patient's adherence to taking medications. Second, the risk for adverse reactions from possible interactions among medications increases as the numbers of medications that patients are required to take increases. Finally, the presence of comorbidities may limit the clinician's therapeutic options. Thus, the coordination of care in such patients poses a serious clinical challenge.

Additional multifaceted research concerning the epidemiology of lifestyle-related multiple chronic conditions is needed to build a more complete understanding of this area. First, studies using large administrative databases would allow a fuller accounting of lifestyle-related conditions and provide sufficient power to characterize the prevalence of unique combinations of conditions. Second, determinants of lifestyle-related chronic diseases require further study. Third, characterizing potential health disparities is essential to designing and directing relevant interventions. Fourth, studies describing the effect of multiple chronic conditions on health-related quality of life and economic studies concerning the direct and indirect costs exacted on the economy by people with multiple chronic conditions are also useful in gauging the clinical and public health burden of these conditions. Fifth, research is needed to characterize the proportions of patients with multiple chronic conditions who are candidates for nonpharmacological treatments and to define possible contraindications or special considerations for subsets of patients. Clinical research examining optimal therapeutic lifestyle treatment models, including optimal composition of therapeutic lifestyle modification and delivery mode, for patients with different combinations of multiple chronic conditions can provide clinicians with evidence-based approaches to managing such patients. Finally, past studies of people with a predominant condition can be useful to inform the development of a generation of studies focused on people with multiple chronic conditions.

The results of our study suggest that the burden of selected major lifestyle-related chronic conditions is increasing slowly but steadily in the United States, a trend that has serious implications for health care costs and the future delivery of health care in the United States. The recently developed HHS strategic framework with national-level strategies for managing patients with multiple chronic conditions is a timely and prudent coordinated response to an evolving public health challenge (7,8). Continued surveillance of the trend in lifestyle-related chronic conditions with data from the NHIS and other data systems can provide critical feedback to track the evolution of the temporal, spatial, and sociodemographic dimensions of multiple lifestyle-related chronic conditions that will allow timely adjustments to the nation's health care system to mitigate the effect of this mounting public health concern.

Acknowledgments

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Tables

Table 1. Age-Adjusted Percentages (Standard Error) of Adults Aged ≥25 Years Who Report Having ≥1, ≥2, or ≥3 Leading Lifestyle-Related Chronic Conditions or Individual Conditions and Who Have ≥2 Self-Reported Leading Lifestyle-Related Chronic Conditions[a] by Selected Sociodemographic Characteristics, by Year, National Health Interview Survey, 2002-2009

Variable	2002 (N = 27,279)	2003 (N = 27,168)	2004 (N =27665)	2005 (N = 27,961)	2006 (N = 21,274)	2007 (N = 20,636)	2008 (N = 19,502)	2009 (N = 24,755)	P Value[b]
	% (SE)								
Chronic disease									
Cardiovascular disease	8.7 (0.2)	8.4 (0.2)	9.0 (0.2)	9.1 (0.2)	8.9 (0.2)	8.7 (0.2)	9.1 (0.2)	9.1 (0.2)	.075
Cancer	8.1 (0.2)	7.5 (0.2)	8.0 (0.2)	8.4 (0.2)	8.0 (0.2)	8.2 (0.2)	8.8 (0.2)	9.0 (0.2)	<0.001
Diabetes	7.4 (0.2)	7.4 (0.2)	7.9 (0.2)	8.3 (0.2)	8.6 (0.2)	8.6 (0.2)	9.0 (0.2)	9.7 (0.2)	<.001
Chronic obstructive pulmonary disease	5.9 (0.2)	5.3 (0.2)	5.8 (0.2)	5.6 (0.2)	5.9 (0.2)	4.9 (0.2)	5.6 (0.2)	6.0 (0.2)	.990
Arthritis	23.5 (0.3)	24.2 (0.3)	24.4 (0.3)	24.0 (0.3)	23.5 (0.3)	23.1 (0.4)	24.9 (0.3)	25.1 (0.4)	.021
≥1 Condition	36.5 (0.3)	36.1 (0.3)	37.3 (0.3)	37.5 (0.3)	36.6 (0.4)	36.3 (0.4)	38.1 (0.4)	38.7 (0.4)	<.001
≥2 Conditions	12.7 (0.2)	12.4 (0.2)	13.2 (0.2)	13.2 (0.2)	13.3 (0.3)	12.8 (0.3)	14.2 (0.3)	14.7 (0.3)	<.001
≥3 Conditions	3.6 (0.1)	3.6 (0.1)	3.8 (0.1)	3.9 (0.1)	4.2 (0.2)	3.7 (0.2)	4.2 (0.1)	4.5 (0.2)	<.001

Variable	2002 (N = 27,279)	2003 (N = 27,168)	2004 (N =27665)	2005 (N = 27,961)	2006 (N = 21,274)	2007 (N = 20,636)	2008 (N = 19,502)	2009 (N = 24,755)	P Value[b]
	% (SE)								
Sociodemographic characteristics									
Age, y									
25–44	2.5 (0.2)	2.2 (0.1)	2.8 (0.2)	2.8 (0.2)	2.6 (0.2)	2.5 (0.2)	3.1 (0.3)	3.2 (0.2)	.003
45–64	13.9 (0.5)	13.6 (0.4)	13.6 (0.4)	13.9 (0.4)	14.1 (0.5)	13.3 (0.5)	15.4 (0.5)	16.1 (0.5)	<.001
≥65	34.6 (0.7)	34.6 (0.7)	36.9 (0.7)	36.4 (0.7)	37.2 (0.9)	36.1 (0.9)	38.4 (0.9)	39.6 (0.8)	<.001
Sex[c]									
Men	12.4 (0.3)	12.0 (0.3)	13.1 (0.3)	12.4 (0.3)	12.8 (0.4)	12.3 (0.4)	12.9 (0.4)	14.7 (0.4)	<.001
Women	13.1 (0.3)	12.8 (0.3)	13.5 (0.3)	13.9 (0.3)	13.9 (0.4)	13.3 (0.3)	15.4 (0.4)	14.9 (0.4)	<.001
Race/ethnicity[c]									
Non-Hispanic white	13.0 (0.2)	13.0 (0.2)	13.6 (0.3)	13.6 (0.2)	13.9 (0.3)	13.2 (0.3)	14.9 (0.4)	15.5 (0.3)	<.001
Non-Hispanic black	13.8 (0.6)	12.6 (0.6)	13.0 (0.6)	13.7 (0.7)	14.3 (0.7)	14.1 (0.6)	14.2 (0.7)	16.0 (0.7)	.002
Hispanic	9.6 (0.7)	8.4 (0.5)	11.2 (0.7)	10.9 (0.6)	10.5 (0.7)	10.4 (0.6)	11.8 (0.6)	11.3 (0.7)	.002
Non-Hispanic other	8.5 (1.2)	8.5 (1.1)	10.2 (1.1)	8.1 (1.0)	8.1 (0.9)	8.8 (1.0)	9.5 (1.0)	7.8 (0.8)	.739
Education[c]									
Less than high school graduate or equivalent	16.6 (0.6)	15.1 (0.5)	17.3 (0.6)	17.0 (0.6)	17.1 (0.7)	17.8 (0.7)	18.5 (0.8)	18.9 (0.8)	<.001
High school graduate or equivalent	13.2 (0.4)	12.4 (0.4)	13.4 (0.4)	13.4 (0.4)	13.5 (0.5)	12.8 (0.5)	15.7 (0.5)	16.1 (0.5)	<.001
>High school	11.3 (0.3)	11.6 (0.3)	11.9 (0.3)	11.9 (0.3)	12.0 (0.3)	11.2 (0.4)	12.2 (0.4)	12.9 (0.4)	.006

[a] Chronic conditions include cardiovascular disease (coronary heart disease, myocardial infarction, angina, or stroke), diabetes, cancer, chronic obstructive pulmonary disease, and arthritis.
[b] P values for linear trend were calculated by using orthogonal polynomial contrasts.
[c] Adjusted for age.

Table 2. Unadjusted Distribution of Co-Occurrence of 5 Major Lifestyle-Related Chronic Conditions Among US Adults Aged 25 Years or Older in 2002 and 2009, by Age Groups, National Health Interview Survey (10)

Return

Age, y	No. of Chronic Conditions	2002, %	2009, %	P Value[a]
≥25	0	63.6	59.9	<.001
	1	23.9	24.0	
	2	9.0	10.7	
	3	2.9	3.7	

	4 or 5	0.7	0.9	
	0	83.6	82.8	
	1	13.9	14.1	
25-44	2	2.1	2.6	.187
	3	0.4	0.5	
	4 or 5	0.1	0.0	
	0	56.4	52.7	
	1	29.7	31.2	
45-64	2	10.4	12.0	.001
	3	2.8	3.3	
	4 or 5	0.6	0.8	
	0	28.2	25.5	
	1	37.2	34.9	
≥65	2	23.0	25.4	<.001
	3	9.3	11.2	
	4 or 5	2.3	3.0	

[a] *P* value from χ^2 test.

Table 3. Age-Adjusted Percentages (Standard Error) of Having One or More Additional Self-Reported Chronic Conditions[a] Among Adults Aged ≥25 Years Who Have a Chronic Condition, by Year, National Health Interview Survey, 2002-2009

Return

	Cardiovascular Disease	Chronic Obstructive Pulmonary Disease	Cancer	Diabetes	Arthritis
Year		% (SE)			
2002	56.6 (2.1)	54.0 (1.4)	47.6 (1.6)	54.1 (1.8)	35.0 (0.8)
2003	58.4 (2.2)	58.4 (1.5)	45.1 (1.6)	49.9 (1.6)	33.1 (0.7)
2004	60.3 (1.8)	58.6 (1.5)	47.7 (1.7)	50.9 (1.6)	35.4 (0.8)
2005	61.0 (2.1)	57.7 (1.5)	47.8 (1.7)	49.7 (1.6)	36.0 (0.8)
2006	61.9 (2.5)	56.6 (1.9)	48.7 (1.9)	48.3 (1.6)	37.4 (1.1)
2007	58.9 (2.4)	60.7 (2.1)	44.3 (2.2)	48.2 (2.0)	35.4 (1.0)
2008	64.9 (2.4)	58.2 (1.9)	48.2 (1.9)	55.9 (2.0)	37.9 (1.1)
2009	68.2 (2.3)	58.5 (1.9)	46.7 (1.9)	52.5 (2.0)	39.2 (0.9)
P value[b]	<.001	.005	.782	.591	<.001

[a] Chronic conditions include cardiovascular disease (coronary heart disease, myocardial infarction, angina, stroke, or hypertension), diabetes, cancer, chronic obstructive pulmonary disease, and arthritis.
P values for linear trend were calculated by using orthogonal polynomial contrasts.

Return

Table 4. Studies Estimating Prevalence of Chronic Conditions in the United States

Study	Data Source	Ages	Conditions Examined	No. of Chronic Conditions	Prevalence (%)
Fryback et al 1993 (30)	Beaver Dam Health Outcomes Study, 1991-92	45–89 y	28 conditions	0	18.3
				1	20.2
				2	20.2
				3	16.8
				4	11.7
				≥5	12.8
Hwang et al 2001 (31)	Medical Expenditure Panel Survey 1996	All ages	2 physician panels reviewed ICD-9 codes: 111 ICD-9 codes in children, 177 ICD-9 codes in adults, 259 clinical classification system categories	0	59.3
				1	23.7
				2	9.6
				≥3	7.4
Wolff et al 2002 (2)	Medicare 1999	≥65 y	Reviewed ambulatory diagnostic groups to identify ICD-9-CM codes	0	18.0
				1	17.3
				2	21.8
				3	18.8
				≥4	24.1
Anderson and Horvath 2004 (3)	Medical Expenditure Panel Survey 1998	All ages	2 physician panels reviewed ICD-9 codes	**Men**	
				1	22.0
				2	9.0
				3	4.0
				4	2.0
				≥5	2.0
				Women	
				1	23.0
				2	12.0
				3	7.0
				4	3.0
				≥5	3.0
Partnership for Solutions 2004 (32)	Medical Expenditure Panel Survey 2001	All ages	2 physician panels reviewed ICD-9 codes	**Men**	
				1	24.0
				2	10.0
				3	5.0
				4	3.0
				≥5	2.0
				Women	
				1	24.0
				2	12.0
				3	8.0

Study	Data Source	Ages	Conditions Examined	No. of Chronic Conditions	Prevalence (%)
				4	4.0
				≥5	4.0
Schneider et al 2009 (5)	Medicare fee-for service 2005	<65–>85 y	21 chronic conditions	0	50.7
				1	29.0
				2	12.7
				≥3	7.6
Paez et al 2009 (6)	Medical Expenditure Panel Survey 2005	All ages	A physician panel reviewed ICD-9 codes: 111 ICD-9 codes in children, 177 ICD-9 codes in adults	0	56.3
				1	19.7
				2	10.7
				≥3	13.3
Anderson 2010 (33)	Medical Expenditure Panel Survey 2006	All ages	2 physician panels reviewed ICD-9 codes	1	22.3
				2	11.8
				3	7.1
				4	3.9
				≥5	4.8
Centers for Medicare and Medicaid Services 2011 (17)	Medicare fee-for-service 2008	<65–>85 y	15 chronic conditions	0-1	33.0
				2-3	33.0
				4	13.0
				5	9.0
				≥6	12.0

Appendix. Questions From the National Health Interview Survey[a] Used to Identify Participants With a Chronic Condition.

Return

Have you ever been told by a doctor or other health professional that you had coronary heart disease?

Have you ever been told by a doctor or other health professional that you had angina, also called angina pectoris?

Have you ever been told by a doctor or other health professional that you had a heart attack (also called myocardial infarction)?

Have you ever been told by a doctor or other health professional that you had a stroke?

Have you ever been told by a doctor or other health professional that you had cancer or a malignancy of any kind?

Have you ever been told by a doctor or other health professional that you had emphysema?

Have you ever been told by a doctor or health professional that you have diabetes or sugar diabetes?

Have you ever been told by a doctor or other health professional that you have some form of arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia?

During the PAST 12 MONTHS, have you been told by a doctor or other health professional that you had chronic bronchitis?

[a] National Health Interview Survey (10).

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PREVENTING CHRONIC DISEASE
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The Dimensions of Multiple Chronic Conditions: Where Do We Go From Here? A Commentary on the Special Collection of *Preventing Chronic Disease*

Robert B. Wallace, MD, MsC; Marcel E. Salive, MD, MPH

The articles in this issue address the high prevalence and substantial clinical burden of multiple chronic conditions (MCC) among adults. All of these papers further the goals outlined in the US Department of Health and Human Services (DHHS) MCC Strategic Framework (1,2). The article by Goodman, Posner, Huang, Parekh, and Koh (3) introduces the topic and describes the origin of the 20 conditions originally selected by the DHHS for emphasis. The authors also provide a conceptual model for standardizing data approaches to the analyses of MCC. The remaining articles document various distributions and rates of MCC on the national level with analyses of important federal health surveys and databases: Lochner and Cox analyzed Medicare claims data (4); Ashman and Beresovsky analyzed 1 year of the National Ambulatory Medical Care Survey (5); Ford, Croft, Posner, Goodman, and Giles explored the prevalence of lifestyle-related MCC from the National Health Interview Survey (6); Steiner and Friedman examined MCC-related acute care hospitalization rates from the Nationwide Inpatient Sample of the Healthcare Cost and Utilization Project (7); Soni and Machlin analyzed the costs of certain MCC from the Medical Expenditure Panel Survey (8), and Ward and Schiller estimated MCC rates from the National Health Interview Survey (9).

Each of these articles explores different data sources, and despite the variation in disease and condition combinations selected, these articles show the ability of many US federal datasets to address and better characterize the scope of MCC as well as incorporate important MCC-related issues such as the effect of MCC on the cost of clinical care and the extent of clinical care use. Collecting data from multiple sources, including population surveys and claims data, and from both institutional settings and ambulatory primary care allows triangulation and better comprehension of this issue. Although the challenges of the complex MCC patient have long been recognized, these articles highlight national prevalence rates and implications for prevention, diagnosis, management, and important outcomes. Here we suggest some directions for addressing MCC in the future and offer suggestions on how to address this complexity on the basis of the work presented in this collection and the growing body of emerging information on MCC.

Defining Diseases in the Context of MCC

A detailed exposition on defining a distinct disease or condition is beyond the scope of this discussion, but important considerations abound. Here we examine some MCC-relevant issues related to such definitions. In this collection, Goodman et al have contributed importantly to solving this problem (3), and even the terms used to describe MCC have varied (10); however, many pragmatic questions remain.

Defining a chronic condition and MCC requires careful consideration. Many have defined such conditions on the basis of duration as conditions lasting at least 6 to 12 months; in the DHHS Framework (1), a chronic condition is defined as a condition lasting 12 or more months and requiring ongoing medical care. But how should remittent diseases such as asthma, certain mental illnesses, or multiple sclerosis be considered? What about late recurrences of tumors thought to be controlled? In our view, period prevalence rates are not sufficient.

Another issue is whether to consider many infectious diseases as chronic conditions. Goodman et al (3) note the chronic nature of HIV infection, but other important chronic infections exist, such as tuberculosis and hepatitis B and C. In our view these conditions, and their co-occurring illnesses, encumber all of the management challenges of important noninfectious diseases such as coronary heart disease, cancer, diabetes, or stroke-related disability (11,12).

These issues dovetail with the challenges of defining MCC, which are highlighted in the articles in this collection and in other articles (13–15).

How do you deal with complex clinical manifestations of conditions, such as signs (visually observable patient abnormalities), symptoms (abnormal perceptions of illness that only the patients can report, such as pain, itching, fatigue, depressive feelings), and syndromes (clusters of signs, symptoms, and other clinical phenomena that may or may not be indicative of a specific underlying disease)? Do these belong in the study of MCC? Our answer is that these signs, symptoms, and syndromes must be carefully and systematically addressed, since many never reach the level of a specific diagnosable "disease" with an ICD code; however, they can cause considerable suffering and require health care.

An "individual" disease — is it one or many? Many diseases that are regarded as single entities exhibit diverse organ involvement and, over time, special and distinct clinical manifestations and sequellae. For example, diabetes mellitus is clearly associated with coronary heart disease, renal insufficiency, retinal disease, skin abnormalities, and other important clinical problems. Should each of these be considered separately in the multiplicity of MCC or as part of 1 condition for analytical purposes? Again, it depends on the question being addressed.

How should the "secondary outcomes" of a variety of biologically unrelated chronic conditions be considered and counted? Many chronic conditions clearly lead to a variety of unfortunately common and functional outcomes that are not necessarily related to the underlying causes or pathogenesis of the primary disease, including falls, cognitive impairment, anemia, malnutrition, polypharmacy, sleep disorders, and sexual dysfunction. Among older persons, some of these conditions have been called "geriatric syndromes" (16). Often, statistically significant associations between various primary index illnesses and these secondary outcomes are present, even if the latter are not biologically related to the primary condition. The complex downstream pathways for additional chronic illnesses, whether they are biologically related or less specific secondary conditions, may all be clinically important; preventive interventions may be as important as managing the primary condition (17).

In counting diseases and conditions, at least 2 other issues remain. First, how should adverse effects of therapy be counted? They can be costly and deadly (18). Second, how should disease risk factors such as hypertension or hypercholesterolemia be considered, and the physiological changes of aging, such as osteopenia or sarcopenia? These "nondiseases" require further consideration as MCC (19,20).

Data Quality in Studying MCC

There are many issues that impinge on the quality of data used to assess MCC that relate to all population data on disease occurrence, as well as to their risk factors, prevention, treatment, and outcomes. Here are some of the central ones:

Taxonomy and nomenclature

Maintaining a consensual, standard nomenclature and taxonomy is, of course, critical for quantifying diseases and conditions in community and health care settings, and equally critical for counting disease co-occurrences and permutations of MCC as well as understanding their outcomes (21). This is particularly important for both health insurance claims data and clinical records, because of variation in medical terminology, so-called "natural language," and coding practices. The International Classification of Diseases (ICD) provides a standard nomenclature for most medical conditions (22).

New research on taxonomy and nomenclature will not only change the taxonomic systems currently in place; it will improve the understanding of disease causation and management. An important example of this is the ability to empirically cluster various individual diseases in terms of how "close" they are to each other with respect to their known pathogenic mechanisms (23), thus allowing a perspective on the preventability of various combinations of MCC. This may lead to some possible "lumping" of conditions that may seem heterogeneous but have common causes and possible common management. This is contrary to current taxonomic activities, where more basic science has led to more "splitting" (disaggregation) of diseases into more and finer diagnostic rubrics.

Medical care access and disease surveillance

Not all persons with diseases have full and equal access to medical care, and thus some diseases and conditions are never identified. Even where full care access is present, professional variation in disease screening, diagnosis, and treatment will occur among individual practitioners and across health care institutions and systems (24). Another source of variation in MCC, so-called "diagnostic bias," may occur because clinically managing one illness may increase the likelihood that another will be identified as a result of more frequent exposure to medical services (25). In MCC analytical studies, disease ascertainment may be enhanced for certain chronic conditions by searching for certain prescription drug or clinical procedures that indicate illnesses that have not per se been noted.

The problem of self-reported conditions

In the United States, there are no comprehensive, clinical record-based datasets for all ages and regions. Even the robust US Medicare databases do not currently have diagnostic data for people in managed care programs, and Medicare does not generally cover dental care (26). This problem is exacerbated by the frequent use of multiple, independent health care providers. In part because of these gaps in health data, federal and other health surveys employ self-reported conditions. These methods have both strengths and weaknesses (27), but they will never provide the fine detail and accuracy on personal conditions and medical procedures needed for full exploration of MCC.

What diseases and conditions should be included in the study of MCC? A remaining issue is that given the thousands of rubrics in the ICD, which are most important? The DHHS has selected 21 chronic conditions to begin emphasizing the problem (1). These are important conditions with public health implications. Many of the most serious and fatal conditions in Western societies are included in this list, but many other important conditions are not. While thoughtful prioritization is programmatically necessary, it may ignore the large number of less common diseases that cause great personal and family suffering. In the future, other priority lists may select diseases based on maximal preventability or the most application to diverse public health programs. Also, the increasing use of electronic health records, including narrative text, should enhance the ability to detect and evaluate large numbers of MCC (21).

Work on the application of MCC is proceeding rapidly. Alternative conceptualizations of MCC have been offered (28). Health care clinics and systems have been working to integrate the multimorbid patient into both primary and specialty care (29–31), including geriatrics and palliative care (32,33). More attention is being paid to the role of appropriate outcome measures sensitive to the MCC patient (19). The necessity of applying existing and newly developed clinical guidelines to the challenges of MCC is also being appreciated (34). Identifying the implications of MCC for health profession education is also occurring (33).

In the end, however, the value of collecting data on MCC, as with all scientific information, depends on how it will be used: whether it is understanding the natural history of diseases, applying clinical preventive interventions, identifying high-risk populations, making clinical or administrative decisions, counseling patients, or planning and evaluating large public health and prevention policies. It appears that much of what we know about health today derives from studying 1 disease at a time. Only recently has this begun to change. Public health has been a leader in addressing the clustering and effect of diverse conditions and MCC. For public health, the challenge will be to define preventive strategies that effectively deal with MCC, both before and after the doctor arrives. Most challenging of all may be developing preventive strategies in the community that can favorably alter long-term clinical outcomes, and perhaps and hopefully alter the risk of acquiring multiple conditions after the first one has occurred.

Some Methodological Suggestions for Addressing MCC Analyses

This collection of articles demonstrates the richness of federal databases for understanding the occurrence and clustering of MCC; this commentary highlights important challenges in organizing and interpreting MCC findings. This important work suggests some methodological steps when considering MCC analyses:

1. Clearly specify the research and programmatic questions and their relevance to public health and clinical practice.
2. Clearly specify all assumptions and definitions used in identifying chronic conditions and their associated risk factors and outcomes.
3. Identify and use the most relevant data to address the questions at hand; this may require using multiple data systems.
4. Attempt to incorporate the patient's views of illness and suffering into the interpretation of MCC data.

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