Supplementary Online Content

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eAppendix 1. Spending on US Health Care: 158 Conditions, 38 Age and Sex Groups, and 7 Types of Care, 1996-2013

This supplementary material has been provided by the authors to give readers additional information about their work.

Spending on US Health Care: 158 Conditions, 38 Age and Sex Groups, and 7 Types of Care, 1996-2013

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Section 1: Overview

The objective of this research was to comprehensively measure and describe spending on health care in the United States (US) using granular, politically and clinically useful categories. We produced annual estimates for 1996 through 2013. These estimates were created to be as comprehensive as possible, and they aggregate to reflect the official US government estimates of US health spending, as reported in the National Health Expenditure Accounts (NHEA).[1] These estimates were produced to reflect actual spending on health, also known as expenditure or payments, rather than charges made by medical providers. In many cases, charges are not paid in full and tracking these would be an overestimate of the resources actually spent on health care.[2–4] Spending estimates were adjusted for inflation using the economy-wide consumer price index from the International Monetary Fund, and were reported in 2015 dollars.[5] In addition to health spending, volume of health goods or services was also estimated – measured as the number of visits, bed-days, or prescriptions filled.

This research focused on two categories of health care spending – personal health care spending and government public health activities. Personal health care spending is defined in the NHEA as "the total amount spent to treat individuals with specific medical conditions," and in 2013 was 84.8% of total US health spending. For this study, personal health care spending was disaggregated into six types of care, including inpatient care, ambulatory care, retail pharmaceuticals, emergency department care, nursing facilities care, and dental care. Together, health care spending incurred through these six types of care constitutes between 86.2% and 86.8% of annual personal health care spending from 1996 through 2013. Government public health activities made up 2.8% of total health spending in 2013. For this study we make preliminary estimates disaggregating by age, sex, and condition of spending by four federal agencies. Together these four agencies make up 18.0% of government public health activities. In addition to personal health spending and government public health activities, investment and two categories related to the administration of publicly funded insurance programs make up total health spending.

The overarching research strategy was to use microdata to inform spending and volume estimates at the most granular level possible. For the disaggregation of personal health care spending, microdata consisted of administrative records, insurance claims, or household surveys that report health spending by condition or reason for the health care event, type of good or service, and demographic information. These sources provided data at the patient, encounter, or claim level. In most cases, spending and volume estimates were disaggregated into age-, sex-, condition -, type of care-, and year-specific categories. For the disaggregation of government public health activities, government budget documents and public agency justification documents were used.

To provide a comprehensive yet granular set of health spending estimates, health spending was split into categories defined by simultaneously applying three distinct frameworks. These three frameworks reflect demography, epidemiology, and the type of health care provided.

1. **Demography:** Health spending and volume of goods and services were estimated for **both sexes** and for **19 age groups**, <1, 1-4, 5-9, 10-14 ... 80-84, and ≥85.
2. **Epidemiology:** Health spending and volume of goods and services were estimated for **158 conditions**. The condition list for this project was based on the Global Burden of Disease (GBD) 2013 study.[6] GBD 2013 classified conditions of health burden at five different levels of disaggregation.

Level III classification was extracted from GBD 2013 for this study. This included 144 conditions of health burden. In addition to these, 14 other categories were added. Four risk factors for other underlying health conditions were added because it was clear that there is substantial spending on the treatment of these risk factors, and this spending is to prevent a wide set of conditions. These additional conditions are spending on hypertension, hyperlipidemia, obesity, and tobacco cessation. In addition to these, seven conditions were added that were not associated with health burden (and are therefore not considered by GBD) but were associated with health spending. Examples of these conditions were well-person care, pregnancy and postpartum care, and well-dental care. Finally, this project also tracked spending on three impairments. These impairments – heart failure, septicemia, and renal failure – are not underlying conditions of health burden, but rather consequences of other underlying conditions. Spending on these conditions was tracked because they represent large portions of health spending and are of political interest. A description and full list of conditions and how they map to the International Classification of Diseases version 9 (ICD-9) are provided in section three of this appendix and in a separate Condition Maps (Section 8).

3. **Types of goods or services:** Health care spending and volume of goods and services were estimated for **seven types of goods and services**: ambulatory care, inpatient care, emergency department care, nursing care, dental care, prescribed retail pharmaceuticals, public health. Definitions for these types of goods and services were designed to reflect the underlying microdata.
    - *Ambulatory care*: Ambulatory care included preventive, curative, and rehabilitative medical and psychiatric services, procedures, and medications provided in ambulatory care settings including physicians' offices, freestanding clinics, and hospital outpatient departments. Emergency room visits and dental visits are excluded from ambulatory care. For ambulatory care, volume was measured as the number of visits.
    - *Inpatient care*: Inpatient care included all spending in an inpatient hospital facility, whether preventive, curative, or rehabilitative, and included all medical goods, whether pharmaceuticals, diagnostics, or devices, consumed by inpatients, regardless of their length of stay. Emergency room visits that result in an inpatient stay are considered inpatient care. For inpatient care, volume was measured as the number of days spent in an inpatient setting.
    - *Emergency department care*: Emergency department care included preventive, curative, and rehabilitative medical and psychiatric care provided at hospital-based and freestanding emergency departments. Emergency department care excluded visits that resulted in inpatient admission. For emergency department care, volume was measured as the number of visits.
    - *Nursing facilities care*: Nursing care included nursing care provided in nursing homes or other residential institutions. Home-based care and palliative or hospice care provided in inpatient settings were excluded. Spending on hoteling costs, such as room and board, is included. For nursing care, volume was measured as the number of days spent in a facility.
    - *Dental care*: Dental care included preventive and curative health care at a dental facility. For dental care, volume was measured as the number of visits to a dental facility.
    - *Prescribed retail pharmaceuticals:* Prescribed retail pharmaceuticals (pharma) included all prescription medicines purchased in a retail pharmacy setting. This category excluded any medications consumed in inpatient, ambulatory, long-term, and emergency settings during a

visit. It also excluded over-the-counter (non-prescribed) medications and therapeutic devices. For prescribed retail pharmaceutical, volume was measured as the number of prescriptions filled. The condition is captured by the diagnoses reported by an individual who held the prescription, not by an Anatomical Therapeutic Chemical (ATC) classification system or medication code.

- *Public health:* Public health included all health protection, health promotion, and disease prevention services provided or funded by any of four federal agencies including the Center for Disease Control (CDC), Health Resources and Services Administration (HRSA), Food and Drug Administration (FDA), and Substance Abuse and Mental Health Services Administration (SAMHSA). Section 7 of this appendix provides information on tracking public health spending. Volume was not measured for public health.

For all estimates, uncertainty was propagated using a bootstrapping method. This process is described in Section 6 of this appendix.

Sections 2 and 3 of this appendix provide more information about these data and how they were extracted and processed. Statistical models were used when necessary to generate a complete set of estimates, combine data sources, and adjust the data for known biases. Sections 4 and 5 of this appendix provide in-depth description of these adjustments. Section 5 also outlines how the spending estimates were scaled to reflect the NHEA. The population-weighted estimates derived from the microestimates were compared and scaled to reflect the total health expenditure for each type of care and year. A brief summary of each step, including the types of care impacted, the effect of the process, and the motivating purpose of the process is provided in Table 1-1 below. This table does not attempt to explain how each step was conducted, as that information is provided in each associated section of this methods appendix. Rather, this table explains briefly why each step was conducted and how it impacted the data.

Table 1.1 Summary of steps taken to get final estimates			
Step	**Types of care**	**Motivation**	**Effect**
Formatting data	Ambulatory, inpatient, emergency department, nursing care, dental, prescribed retail pharmaceuticals	To enable all data sources to go through same statistical machinery	All data were structured in the same manner, and variable names and variable formats were systematized across all data sources used
Bootstrapping	Ambulatory, inpatient, emergency department, nursing care, dental, prescribed retail pharmaceuticals	To obtain 1,000 bootstrap samples upon which all other steps could be run independently, in order to quantify uncertainty	1,000 samples were created for analysis based on survey adjusted bootstrapping methods
Detruncation	Ambulatory (spending data only), emergency department (spending data only), prescribed retail pharmaceuticals	To estimate more detailed four- and five-digit ICD-9 diagnoses from the three-digit diagnoses recorded in Medical Expenditure Panel Survey (MEPS)	Variation within each bootstrap draw and across draws for data from MEPS was increased
Redistribution	Ambulatory, inpatient, emergency department, nursing care, prescribed retail pharmaceuticals	To attribute all spending and volumes to conditions that represent the true underlying reason for a health care encounter	Spending and volume originally attributed to ICD-9 codes that do not map to GBD conditions were assigned to GBD conditions based on redistribution packages developed by the IHME GBD research. This redistributions were designed to take into account age and sex. While each condition is impacted differently by the redistribution process, spending per condition, measured at the age, sex, type, and year level, goes up or stays the same, while spending attributed to “garbage codes” is removed.

Table 1.1 Summary of steps taken to get final estimates continued			
Step	**Types of care**	**Motivation**	**Effect**
Mapping	**Ambulatory, inpatient, emergency department, nursing care, dental, prescribed retail pharmaceuticals**	**To divide spending into 158 medically important and policy-relevant categories**	**Conditions were aggregated from ICD-9 codes to 158 GBD conditions, leading to more data for each condition-, year-, age-, sex-, type-combination**
Injury adjustment	Ambulatory, inpatient, emergency department, nursing care, prescribed retail pharmaceuticals	To have all spending and volume due to injuries be defined by external condition codes, rather than less actionable nature of injury codes	All spending attributed to injuries was defined by the external condition of injury
Comorbidity adjustment	Ambulatory, inpatient, emergency department, nursing care	To redistribute resources toward the underlying condition of the health care spending, rather than merely the primary diagnosis	Spending was moved from some conditions to others, based on whether, on average, the condition leads to excess spending (as comorbidity) or is a primary diagnosis that has spending increased by excess spending on comorbidities
Age-splitting	Nursing care	To have Medicare nursing care claims data be consistent with all other data sources, as Medicare aggregates younger ages to ensure patient privacy	Charges captured in Medicare claims were split up from larger age bins into the age bins used in the study
Inpatient charges-to-payments adjustment	Inpatient	To estimate total inpatient spending from the inpatient facility charges report in the National Inpatient Sample	Inpatient spending estimates were made smaller than originally reported in National Inpatient Sample, based on condition, year, payer-specific payment to charge ratios

Table 1.1 Summary of steps taken to get final estimates continued			
Step	**Types of care**	**Motivation**	**Effect**
Completing the series	**Ambulatory, inpatient, emergency department, nursing care, dental, prescribed retail pharmaceuticals**	**To have estimates for years in which data do not exist, to obtain estimates for spending that are missed due to survey designs, and to have estimates that are appropriately consistent across age and time**	**Multiple data sources were combined to leverage strengths across data sources, such that every type-, age-, year-, condition-, and sex-combination was estimated and "smooth" series were produced**
Nursing-care adjustment	Nursing care	To estimate nationally representative spending and volume estimates for short- and long-term stays at nursing homes	Three data sources were leveraged together, two using linear regression, to create nationally representative spending and volume estimates for short-term and long-term nursing facility care
Mental health adjustment	Ambulatory, inpatient	To address the under sampling of mental health and substance abuse specialty facilities and create mental health and substance abuse health care spending aggregates that are commensurate with official US government estimates.	Spending and volume on mental illnesses were increased, relative to non-mental illness conditions, for the ambulatory and inpatient types of care
Scaling	Ambulatory, inpatient, emergency department, nursing care, dental, prescribed retail pharmaceuticals	To match spending estimates that reflect the official US government numbers, as no data source offers complete census of health care spending	Estimates for spending were increased or decreased depending on type of care

Section 2: Data sources, extraction, and pre-processing

This section of the appendix describes the data sources used for this study and highlights methods used for the extraction and processing of each data source. Many of these methods are specific to an individual data source, as they examine the process of extracting data and making it comparable to other sources. In addition, this section also summarizes the standard adjustments that are applied to each data source. These adjustments are explained completely in Sections 3 through 5.

Tables 2.1 summarizes the primary data sources and years of data used for this study.

- The **National Health Expenditure Accounts (NHEA)** is a primary data source used to provide macro-estimates of annual health spending. Produced annually by the Office of the Actuary at the US Centers for Medicare and Medicaid Services (CMS), the NHEA constitutes official estimates of total health care spending in the US, dating back to 1960.[1] In addition to reporting total health spending, the NHEA reports health spending by type of goods and services, source of funding, and type of sponsor. Data from the National Health Expenditures tables were used. These data "measure annual US expenditure for health care goods and services, public health activities, government administration, the net cost of health insurance, and investment related to health care." This study focused on generating annual spending and volume estimates that could be scaled to reflect these type-specific spending totals. Scaling to NHEA totals was necessary because no single source of microdata fully captured the NHEA type-specific envelope, due to incomplete sampling frames and biases associated with small samples. This study assumes that the portion of NHEA directly accounted for in the microdata is proportional to the portion of NHEA not accounted for in the microdata, unless otherwise adjusted. These NHEA data were extracted from the CMS website.[7]
- The **Medical Expenditure Panel Survey (MEPS)** was a primary microdata source used to estimate the distribution of annual health spending across age, sex, and disease groups.[8] MEPS is produced by the US Agency for Healthcare Research and Quality (AHRQ) and provides data on the frequency of health services, health status and conditions, payments, and methods of payment for health services. MEPS draws from an annual survey sample of between 21,000 and 37,000 non-institutionalized civilians. Survey weights included in the data were used throughout this study to make MEPS estimates nationally representative. For each health system encounter, MEPS reports information on both payments and conditions leading to a health system encounter using the International Classification of Disease version 9 (ICD-9). ICD-9 codes were truncated by AHRQ to include only the first three digits of codes that are often four or five digits long. To address this, three digit codes were assigned four- or five-digit codes probabilistically for patient-level data and proportionally for aggregated data. Probabilities for this reassignment were generated from data sources that include four- and five-digit codes. This detruncation process is described in more detail in Section 3. MEPS is already disaggregated into types of goods and services, which generally correspond closely to the types used in the NHEA. To make NHEA and MEPS data align more completely, emergency department (ED) visits that result in inpatient stays were removed from the MEPS ED data. These visits are identified by an indicator in the survey or by assessing if an inpatient stay and ED visit occurred on the same day and share at least one ICD-9 diagnosis in common.
- **Substance Abuse and Mental Health Services Administrative (SAMHSA)** data provide estimates on health spending in mental health and substance abuse specialty clinics. Estimates for spending in

these settings are often not included in other data sources, and it is important to account for this to accurately capture spending on certain conditions. Data were extracted from the National Expenditure for Mental Health Services & Substance Abuse Treatment: 1986–2009, and from the Projections of National Expenditure for Mental Health Services and Substance Abuse Treatment: 2004–2014. These data were used to adjust the microdata when scaling to the NHEA totals.[9,10] Section 5 provides more detail on how these data were used.

- The Truven Health **MarketScan©** Commercial Claims and Encounters Database provides claim-level health care information on more than 53 million commercially insured enrollees. These data were combined with the Truven Medicare Supplemental and Coordination of Benefits Database, which covers more than 4 million Medicare-eligible retirees with employer-sponsored supplemental plans in 2012. These data were used to create health system encounter profiles by age, sex, type, and condition. These profiles then served as Bayesian priors for volume and spending estimates. More details about this process can be found in Section 4.
- The **National Ambulatory Medical Care Survey (NAMCS)** and **National Hospital Ambulatory Medical Care Survey (NHAMCS)** are annual surveys conducted by the US Centers for Disease Control and Prevention (CDC) to collect data on the utilization and provision of outpatient and ED services. These data are collected from physicians who primarily engage in direct patient care. Together, these two surveys cover 69 and 109 thousand patients per year. These data provide age, sex, type, and condition estimates. Conditions are reported using five-digit ICD-9 codes. Because this data source does not include information on costs or spending, it was used only to inform volume estimates. Survey weights were used to make estimates nationally representative.
- The **National Inpatient Sample (NIS)** is also produced by AHRQ and is the largest publicly available all-payer inpatient health care database with nationally representative US spending estimates. The NIS covers 6 to 8 million inpatient hospital stays per year and includes information on age, sex, condition, days spent hospitalized, and charges. Conditions are reported using five-digit ICD-9 codes. Section 5 of this appendix provides information about how payments were estimated based on reported charges in the NIS.
- CMS provides data with information about Medicare beneficiaries, Medicaid eligibility, **Medicare and Medicaid claims**, Medicare providers, and clinical data. These data are stripped of personally identifying information. Data on beneficiaries and claims for health care at skilled-nursing facilities were obtained from this database. Data on payments and conditions, reported using five-digit ICD-9 codes, were used only for beneficiaries 65 years and older. These data include between 2 and 4 million claims per year.
- The **National Nursing Home Survey (NNHS)** was used to supplement information from Medicare and Medicaid claims in skilled nursing facilities. While the Medicare and Medicaid claims only provide information on patients with public funding in skilled nursing facilities, the NNHS provides information on patients regardless of payer in both skilled and unskilled nursing facilities. NNHS is nationally representative and provides information on payments and conditions, which are reported using five-digit ICD-9 codes. Data were provided for between 20,000 and 36,000 current long-term care residents per year.
- The **Medicare Current Beneficiary Survey (MCBS)** was used to supplement information from Medicare and Medicaid claims in skilled nursing facilities and from the NNHS. The MCBS is a nationally representative sample of those on Medicare, including spending and volume in nursing

homes. The MCBS includes not only nursing care spending covered by Medicare, but also supplemental insurance and out-of-pocket spending. MCBS was received in an aggregated form from the Bureau of Economic Analysis. These spending and volume estimates were stratified by age, year, sex, and condition in Clinical Classification Software codes.

- To generate estimates for spending on public health by age, sex, and condition, data from the US President's Budget Appendix, US Congressional Reports, and US agency justification documents from the Center for Disease Control (CDC), Food and Drug Administration (FDA), Substance Abuse and Mental Health Services Administration (SAMHSA), and Health Resources and Services Administration (HRSA) were used. More information about these data and how they were used is included in Section 7 of this appendix.

Table 2.1: List of primary data sources

Type of care	Macro spending data and years	Micro spending data and years	Micro volume data and years
Ambulatory	NHEA (1996 – 2013)*	MEPS (1996 – 2013); SAMHSA (1998, 2002, 2004, 2005, 2009); MarketScan (2000, 2010, 2012)	NAMCS (1996 – 2011); NHAMCS (1996 – 2011); MarketScan (2000, 2010, 2012)
Inpatient	NHEA (1996 – 2013)	NIS (1996 – 2012); SAMHSA (1998, 2002, 2004, 2005, 2009); MarketScan (2000, 2010, 2012)	NIS (1996 – 2012); MarketScan (2000, 2010, 2012)
Emergency department	NHEA (1996 – 2013)*	MEPS (1996 – 2013); MarketScan (2000, 2010, 2012)	NHAMCS (1996 – 2011); MarketScan (2000, 2010, 2012)
Nursing care	NHEA (1996 – 2013)	Medicare claims data (1999 – 2001, 2002, 2004, 2006, 2008, 2010, 2012); NNHS (1997, 1999, 2004); MCBS (1999-2011); MarketScan (2000, 2010, 2012), MCBS (1999 – 2011)	Medicare claims data (1999 – 2001, 2002, 2004, 2006, 2008, 2010, 2012); NNHS (1997, 1999, 2004); MCBS (1999-2011); MarketScan (2000, 2010, 2012)
Dental	NHEA (1996 – 2013)	MEPS (1996 – 2013)	MEPS (1996 – 2013)

Table 2.1: List of primary data sources continued

Type of care	Macro spending data and years	Micro spending data and years	Micro volume data and years
Prescribed retail pharmaceuticals	NHEA (1996 – 2013)	MEPS (1996 – 2013)	MEPS (1996 – 2013)
Public health	NHEA (1996 – 2013)	President's Budget Appendix (1996 – 2014); Congressional Reports (1997, 1998, 2000 – 2014); Agency Justification documents from the CDC, FDA, HRSA, and SAMHSA (2004 – 2014)	Not disaggregated
Other	NHEA (1996 – 2013)	Not disaggregated	Not disaggregated

In addition to the source-specific adjustments described above, several additional adjustments were made to the data throughout our study. These adjustments are described in detail in Sections 3 through 5 of this appendix. As a summary, Table 2.2 lists the standard adjustments that were applied to each type of good or service.

Table 2.2: Application of standard adjustments

Type of good or service	ICD9ICD-9 3-digit to 5-digit adjustment	Injury adjust	Charge to payment adjustment	Facility to total payment adjustment	Comorbidity adjustment	Smoothing adjustment	Mental Health Adjustment
Ambulatory	Spending	Spending and volume			Spending	Spending and volume	Spending and volume
Inpatient		Spending and volume	Spending	Spending	Spending	Spending and volume	Spending and volume
Emergency department	Spending	Spending and volume			Spending	Spending and volume	
Nursing care		Spending and volume			Spending	Spending and volume	Spending and volume
Dental						Spending and volume	
Prescribed retail pharmaceuticals	Spending and volume	Spending and volume				Spending and volume	
Public health							
Other							

Together, these data make up a comprehensive and robust picture of health care spending in the US. The specifics of populations and encounters collected are listed in Tables 2.3.1 and 2.3.2.

Table 2.3.1: Summary of data used - volume

Type of Care	Data	Years	Metric	Observations	Raw (thousands)			Patient-Weighted (thousands)		
					mean	min	max	mean	min	max
AM	MEPS AM	1996-2013	Visits	2680505	148.92	107.56	195.69	1601515.67	1356394.89	1898774.00
AM	NAMCS_AM	1996-2011	Visits	955958	59.75	50.08	66.91	98469.18	806635.48	1139320.68
DV	MEPS_DV	1996-2013	Visits	488922	27.16	21.51	35.30	278481.55	297193.53	315713.16
ER	MEPS_ER	1996-2013	Visits	89462	4.97	3.30	6.83	45457.97	38545.28	59296.41
ER	NHAMCS_ED	1996-2012	Visits	464279	27.31	18.07	34.89	82089.07	100148.44	120067.66
IP	NIS	1996-2012	Bed-days	128223548	34721.53	28530.18	36964.56	167161.94	146437.70	173582.93
NH	CMS_SNF	1999-2001, 2002,2004, 2006,2008, 2010,2012	Bed-days	25449729	68451.04	48481.71	90359.74	68451.04	48481.71	90359.74
NH	NNHS	1997,1999, 2004	Bed-days	23428	2521.87	2120.69	3318.86	403564.31	367736.94	422407.32
RX	MEPS_RX	1996-2013	Visits	4908359	272.69	145.12	336.11	2748649.75	1865404.20	3309785.26

Table 2.3.2: Summary of data used - spending

Type of Care	Data	Years	Metric	Observations	Raw (billions)			Patient-Weighted (billions)		
					mean	min	max	mean	min	max
AM	MEPS AM	1996-2013	payments	2680505	0.03	0.01	0.04	302.68	159.34	470.45
DV	MEPS_DV	1996-2013	payments	488922	0.007	0.004	0.010	69.46	43.15	91.83
ER	MEPS_ER	1996-2013	payments	89462	0.003	0.001	0.006	30.47	14.87	59.24
IP	NIS	1996-2012	charges	128223548	162.83	68.91	272.09	781.50	349.32	1310.98
NH	CMS_SNF	1999-2001, 2002,2004, 2006,2008, 2010,2012	charges	25449729	30.44	19.25	48.41	30.44	19.25	48.41
NH	NNHS	1997,1999, 2004	charges	23428	0.35	0.22	0.51	50.50	43.94	0.51
RX	MEPS_RX	1996-2013	Payments	4908359	0.02	0.01	0.03	189.37	65.29	307.79

Section 3: Mapping

Mapping ICD-9 to the GBD hierarchy

ICD-9 codes for all observations were mapped to conditions leading to health care events, nature of injury codes (N-codes), or "garbage codes" using the condition map in Table 8.1. A higher level of organization can be placed on these conditions and a full hierarchy is found in table 10.Garbage codes are codes that cannot be reliably mapped to the underlying condition of lading to a health care event. For a description of garbage codes and how they are redistributed, see the sub-section on redistribution. Some observations did not contain valid ICD-9 codes. If an observation's ICD-9 code failed to map and contained more than three digits, the last digit was removed and it was re-mapped. This assumes that the ICD-9 stem was correctly coded and that the detailed disease specification was not. Observations in which the three-digit ICD-9 stem failed to map were marked as all-condition garbage.

Selecting a primary diagnosis

Injuries were prioritized when assigning primary diagnoses for observations. Injuries can be coded in the ICD-9 system one of two ways: by the nature of injury (N-codes) or by the external cause of injury (E-codes). For example, the external cause of an injury might be a car crash, while the nature of that injury might be a broken hip. Injuries in the GBD hierarchy correspond to injuries classified by E-codes. However, according to the ICD coding manual, E-codes cannot be listed as the primary diagnosis.[11] E-codes were only selected as the primary diagnosis when the first listed code was an N-code and an E-code was also present. Otherwise, E-codes were not used as primary diagnoses. MEPS only records N-codes for health system encounters resulting from injuries. For all MEPS sources except MEPS HH and DV, the first listed N-code was taken as the primary diagnosis. For observations in which an N-code for injury was not present, the first listed diagnosis was taken as primary.

E-codes corresponding to adverse medical treatment were not allowed to be primary diagnoses. These E-codes appear mostly in inpatient and nursing facilities care settings. In these cases, the adverse treatment is assumed to result from the care provided and cannot be the initial reason for the encounter. To capture the true reason for a health system encounter, these codes were ignored when selecting injuries as primary diagnoses. If there were multiple E-codes for observations with an N-code as the first-listed code, the first E-code which was not adverse medical treatment was taken as primary.

ICD-9 codes corresponding to non-disease well-person care were not allowed to be primary diagnoses for inpatient and emergency room services unless they described the birth of a newborn in the inpatient setting. Emergency care and care involving since these settings do not generally provide well-person care unrelated to births.

If the age of a patient was outside the valid range for the primary diagnosis, or if the sex was not allowed for the diagnosis (see Table 8.1), the observation was recoded as garbage. This assumes that information about age and sex is more reliable than information about diagnoses. Thus, if an age-sex-condition combination appears that is not clinically possible, we assume that the diagnosis information is incorrect. Garbage codes and N-codes have no age or sex restrictions.

MEPS dental visits

Encounters in MEPS Dental files do not contain ICD-9 codes. Therefore, dental encounters were mapped to conditions according to dental procedures (Table 3.1). If any procedure related to oral disease was performed

during the encounter, the diagnosis was assumed to be oral disease. If procedures related to well dental care were performed, and no procedures related to oral disease were performed, the diagnosis was assumed to be well dental. If no procedures were listed, the expenditure and volume were distributed between oral disease and well dental care according to the proportion of oral disease and well dental care present within the same age, sex, and year category.

Table 3.1: Dental procedures and corresponding conditions

Dental procedure	Condition
Fluoride treatment	Oral disease
Sealant application	Oral disease
Fillings	Oral disease
Inlays	Oral disease
Crowns or caps	Oral disease
Root canal	Oral disease
Extraction	Oral disease
Abscess or infection treatment	Oral disease
Gum surgery	Oral disease
Periodontal recall visit	Oral disease
Implant	Oral disease
Bridges	Oral disease
Dentures or partial dentures	Oral disease
Repair of bridges/dentures or relining	Oral disease
Oral surgery	Oral disease
Cleaning prophylaxis or polishing	Well Dental
General exam or consultation	Well Dental
X-rays, radiographs, or bitewings	Well Dental
Orthodontia, braces, or retainer	Well Dental
Bonding, whitening, or bleaching	Well Dental

Truncated ICD-9 codes

MEPS data report ICD-9 codes truncated to three digits for privacy reasons. In some cases, these truncated, three-digit codes map to a different condition than the full four- or five-digit code. This causes a portion of the encounters to be classified incorrectly. For a few conditions, such as atrial fibrillation and eating disorders, only full four- and five-digit codes map to these conditions, and the truncated codes map to another condition.

To correct for the misclassification introduced by truncation, ICD-9 codes in MEPS were replaced with full four- or five-digit ICD-9 codes using a patient-level probabilistic replacement. During this process, if a three-digit ICD-9 code could map to multiple four- or five-digit codes, the three-digit code was reassigned to a four- or five-digit code based on probabilities of occurring found in datasets with both truncated and full ICD-9 codes. Each MEPS source was paired with a comparable survey containing information about a similar good or service that has full ICD-9 codes (Table 3.2). This survey was then used to calculate the probabilities for reassignment.

Table 3.2: Sources used to calculate proportion of fully specified ICD-9 codes

Source	5 to 3 digit proportions from
MEPS AM	NAMCS
MEPS IP	NIS
MEPS ER	NHAMCS ED
MEPS HO	CMS
MEPS RX	NAMCS

Often all the conditions corresponding to five-digit codes mapped to the same condition as the corresponding four-digit code. When this occurred, only the four-digit code was considered a valid target for replacement. If the three-digit stem appeared in the source with full ICD-9 codes, it was also a valid target, meaning that a truncated ICD-9 code in MEPS could be replaced with itself. Taken together, this process causes truncated ICD-9 codes to be replaced primarily with four-digit codes, but occasionally with three- or five-digit codes.

The probability of occurring was taken to be the proportion of total volume of a three-digit code that comes from a given four- or five-digit code.

These proportions for the probabilistic replacement were calculated using weighted, nationally representative volume estimates, which are measured in bed-days for inpatient and nursing facilities care, and in visits for ambulatory and emergency department care. Volume was used for MEPS AM, MEPS ER, and MEPS RX because the data sources with four- and five-digit codes for the same type had volume estimates only. Proportions for MEPS IP and MEPS HO were then calculated from volume estimates to be consistent across types of care. Proportions of each target ICD-9 code within a truncated ICD-9 code were first calculated by age and sex. If no target codes appeared within an age and sex, proportions were calculated within wider age groups still stratified by sex. Ages were pooled as follows: 0 to 19, 20 to 44, 45 to 64, and 65 and older. If there were still no valid targets found, sexes were pooled within these wider age groups. If no valid targets were found within the age group, proportions were calculated using any valid target code within the same sex regardless of age. If no valid conditions were found, proportions were calculated using any valid target. If no valid target appeared in the source, each valid target was given the same likelihood of appearing. Table 3.3 summarize this process.

Table 3.3: Cascade of stratifying variables used for calculating detruncation adjustments

Attempt	Stratifier
1	Sex and standard age groups (under 1, ages 1 to 4, five-year groups, ≥80)
2	Sex and wide age groups (0 to 19, 20 to 44, 45 to 65, ≥65)
3	Wide age groups (0 to 19, 20 to 44, 45 to 65, ≥65)
4	Sex
5	none
No match	All targets equally likely

Once data were pooled across different ages and sexes, it became possible for an ICD-9 code that maps to a condition that violates age or sex restrictions to be included as a target for the given age-sex combination. In every attempt after the first, ICD-9 codes that were invalid for the given age and sex combination were excluded from proportions. Table 3.4 shows the probabilities of resampling four truncated ICD-9 codes from full ICD-9 codes for ambulatory services.

Table 3.4: Probability of full ICD codes for ambulatory services

Truncated ICD-9 code	Full ICD-9 code	Condition	Probability
112	112.0	Other infectious	23.87%
112	112.3	Other infectious	19.31%
112	112.4	HIV/AIDS	8.32%
112	112.8	HIV/AIDS	18.68%
112	112.9	HIV/AIDS	29.81%
123	123.1	Cysticercosis	40.87%
123	123.3	Other NTDs	32.85%
123	123.9	Other NTDs	26.28%
125	125.0	Lymphatic filariasis	100.00%
127	127.0	Ascariasis	9.24%
127	127.4	Other NTDs	53.09%
127	127.9	Other NTDs	37.67%

All MEPS ICD fields underwent this detruncation process before mapping to GBD conditions.

Redistribution of garbage codes

Some of the ICD-9 codes represent ill-defined or "garbage" conditions. These conditions include codes which generally do not fit well into the framework of GBD, such as "fracture of unspecified bones," "certain early complications of trauma," and "care involving use of rehabilitation procedures." Table 3.5 details how many of the data map to garbage conditions, after the initial fomatting and mapping processes.

Table 3.5: Spending and volume in input data after mapping, with percent coded to garbage. Shown by metric and type of service for both sexes and all ages combined, 1996–2013.

Service type	*Spending*	*Volume*

	Total amount (billions 2015 USD)	Percent garbage	Total amount (millions counts or bed-days)	Percent garbage
Ambulatory	78,623	20.5	15,816	17.9
Inpatient	15,852	19.4	617	18.6
Emergency	2,291	51.0	1,703	32.5
Nursing care	326	44.8	25	41.9
Prescribed pharmaceutical	18,447	24.8	225,933	28.1

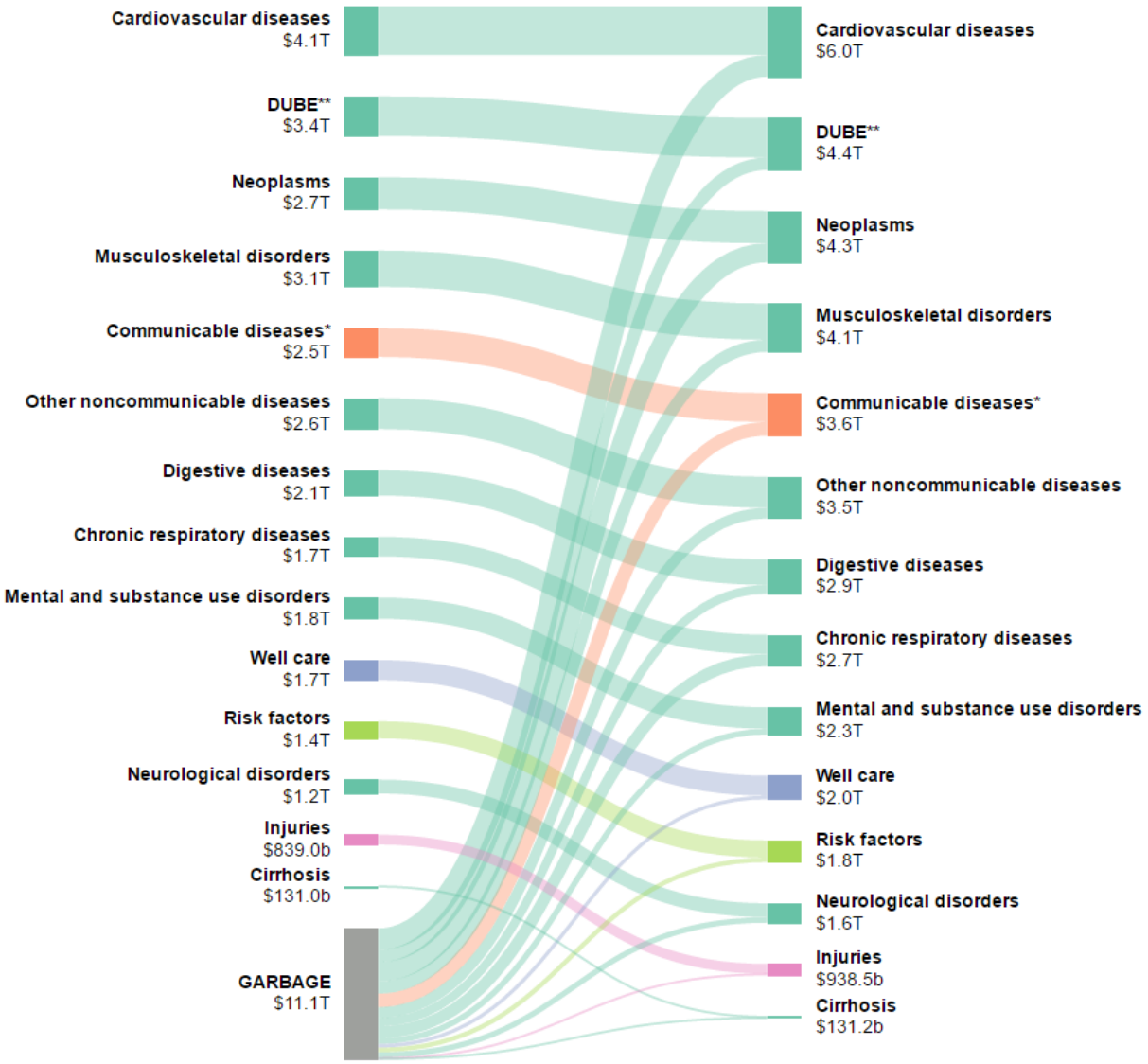
While garbage codes cannot be directly connected to conditions or health care spending, they often contain provide valuable information regarding diagnoses. Furthermore, spending or volume attributed to garbage conditions cannot simply be dropped from the analysis. Dropping these data would inaccurately bias the distribution of spending or volume among non-garbage conditions, ages, sexes, and years. Therefore, it is important to retain diagnostic information while preserving the desired framework of conditions. To achieve this end, spending and volume assigned to garbage conditions were redistributed to non-garbage conditions using a method previously established in GBD 2013.[12] The mechanics of this redistribution process are described below, followed by details on the adjustments that were made to account for analytical differences between GBD and this project.

Redistribution packages

Redistribution packages from GBD were adapted for this project. A redistribution package outlines how a given set of garbage codes maps to a given set of "target" codes, all at the ICD-9 level. For some codes, the package specifies proportions in which data for a given garbage code should be redistributed onto its target codes. These proportions are determined based on the relationship between garbage and non-garbage data.[12] Packages from GBD were used mostly as-is, with some modifications made to incorporate non-GBD elements, detailed below.

Spending and volume data attributed to garbage codes were redistributed onto target conditions by type of service, age, sex, and year according to proportions and restrictions designated in the redistribution packages. After redistribution, the condition distribution of the entire dataset is shifted, with various non-garbage conditions receiving more or less of the garbage. Figure 3.1 illustrates this shift.

Figure 3.1: Change in condition distribution of spending at a customized version of GBD condition Level two before and after garbage redistribution. Shown for all service types, both sexes, and all ages combined, 1996–2013.



*Includes maternal, neonatal, and nutritional disorders

** Diabetes, urogenital, blood, and endocrine diseases

Adjustments to account for differences between GBD and this analysis

There are several differences between GBD and this project that affect both the list of included ICD codes and the mapping between ICD codes and conditions. One major distinction is that GBD is focused only on death and disease burden, whereas this project measures health care spending, which can include well-care and prevention. Another difference is the granularity of the condition map – while the GBD map allows for four levels of aggregation, this project uses only the third-most granular level.

Therefore, while the essential redistribution method for DEX was consistent with GBD, a few changes were made to account for condition map differences. For example, ICD-9 codes associated with certain conditions deemed garbage by GBD, such as renal failure and hyperlipidemia, were promoted to non-garbage status. In addition, well-conditions like well-pregnancy and donor codes were incorporated into the overall condition list. Table 3.6 lists all of the conditions in question and details the method used to modify the redistribution process for each one.

Table 3.6 Modifications made to GBD redistribution packages for DEX analysis

Code type	Method
Place of o**ccurrence** codes, specifying where an injury occurred, such as home or work ("E849" codes)	Added to garbage lists, removed from target lists in existing redistribution packages.
Codes with a level-two or level-one mapping, but no specific level-three mapping (Not-elsewhere-classified, or "NEC" codes)	Created new packages such that these codes were redistributed onto their sibling conditions according to proportions in the dataset. For example, data mapping to Neonatal NEC are redistributed onto five sibling conditions: Neonatal preterm birth complications, Neonatal encephalopathy, Neonatal sepsis, Neonatal hemolytic, and Other neonatal.
Renal failure, septicemia, and heart failure ("impairments"), and hypertension, hyperlipidemia, obesity, and tobacco use ("risk factors")	Promoted to non-garbage status in existing redistribution packages with a few exceptions.
Procedure codes ("V-codes")	Removed from garbage lists in existing redistribution packages.
Self-harm codes	Removed from target lists in existing redistribution packages, but allowed injury-adjustment described below to target self-harm codes.
Adverse effect of medical treatment ("Medical injury" codes)	Removed from target lists in existing redistribution packages.

The GBD redistribution packages were also designed with slightly different age groups than those used by this project. For this analysis, the proportions for age ≥ 80 were used for both ages 80-84 and ages ≥ 85.

A few limitations to this approach should be acknowledged. First of all, the methods used in the GBD for the mechanics of redistribution have been updated since previous publications, and these updates were not incorporated in this study. However, these updates were implemented to primarily affect computation times, rather than the content of the analysis. Secondly, the proportions used in the GBD for the redistribution packages were derived from data on deaths. By using the GBD redistribution packages largely as-is for this study, it was assumed that the relationship between conditions coded to garbage and non-garbage is similar for deaths and as for our metrics, health care spending and volume. However, this is unlikely to be a realistic

assumption for a few reasons. One is that the entities responsible for condition coding are different for health care than for mortality, and may have varied coding practices that affect the correspondence between garbage coding and the underlying non-garbage diagnoses. Another is that in the mortality analysis, some codes are considered garbage and redistributed if they are not a plausible cause of death, but the original diagnosis may be a realistic condition leading to health care spending or volume. Therefore such codes should not be redistributed for this analysis. These limitations were partially addressed by the alterations described above, such as the changes made to self-harm packages. Future iterations of this research will certainly see further adjustments introduced.

Sparse-data adjustments

After the redistribution of garbage codes, two adjustments were made to account for sparse data. First, there were some instances in the post-processed data in which a small amount of spending or volume was associated with a garbage code that had many targets. When these small amounts were divided into their many pieces during redistribution, the resulting data sometimes contained very small amounts of spending or volume associated with conditions that did not show up elsewhere in the dataset. This pattern was not a believable reflection of reality. To address this issue, these observations were set to zero. This adjustment was only applied to observations with spending or volume numbers below a certain threshold, which varied for spending versus volume. For volume, any values less than one were set to zero. Since the volume metric represented phenomena that only can exist as integers, such as a bed-day or an encounter, it did not make sense to see fractional values for volume. For spending, the minimum observed values post-mapping, pre-redistribution were calculated for every unique age, sex, year, and level-three condition by source. After redistribution, values created by redistribution that were less than this pre-redistribution minimum were set to zero.

Injury adjustment

All sources contained some observations in which the primary diagnosis was an N-code, even after selecting E-codes as the primary diagnosis when available. N-codes cannot be mapped directly to valid conditions for this analysis, but E-codes can. Therefore, after the data underwent garbage code redistribution and the sparse-data adjustments detailed above, N-codes were converted to valid conditions based on their estimated correspondence to E-codes. To achieve this conversion, the spending or utilization for each N-code was split proportionally among the conditions that mapped to E-codes which co-occurred with the N-code in question in the patient-level data. Proportions were determined using patient-level data from sources which coded both N-codes and E-codes. When a source did not have both N- and E-codes in the patient-level data, proportions were used from a source with the same or similar type of goods or services, as detailed in Table 3.7.

Table 3.7: Sources used to calculate proportions for injury adjustments

Source	Injury-adjusted using proportions from
MEPS AM	NAMCS
NAMCS	NAMCS
NIS	NIS
MEPS IP	NIS
MEPS ER	NHAMCS ED
NHAMCS ED	NHAMCS ED
CMS	CMS
NNHS	CMS
MEPS HO	CMS
MEPS RX	NAMCS

Observations in which both an N-code and an E-code were coded for an encounter were used to determine the proportions. If multiple N-codes or E-codes were listed, the first listed N-code and first listed E-code which did not correspond to adverse medical treatment and was not a Place of Occurrence code were used. Some E-codes are non-specific and include multiple injury conditions. These E-codes, which are mapped to garbage, were excluded from this analysis. Thus, targets for N-code encounters were any non-garbage conditions which had been mapped from an E-code, except adverse effects of treatment and Place of Occurrence codes.

Proportions were calculated using utilization (bed-days for inpatient and long-term care, and visits for ambulatory and emergency department care) weighted to be nationally representative. Proportions of each E-code condition within an N-code were first calculated by age and sex. If no E-code conditions appeared within an age and sex, proportions were calculated within wider age groups still stratified by sex. Ages were pooled as follows: 0 to 19, 20 to 44, 45 to 64, and ≥ 65. If no E-code conditions were found, sexes were pooled by wider age group. If no valid E-code conditions were found within the age group, proportions were calculated using any valid target code within the same sex regardless of age. If no valid conditions were found, proportions were calculated using any valid target. If no valid target appeared in the source then each valid E-code condition was given the same likelihood of appearing. Table 3.8 summarizes this process.

Table 3.8: Cascade of stratifiers for calculating injury adjustments

Attempt	Stratifier
1	Sex and standard age groups (under 1, ages 1 to 4, five-year groups, ≥80)
2	Sex and wide age groups (0 to 19, 20 to 44, 45 to 65, ≥65)
3	Wide age groups (0 to 19, 20 to 44, 45 to 65, ≥65)
4	Sex
5	none
No match	All targets equally likely

Once data were pooled across different ages and sexes, it became possible for conditions that violate the age or sex restrictions to be included as targets for the given age-sex combination of interest. For example, E-codes that correspond to suicide or drug use overdose cannot occur in the youngest age groups. To address this problem, these conditions were excluded from proportions of the youngest age groups in every attempt after the first.

Section 4: Smoothing

Purpose

A systematic model of the relationship between spending, volume, and price data was used to address issues of incompleteness and irregularity in the data, fill in missingness, and leverage multiple datasets to produce the best possible estimates. Our model hinges on the following identity:

$$expenditure = volume * price$$

We use a hierarchical Bayesian model to simultaneously estimate all three variables while preserving this fundamental identity.[13] Our model leveraged data from across years, ages, and datasets to produce credible spending estimates for each age, sex, condition, and type of health care.

Data

Prices are generated by merging together spending and volume data by unique year, age, sex, condition, and type, and taking the quotient of expenditure and volume. Data were pulled from the same data source, so if MEPS data was used for age, sex, type, and year estimates as it is for ambulatory care, volume was taken also from MEPS, even if we relied on another data source for other parts of the process for volume estimates (See Table 1). Prices calculated to be zero or infinity are set to missing.

Table 4.1: Data sources for smoothing models

	Ambulatory	Inpatient	Pharma	Nursing care	Dental	Emergency department
Expenditure	MEPS	NIS	MEPS	CMS-SNF and NNHS	MEPS	MEPS
Volume	NHAMCS and NAMCS	NIS	MEPS	CMS-SNF and NNHS	MEPS	NHAMCS
Price	MEPS	NIS	MEPS	CMS-SNF and NNHS	MEPS	MEPS

Once prices were generated, those data were merged together with volume and expenditure data and logical constraints were applied (See Table 4.2). This table illustrates possible combinations of expenditure, volume, and price data that arise once this merge is performed. In order to improve model quality, these data were constrained where the combination of data indicated potential poor data quality. The table at left indicates specification combinations of data, while the 'operation' column indicates how the data are transformed. Two arbitrary examples of specific situations are provided to further illustrate operations.

Next, the domain is extended to encompass all years and ages for which a prediction is desired. For ages, this is condition-specific and determined by the same restrictions used prior in this paper. For years, this is 1996–2013, except for the National Nursing Home Survey (NNHS) dataset, which is not modeled for any years other than those present in the data (1999, 2000, and 2004). Volume and price data from the Skilled Nursing Facilities survey (CMS-SNF) are extended backward from the year 1999 by taking the point estimates at 1999 for a specific age and sex and using them for the data prior to 1999. This because the years from 1996 to 1999 are systematically missing and the extension aids in reducing edge effects while minimally altering estimates because of model flexibility and the contribution of spending data.

Table 4.2: Enforced logical constraints

Expenditure	Volume	Price
Positive value	Positive value	Positive value
Positive value	Positive value	Missing value
Positive value	Zero	Positive value
Positive value	Zero	Missing value
Positive value	Missing value	Positive value
Positive value	Missing value	Missing value
Zero	Positive value	Zero
Zero	Positive value	Missing value
Zero	Zero	Zero
Zero	Zero	Missing value
Zero	Missing value	Zero
Zero	Missing value	Missing value
Missing value	Missing value	Missing value
Missing value	Positive value	Missing value
Missing value	Zero	Missing value

Operation
Leave value As Is
Leave missing
Replace value with missing
Replace missing with zero

Examples	Before constraint	After constraint
Expenditure	10001,000	Missing
Volume	0	0
Price	100	100
Expenditure	0	0
Volume	Missing	0
Price	Missing	Missing

Once these adjustments have been made, outliers are detected among the volume and price data using median absolute deviation (MAD) as shown below.

$$MAD = median(|x_i - median(X)|) \qquad Z_{modified} = 0.6745 * \frac{(x_i - median)}{MAD}$$

The modified Z-score threshold for identifying an outlier was 3.5, inclusive.

Model overview

Once the data have been processed, modeling takes place on a draw-specific level. Variance, data sparsity (percentage of data missing in the domain), and age and time splines are calculated from the raw data. If the

entirety of expenditure, volume, or price is missing then that draw is skipped altogether. The model is fit by finding the maximum *a posteriori* estimate via Powell's algorithm using the *PyMC2* package (version 2.3.6) for Python (version 3.5).[14] If Powell's algorithm fails to converge, the missing data are filled in using linear averaging (between observed data points) and missing end points are set equal to the nearest time point, and then the fit is attempted again. If fitting again fails then the process is stopped. After fitting, all predicted data are outlier-detected using the MAD method with a threshold of 3.5. These fitting procedure is performed on each bootstrap draw individually.

Covariates

The backbone of the model is the linear models of the mean of the raw data. For the price model, year and age splines are used as covariates. For the MEPS data, indicators for years before 2007 are used to mark changes in survey design. The volume model includes these as well as indicators for zero- and 85-year-olds as well as treated prevalence data extracted from MarketScan. The splines are specifically fourth-order basis-splines with 16 knots, calculated using the Cox - De Boor algorithm with three additional repeating knots at each endpoint.[15,16] If not enough points are present to generate the splines, then no splines are used, only the raw data. The prevalence data is an age profile that is time-invariant and generated from MarketScan data as the average of 2010 and 2012 count of visits, prescriptions or bed-days (depending on type of care). Each covariate used in the linear models are mean-standardized.

Equations

Point estimates are modeled as log-normally distributed with inverse-Gamma distributed variances. An offset is calculated as one percent of the median of the data.

$$y_{expenditure} \sim LogN\left(\mu_{expenditure} + \rho_{offset}\,,\quad \sigma^2_{expenditure}\right)$$
$$y_{volume} \sim LogN\left(\mu_{volume} + \rho_{offset}\,,\quad \sigma^2_{volume}\right)$$
$$y_{price} \sim LogN\left(\mu_{price} + \rho_{offset}\,,\quad \sigma^2_{price}\right)$$
$$\sigma^2_{expenditure,\ volume,\ price} \sim InvGamma(1.0, 5.0)$$

The means are modeled linearly in log space to facilitate positive predictions. Expenditure is explicitly calculated as the product of volume and expenditure to enforce consistency.

$$\mu_{expenditure} = \mu_{volume} * \mu_{price}$$

$$\begin{aligned}\log(\mu_{volume}) = \beta_0 &+ i_{invsparsity}\left(\sum_I year_{spline_i} * \beta_i + \sum_J age_{spline_j} * \beta_j\right) + \beta_{inter} * year * age \\ &+ \beta_{prevalence} * i_{sparstiy} * prevalence + \beta_{zero} * i_{zero} + \beta_{85} * i_{85} + \beta_{MEPS} * i_{MEPS}\end{aligned}$$

$$\log(\mu_{price}) = \beta_0 + \sum_I year_{spline_i} * \beta_i + \sum_J age_{spline_j} * \beta_j + \beta_{inter} * year * age + \beta_{MEPS} * i_{MEPS}$$

$$\beta_0 \sim N\left(0.0, {\sigma_\beta}^2_0\right), \quad {\sigma_\beta}^2_0 \sim InvGamma(1.0, 5.0)$$

$$\beta_{inter} \sim N\left(0.0, {\sigma_\beta}^2_{inter}\right), \quad {\sigma_\beta}^2_{inter} \sim InvGamma(1.0, 5.0)$$

$$\beta_{prevalence} \sim HalfNormal\left(\sigma^2_{\beta_{prevalence}}\right), \quad {\sigma_\beta}^2_{prevalence} \sim InvGamma(1.0, 5.0)$$

$$i_{MEPS} = \begin{cases} 1, & year < 2007 \\ \frac{1}{2}, & year = 2007 \\ 0, & year > 2007 \end{cases}$$

$$i_{sparsity} = \begin{cases} 1, & sparsity \geq 0.8 \\ 0, & sparsity < 0.8 \end{cases}$$

$$i_{invsparsity} = \begin{cases} 0, & sparsity \geq 0.8 \\ 1, & sparsity < 0.8 \end{cases}$$

Indicators are added for ages zero and 85 when present because these two age categories often represent unique trends in volume and spending, especially because the 85-year-old age category is uncapped. The MEPS indicator is included at the recommendation of the survey itself. The outcome data are predicted as if MEPS data were post-2007. Within the volume model, prevalence is only used in draws with high sparsity, greater than 40%. For these draws, it is believed the data are too sparse to inform a good trend with splines, so the MarketScan data are relied upon and the splines are not included.

The coefficients for the splines are determined via a random walk. This method provides some measure of regularization and allows for the inclusion of relatively large numbers of knots compared to the amount of data being modeled while avoiding Runge's phenomenon.[15] This was especially important for this application because extrapolation is commonly performed. The first knot is initialized with an uninformative prior and a value of 1, and each subsequent coefficient is walked to according to a normal distribution. For N splines:

$$\beta_0 = 1.0$$

$$for\ i\ \in N, \qquad \beta_i = \beta_{i-1} + e_{i-1}$$

$$e_{i-1} \sim N(0.0, \sigma^2)$$

The variance of the random walk parameter dictates the "smoothness" of the resulting fit, and so is tuned as a function of the sparsity of the data to provide more regularization when fewer data are present. This is done differently depending on the dependent and independent variables. Maximal flexibility is given to the volume age trends, while less flexibility is given to the year trends in volume and price. Here the inverse variances are represented as that is how the program is specified, so larger values represent more regularization.

$$\sigma^{-2}_{volume_{year}} = \begin{cases} 100, & sparsity \leq 0.4 \\ 333 * (sparsity - 0.4) + 200, & sparsity > 0.4 \end{cases}$$

$$\sigma^{-2}_{volume_{age}} = \begin{cases} 1, & sparsity \leq 0.4 \\ 246 * (sparsity - 0.4) + 1, & sparsity > 0.4 \end{cases}$$

$$\sigma^{-2}_{price_{year}} = \begin{cases} 100, & sparsity \leq 0.4 \\ 333 * (sparsity - 0.4) + 200, & sparsity > 0.4 \end{cases}$$

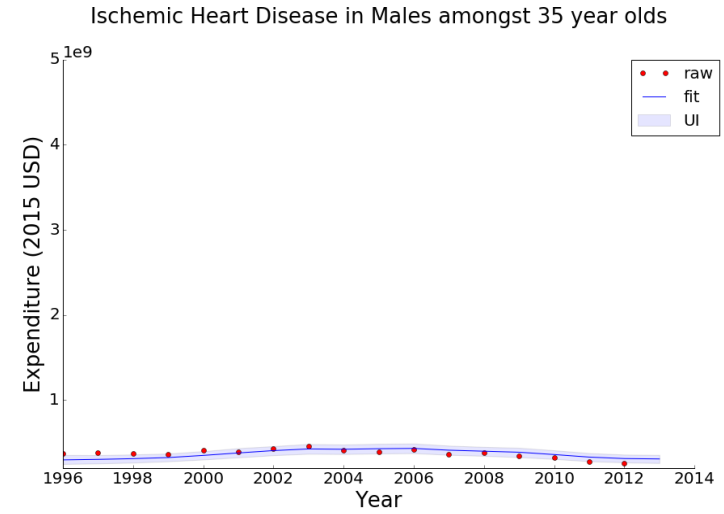
$$\sigma^{-2}_{price_{age}} = \begin{cases} 50, & sparsity \leq 0.4 \\ 246 * (sparsity - 0.4) + 50, & sparsity > 0.4 \end{cases}$$

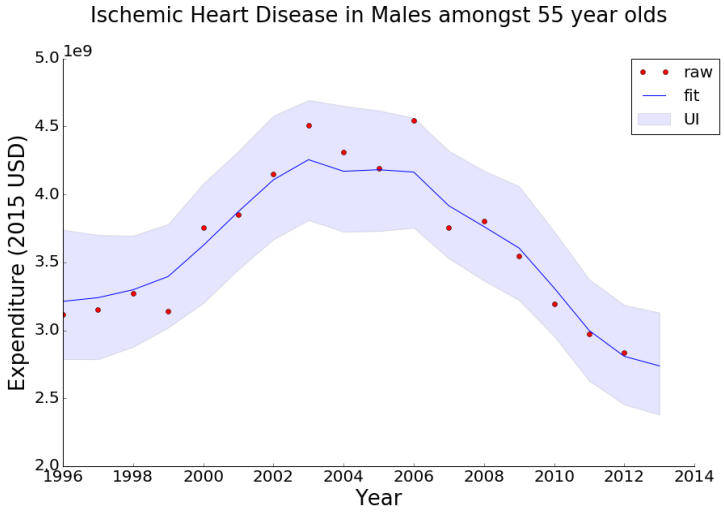
Example output

The following data shows the granularity of estimation performed by this model. The data are derived from males in the Inpatient setting diagnosed with ischemic heart disease. Figure 1 shows expenditure across ages for three selected years. Figure 2 shows expenditure across years for three selected ages. Figure 3 shows an

example cross-section for estimates of each quantity across age for the year 2012. In each of these figures, the shaded blue region represents the uncertainty interval (UI) that is calculated as the 2.5th and 97.5th percentile for a given data point across the 10001,000 bootstrapped draws. This is not a confidence interval analytically derived or calibrated to a specific alpha value.

Figure 4.1: Expenditure across age





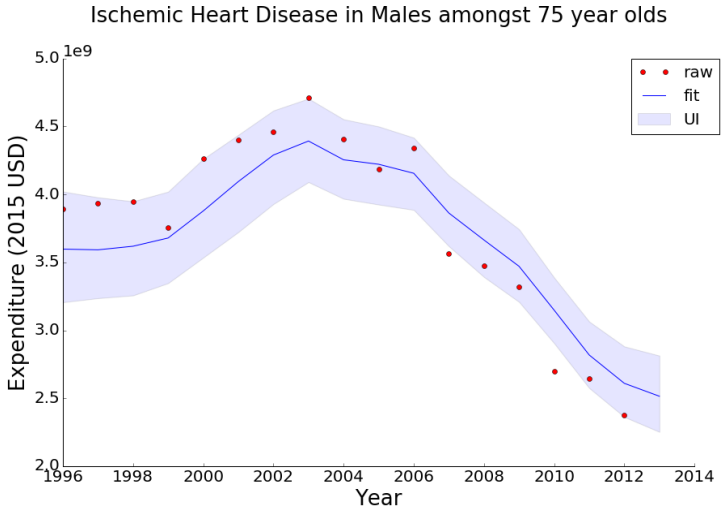
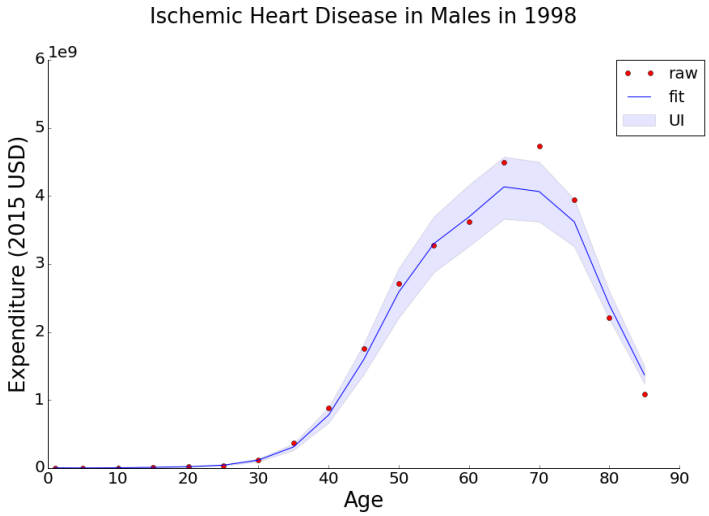
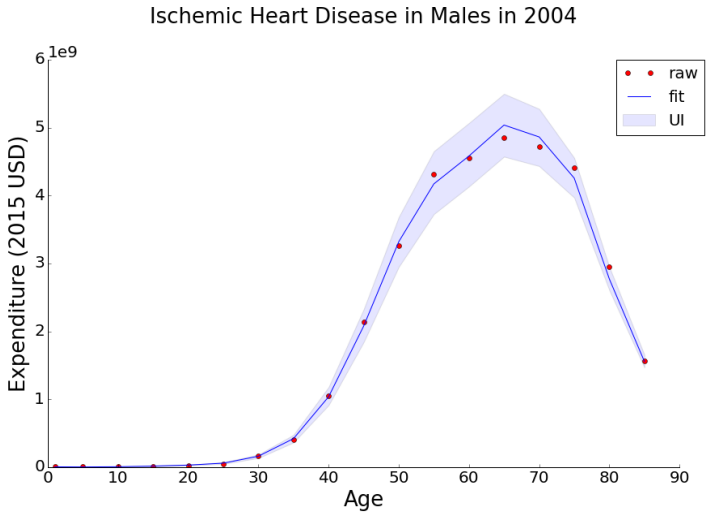


Figure 4.2: Expenditure across time





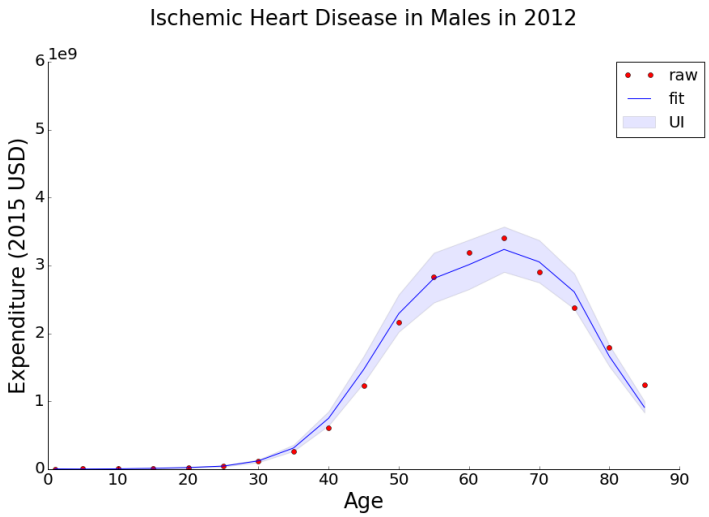
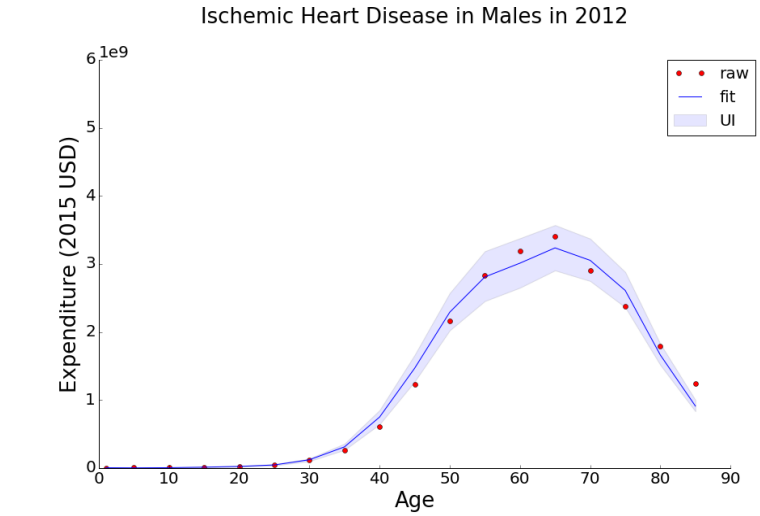
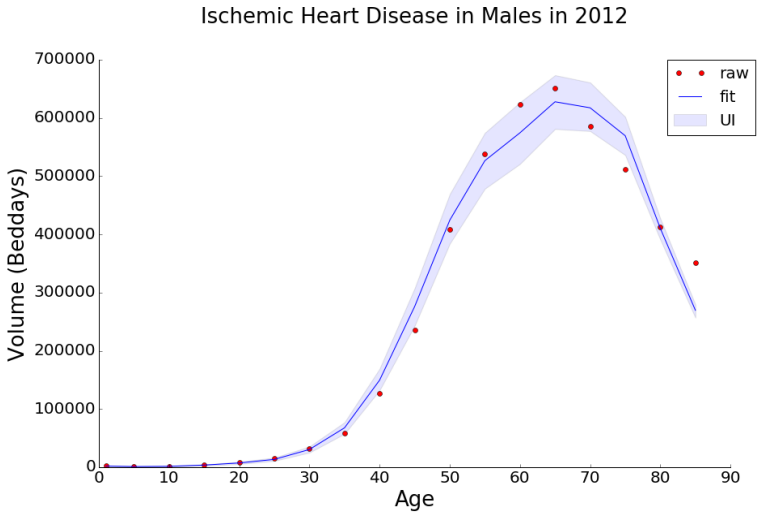


Figure 4.3: Expenditure, volume, price across age – Ischemic Heart Disease





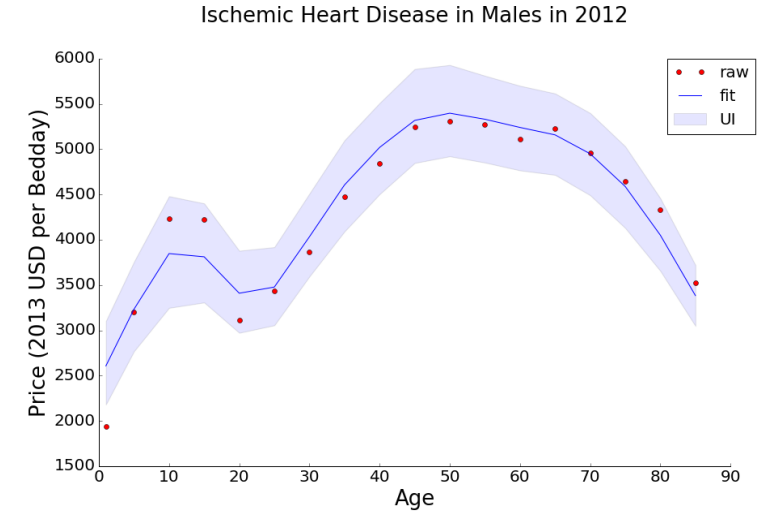
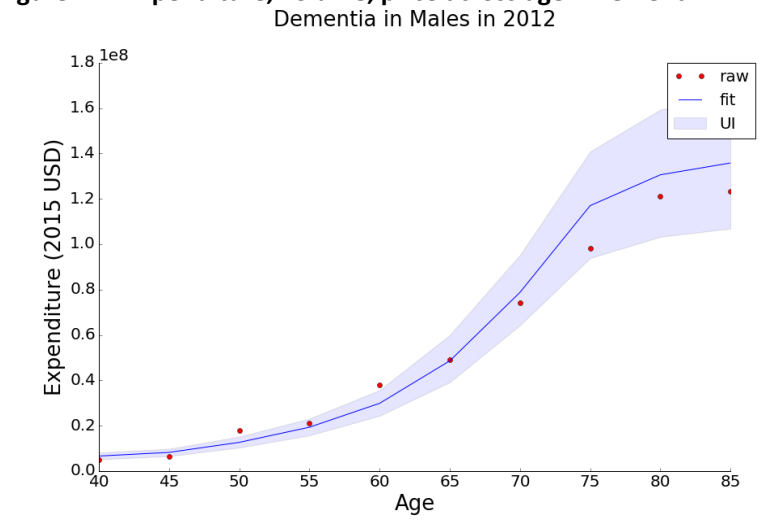
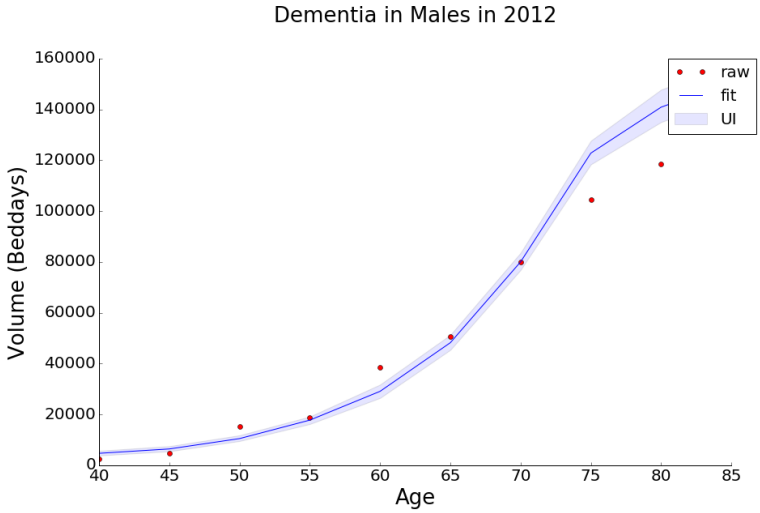


Figure 4.4: Expenditure, volume, price across age – Dement





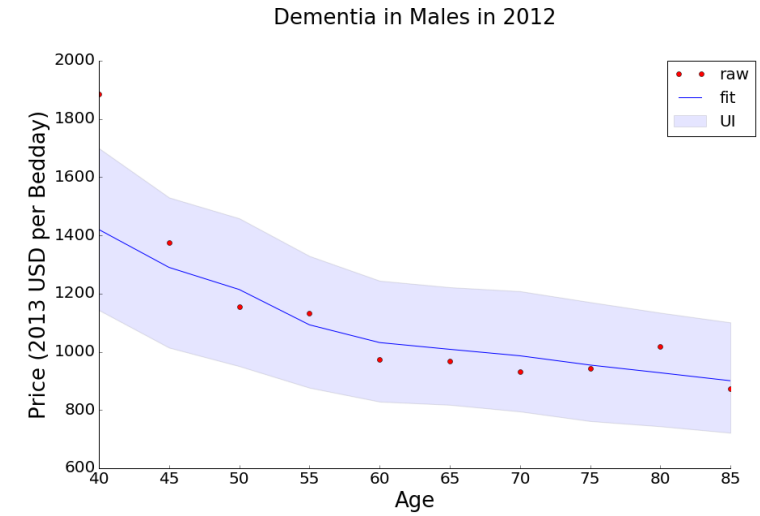
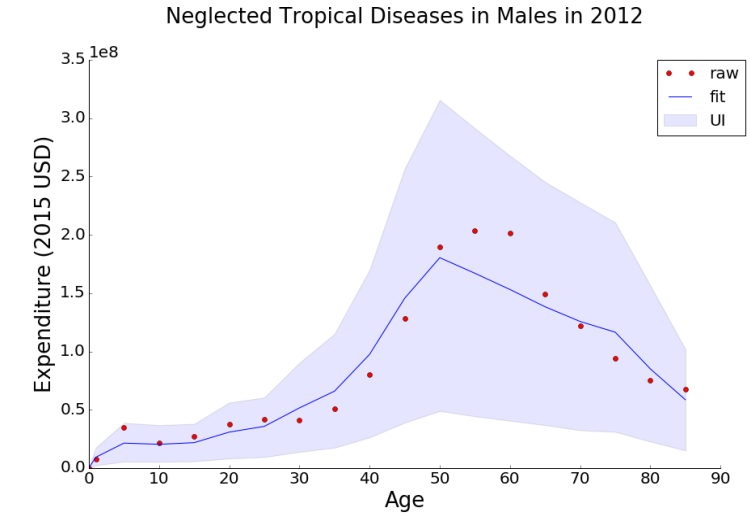
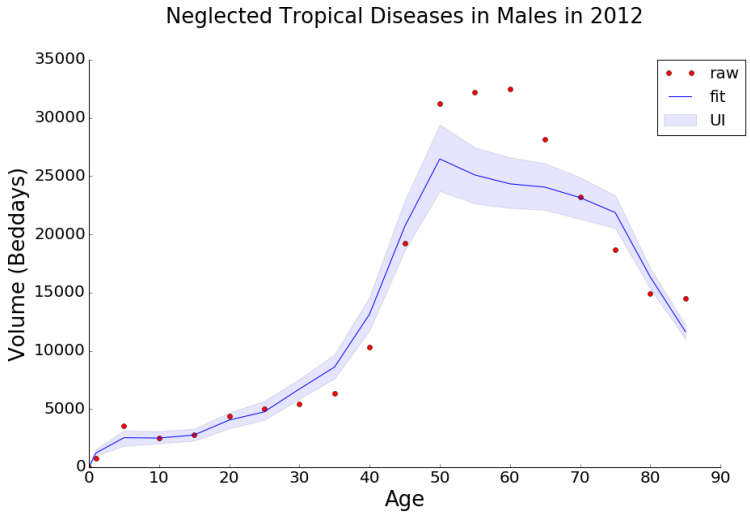
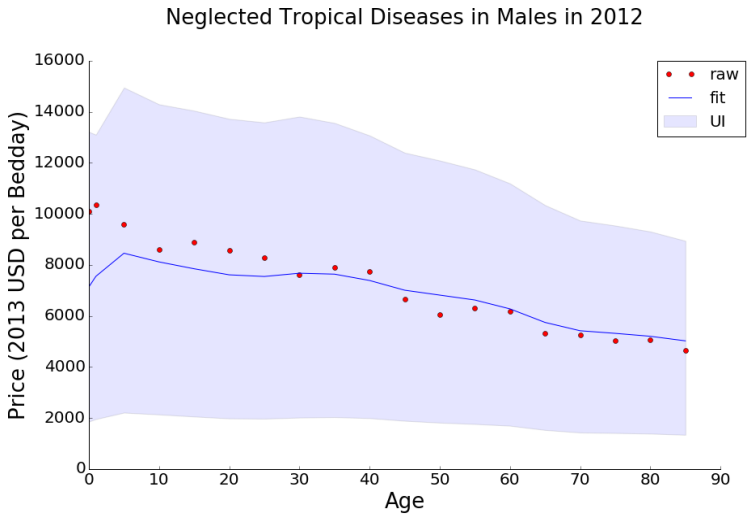


Figure 4.4: Expenditure, volume, price across age – Neglected tropical diseases







Section 5a: Adjusting for comorbidities

A regression-based framework was used for modeling excess spending due to comorbidities. This regression was based on observed patterns of spending and comorbidity diagnoses in the data. In this model, spending was redistributed across all conditions to more accurately reflect the true cost of treating each condition. The methods below are explained and explored in more detail in forthcoming research.[17]

Input data

We based comorbidity adjustment on two datasets: the National Inpatient Sample survey (NIS) and the Center for Medicare and Medicaid Services' Skilled Nursing Facility survey (CMS). These datasets were chosen because they contain information on multiple secondary diagnoses, in addition to the primary diagnosis. The NIS and CMS datasets list, on average, 5.2 and 5.6 secondary diagnoses per encounter, respectively (Table 5b-1). These datasets were analyzed at the encounter level, where each observation in the data corresponds to a single hospital stay (NIS) or a single long-term health care event (CMS).

Table 5a-1: Mean number of diagnoses per encounter by data source and year in the raw data

Year	NIS	CMS
1996	3.6	-
1997	3.7	-
1998	3.8	-
1999	3.8	5.0
2000	3.9	5.1
2001	4.1	5.3
2002	4.4	4.7
2003	4.6	-
2004	4.8	5.0
2005	5.1	-
2006	5.4	5.4
2007	5.8	-
2008	6.3	5.8
2009	6.9	-
2010	7.4	6.3
2011	8.0	-
2012	8.2	7.6

The input data used in the comorbidity analysis were mapped from ICD-9 codes to GBD conditions, but they did not go through garbage code redistribution. Therefore, before cleaning, they still contained N-codes for injuries, not-elsewhere-classified (NEC) conditions, and garbage codes.

The data also included demographic information associated with each encounter: namely the sex and age of the patient, with ages binned into 5-year groups. The comorbidity analysis was performed using data from all age groups for the NIS. For CMS, the analysis was restricted to ages 65 years and older, due to data sparseness in the younger age groups.

Data cleaning

Select diagnoses were reassigned to alternative ones that were considered more informative, condition-restrictions were applied, data were divided into four age categories, conditions with very few observations were dropped from the analysis, and bootstrap draws were merged on.

A probabilistic replacement was used to reassign certain injury conditions (N-codes) and Not-Elsewhere-Classified (NEC) conditions to alternative related diagnoses that were more relevant for this analysis. These codes and the motivations for removing them are described in more detail in Section 3 of this appendix. Probability maps were created for the injury adjustment by using data from years that provided both N-codes and E-codes to calculate the proportions of multiple N-codes to each E-code. These data were combined across all years to make probability maps specific to data source and age group. The maps were created at the source-age level, because disease burden and the distribution of conditions are a function of age. Thus, the maps capture the variability in disease patterns across ages.

If multiple E-codes were listed for a given encounter, the first one was used to create the map. If multiple N-codes were listed for a given encounter, the most severe injury N-code was used to create the map, based on a severity hierarchy developed in GBD 2013. This means that if an encounter presented with multiple injuries coded as N-codes, the diagnosis that was likely to be responsible for the largest cost and burden was the one selected.[18]

For the NEC-adjustment, spending for each NEC-condition was probabilistically reassigned to a non-NEC condition in the same family. For instance, NEC cardiovascular disease might be reassigned to ischemic heart disease, cerebrovascular disease, or a number of other cardiovascular sibling-conditions. The probability of being reassigned to a given sibling condition was based on the relative proportions of spending for each sibling condition in the data. For instance, IHD comprised 69% of the non-NEC cardiovascular spending, whereas heart failure comprised only 8%. Spending for NEC cardiovascular disease would therefore have a 69% probability of being reassigned to IHD, or an 8% chance of being reassigned to heart failure.

EXAMPLE. N-code proportions and replacement

Among 55-year-olds in the inpatient setting, the GBD injury conditions and the corresponding probability weights associated with the N-code, N11, are:

- **Animal contact (0.004)**
- **Exposure to mechanical forces (0.015)**
- **Other transport injuries (0.079)**
- **Garbage code (0.098)**
- **Other unintentional injuries (0.059)**
- **Road injuries (0.182)**
- **Falls (0.563)**

Thus, whenever N11 appeared in the diagnosis list for 55-year-olds, it was remapped as falls in 56.3% of observations, as road injuries in 18.2% of observations, etc.

EXAMPLE. NEC proportions and replacement

Among 55-year-olds in the inpatient setting, the conditions in the cardiovascular disease (CVD) family and their corresponding probabilities of occurrence are:

- **Hyperlipidemia (0.001)**
- **Endocarditis (0.002)**
- **Aortic aneurysm (0.002)**
- **Cardiomyopathy and myocarditis (0.002)**
- **Rheumatic heart disease (0.001)**
- **Hypertensive heart disease (0.007)**
- **Peripheral vascular disease (0.014)**
- **Hypertension (0.008)**
- **Atrial fibrillation and flutter (0.037)**
- **Other cardiovascular and circulatory diseases (0.073)**
- **Heart failure (0.080)**
- **Cerebrovascular disease (0.079)**
- **Ischemic heart disease (0.694)**

Thus, whenever a CVD NEC condition appeared in the diagnosis list for 55-year-olds, it was remapped as ischemic heart disease in 69.4% of observations, cerebrovascular disease in 7.9% of observations, etc.

After removing N-codes and NEC conditions from the data set, GBD restrictions were applied in the same manner as described in Section 3. All observations with a garbage code as the primary diagnosis were dropped from the dataset. If a primary diagnosis was not a garbage code, but a secondary diagnosis was a garbage code, that secondary diagnosis was replaced as missing. If a single observation had multiple diagnoses with ICD-9 codes that mapped to the same GBD condition (for example, two or more secondary diagnoses of “septicemia”), the duplicates were replaced as missing in the diagnosis list. All missing

secondary diagnoses were removed from the data. This meant that there were fewer secondary diagnoses in the clean data than in the raw data, as illustrated by Table 5b-2.

Table 5a-2: Mean number of diagnoses by data source and year in the cleaned data

YEAR	NIS	CMS
1996	2.1	-
1997	2.2	-
1998	2.2	-
1999	2.2	2.0
2000	2.3	2.0
2001	2.4	2.1
2002	2.5	2.2
2003	2.7	-
2004	2.8	2.3
2005	3.0	-
2006	3.2	2.5
2007	3.5	-
2008	3.8	2.7
2009	4.2	-
2010	4.4	2.9
2011	4.8	-
2012	4.9	3.6

Encounters were divided into four age categories and all analysis was done at the source-age category-level. The four age categories were (i) 0-14 years, (ii) 15-44 years, (iii) 45-64 years, and (iv) 65 years and above. These age groupings were chosen to reflect the observed age-delineations in patterns of disease burden and in the distribution of comorbidities. Because burden and comorbidity distributions differ across these age categories, four age category-specific lists of primary diagnoses and comorbidities were used in the analysis. Although the analysis was only conducted at the age category level, the sex and year variables were retained to inform the regression.

Even after pooling the data across all years and both sexes, several conditions still appeared as a primary diagnosis on only a relatively small number of encounters. These conditions, such as leprosy, were conditions with low prevalence in the US. Because these conditions accounted for a negligible share of the total sample size, a lower bound on the reported number of encounters necessary for inclusion of a condition in analysis was set. Conditions with fewer than 1,000 reported encounters across all years and both sexes within an age category were excluded from analysis. The final lists of conditions considered for this analysis, by age category, are listed in Table 5a-3. The age categories were determined by experts and researchers working on the Global Burden of Disease at the Institute for Health Metrics and Evaluation. The main factor dictating differences between conditions included in each age group are restrictions imposed according to the pathology of each condition. For example, maternal complications such as sepsis are only considered for childbearing ages.

Table 5a-3: Conditions included in analysis by age category

Condition	0-14 years	15-44 years	45-64 years	65 years and older
Acute glomerulonephritis	Included	Included	Included	Included
Acute renal failure	Included	Included	Included	Included
Alcohol use disorders	Included	Included	Included	Included
Alzheimer's disease and other dementias	Restricted	Restricted	Included	Included
Animal contact	Included	Included	Included	Included
Anxiety disorders	Included	Included	Included	Included
Aortic aneurysm	Restricted	Included	Included	Included
Appendicitis	Included	Included	Included	Included
Asthma	Included	Included	Included	Included
Atrial fibrillation and flutter	Restricted	Included	Included	Included
Attention-deficit/hyperactivity disorder	Included	Included	Restricted	Restricted
Autistic spectrum disorders	Included	Included	Restricted	Restricted
Bipolar disorder	Included	Included	Included	Included
Bladder cancer	Restricted	Included	Included	Included
Brain and nervous system cancers	Included	Included	Included	Included
Breast cancer	Restricted	Included	Included	Included

Table 5a-3: Conditions included in analysis by age category, continued

Condition	0-14 years	15-44 years	45-64 years	65 years and older
Cardiomyopathy and myocarditis	Included	Included	Included	Included
Cerebrovascular disease	Included	Included	Included	Included
Cervical cancer	Restricted	Included	Included	Included
Chronic kidney diseases	Included	Included	Included	Included
Chronic obstructive pulmonary disease	Included	Included	Included	Included
Cirrhosis of the liver	Included	Included	Included	Included
Collective violence and legal intervention	Restricted	Included	Included	Included
Colon and rectum cancers	Restricted	Included	Included	Included
Complications of abortion	Restricted	Included	Included	Restricted
Conduct disorder	Included	Included	Restricted	Restricted
Congenital anomalies	Included	Included	Included	Included
Depressive disorders	Included	Included	Included	Included
Diabetes mellitus	Included	Included	Included	Included
Diarrheal diseases	Included	Included	Included	Included
Drowning	Included	Included	Restricted	Restricted
Drug use disorders	Included	Included	Included	Included

Table 5a-3: Conditions included in analysis by age category, continued

Condition	0-14 years	15-44 years	45-64 years	65 years and older
Encephalitis	Included	Included	Included	Included
Endocarditis	Restricted	Included	Included	Included
Endocrine, metabolic, blood, and immune disorders	Included	Included	Included	Included
Epilepsy	Included	Included	Included	Included
Esophageal cancer	Restricted	Included	Included	Included
Exposure to forces of nature	Restricted	Included	Included	Included
Exposure to mechanical forces	Included	Included	Included	Included
Falls	Included	Included	Included	Included
Fire, heat and hot substances	Included	Included	Included	Included
Foreign body	Included	Included	Included	Included
Gallbladder and biliary diseases	Included	Included	Included	Included
Gallbladder and biliary tract cancer	Restricted	Restricted	Included	Included
Gastritis and duodenitis	Included	Included	Included	Included
Gout	Restricted	Included	Included	Included
Gynecological diseases	Included	Included	Included	Included
HIV/AIDS	Included	Included	Included	Included

Table 5a-3: Conditions included in analysis by age category, continued

Condition	0-14 years	15-44 years	45-64 years	65 years and older
Heart Failure	Included	Included	Included	Included
Hemoglobinopathies and hemolytic anemias	Included	Included	Included	Included
Hemolytic disease in fetus and newborn and other neonatal jaundice	Included	Restricted	Restricted	Restricted
Hepatitis	Included	Included	Included	Included
Hodgkin lymphoma	Restricted	Included	Included	Included
Hypertensive heart disease	Restricted	Included	Included	Included
Idiopathic intellectual disability	Restricted	Restricted	Restricted	Included
Indirect maternal deaths	Included	Included	Included	Restricted
Inflammatory bowel disease	Included	Included	Included	Included
Inguinal or femoral hernia	Included	Included	Included	Included
Interpersonal violence	Included	Included	Included	Included
Interstitial lung disease and pulmonary sarcoidosis	Included	Included	Included	Included
Intestinal infectious diseases	Included	Included	Included	Included
Iron-deficiency anemia	Included	Included	Included	Included
Ischemic heart disease	Restricted	Included	Included	Included
Kidney cancer	Included	Included	Included	Included

Table 5a-3: Conditions included in analysis by age category, continued

Condition	0-14 years	15-44 years	45-64 years	65 years and older
Larynx cancer	Restricted	Included	Included	Included
Leukemia	Included	Included	Included	Included
Liver cancer	Restricted	Included	Included	Included
Low back and neck pain	Included	Included	Included	Included
Lower respiratory infections	Included	Included	Included	Included
Malignant skin melanoma	Restricted	Included	Included	Included
Maternal hemorrhage	Restricted	Included	Restricted	Restricted
Maternal hypertensive disorders	Included	Included	Included	Restricted
Maternal sepsis and other pregnancy related infection	Restricted	Included	Restricted	Restricted
Meningitis	Included	Included	Included	Included
Mesothelioma	Restricted	Restricted	Included	Included
Migraine	Included	Included	Included	Included
Mouth cancer	Restricted	Included	Included	Included
Multiple myeloma	Restricted	Included	Included	Included
Multiple sclerosis	Restricted	Included	Included	Included
Nasopharynx cancer	Restricted	Included	Included	Included

Table 5a-3: Conditions included in analysis by age category, continued

Condition	0-14 years	15-44 years	45-64 years	65 years and older
Neglected tropical diseases and malaria	Included	Included	Included	Included
Neonatal encephalopathy (birth asphyxia and birth trauma)	Included	Restricted	Restricted	Restricted
Non-Hodgkin lymphoma	Included	Included	Included	Included
Non-melanoma skin cancer	Restricted	Included	Included	Included
Obstructed labor	Restricted	Included	Restricted	Restricted
Oral disorders	Included	Included	Included	Included
Osteoarthritis	Restricted	Included	Included	Included
Other cardiovascular and circulatory diseases	Included	Included	Included	Included
Other chronic respiratory diseases	Included	Included	Included	Included
Other digestive diseases	Included	Included	Included	Included
Other infectious diseases	Included	Included	Included	Included
Other maternal disorders	Included	Included	Included	Restricted
Other mental and behavioral disorders	Included	Included	Included	Included
Other musculoskeletal disorders	Included	Included	Included	Included
Other neonatal disorders	Included	Restricted	Restricted	Restricted
Other neoplasms	Included	Included	Included	Included

Table 5a-3: Conditions included in analysis by age category, continued

Condition	0-14 years	15-44 years	45-64 years	65 years and older
Other neurological disorders	Included	Included	Included	Included
Other nutritional deficiencies	Restricted	Included	Included	Included
Other pharynx cancer	Restricted	Included	Included	Included
Other transport injuries	Included	Included	Included	Included
Other unintentional injuries	Included	Included	Included	Included
Otitis media	Included	Included	Included	Included
Ovarian cancer	Restricted	Included	Included	Included
Pancreatic cancer	Restricted	Included	Included	Included
Pancreatitis	Included	Included	Included	Included
Paralytic ileus and intestinal obstruction	Included	Included	Included	Included
Parkinson's disease	Restricted	Restricted	Included	Included
Peptic ulcer disease	Included	Included	Included	Included
Peripheral vascular disease	Restricted	Included	Included	Included
Pneumoconiosis	Restricted	Restricted	Restricted	Included
Poisonings	Included	Included	Included	Included
Preterm birth complications	Included	Restricted	Restricted	Restricted

Table 5a-3: Conditions included in analysis by age category, continued

Condition	0-14 years	15-44 years	45-64 years	65 years and older
Prostate cancer	Restricted	Included	Included	Included
Protein-energy malnutrition	Included	Included	Included	Included
Rheumatic heart disease	Restricted	Included	Included	Included
Rheumatoid arthritis	Included	Included	Included	Included
Road injuries	Included	Included	Included	Included
Schizophrenia	Included	Included	Included	Included
Self-harm	Included	Included	Included	Included
Sense organ diseases	Included	Included	Included	Included
Sepsis and other infectious disorders of the newborn baby	Included	Restricted	Restricted	Restricted
Septicemia	Included	Included	Included	Included
Sexually transmitted diseases excluding HIV	Included	Included	Included	Included
Skin and subcutaneous diseases	Included	Included	Included	Included
Stomach cancer	Restricted	Included	Included	Included
Tension-type headache	Restricted	Included	Included	Included
Testicular cancer	Restricted	Included	Restricted	Restricted
Thyroid cancer	Restricted	Included	Included	Included

Table 5a-3: Conditions included in analysis by age category, continued

Condition	0-14 years	15-44 years	45-64 years	65 years and older
Trachea, bronchus, and lung cancers	Restricted	Included	Included	Included
Tuberculosis	Included	Included	Included	Included
Upper respiratory infections	Included	Included	Included	Included
Urinary diseases and male infertility	Included	Included	Included	Included
Uterine cancer	Restricted	Included	Included	Included
Varicella	Included	Included	Included	Included
Vascular intestinal disorders	Restricted	Included	Included	Included
Pertussis	Included	Included	Included	Included
Total Included Conditions	90	125	137	118

One thousand draw frequencies were merged on to the cleaned input data by source, year, age, sex, and primary diagnosis. In order to integrate the comorbidity analysis with the rest of the disease expenditure analysis, the same bootstrap frequencies were used as in the rest of the study. All subsequent steps in comorbidity analysis were carried out 1,000 times, separately for each draw. This bootstrapping method was used to generate the uncertainty interval around point estimates. All reported comorbidity results are the mean estimates across the 1,000 bootstrap sample draws.

Comorbidity selection

To maintain the comprehensive nature of the analysis, nearly all conditions present in the data as primary diagnoses and as comorbidities were included. However, the list of comorbidities allowed for a given primary diagnosis was restricted because of the aims of the research and data availability.

Infrequently occurring comorbidities can present as merely noise in the dataset. For this framework, the comorbidities for each primary condition were defined by their probability of occurrence. For a given primary diagnosis, any secondary diagnosis with a probability of occurring greater than or equal to a lower bound threshold of 10% was considered as a viable comorbidity threshold. This threshold ensured that only the most pertinent and robust primary diagnosis-comorbidity pairs were considered in analysis.

EXAMPLE. Comorbidity pairs selection

Among 45-64 year olds in the inpatient setting, ischemic heart disease (IHD) occurs as both a primary and secondary diagnosis.

As a primary diagnosis, IHD had 122 associated secondary diagnoses. Of the 122 associated secondary diagnoses, only nine had probabilities of co-occurrence greater than or equal to 10%. Therefore, only the following secondary diagnoses were considered as comorbidities for IHD:

Comorbidity	Probability
Hypertension	55.6%
Hyperlipidemia	51.9%
Drug use disorders	34.3%
Diabetes mellitus	31.8%
Other cardiovascular and circulatory diseases	17.7%
Heart failure	16.8%
Endocrine, metabolic, blood, and immune disorders	16.5%
Other digestive disorders	12.8%
Chronic obstructive pulmonary disease	11.6%

IHD occurred as a secondary diagnosis for 123 primary diagnoses. Of the 123 primary diagnoses, IHD occurred with a probability greater than or equal to 10% in 85. Therefore, IHD was considered as a comorbidity for 85 primary diagnoses. The top 10 primary diagnoses for which IHD was a comorbidity were:

Primary diagnosis	Probability
Heart failure	51.4%
Peripheral vascular disease	44.7%
Hypertensive heart disease	40.5%
Rheumatic heart disease	39.9%
Aortic aneurysm	38.9%
Cardiomyopathy and myocarditis	38.2%
Atrial fibrillation and flutter	34.4%
Other cardiovascular and circulatory diseases	31.3%
Chronic kidney disease	27.6%
Cerebrovascular disease	26.8%

After setting the comorbidity threshold, several secondary diagnoses still remained that were not viable comorbidities. These secondary diagnoses were manifestations of underlying conditions rather than true comorbidities. To account for these false comorbidities, the following were excluded as comorbidities:

1. All intermediate conditions, such as skin and subcutaneous disease as a comorbidity for diabetes and heart failure as a comorbidity for CVD
2. All residual "other" categories, such as other indirect maternal conditions and other infectious diseases
3. All risk factors, impairments, and well care conditions, such as hyperlipidemia, renal failure, and well pregnancies

These restrictions were set in consultation with medical professionals who have an understanding of ICD-9 coding in clinical settings. The full list of restrictions is outlined in Table 5a-4.

Table 5a-4: Comorbidity restrictions

Table 5a-4 shows the restrictions placed on flows of expenditure between primary diagnoses and comorbidities. Funds were not permitted to flow from the primary diagnoses in the left column to the comorbidities in the right column.

Primary diagnosis	Comorbidity
All conditions	Indirect maternal conditions
	Protein-energy malnutrition
	Iron-deficiency anemia
	Other infectious diseases
	Septicemia
	Hypertension
	Hyperlipidemia
	Urinary diseases and male infertility
	Endocrine, metabolic, blood, and immune disorders
	Acute renal failure
	Adverse effects of medical treatment
	All "other" residual conditions
All conditions *except* lower and upper respiratory infections	Otitis media
Preterm birth complications	All comorbidities
All cancers	
All cardiovascular diseases	Atrial fibrillation and flutter
	Heart failure
Diabetes	Skin and subcutaneous diseases
All injuries	Skin and subcutaneous diseases
	Sense organ diseases
	All injuries

EXAMPLE. Comorbidity pairs restriction

After setting the probability threshold, IHD among 45-64 year olds in the inpatient setting appeared as a primary diagnosis in nine primary diagnosis-comorbidity pairs and as a comorbidity in 85 pairs. Comorbidity restrictions were applied to IHD, further reducing the number of IHD-related pairs that occurred in the regression input data.

After restrictions, IHD occurred as a primary diagnosis in just three pairs, with the following comorbidities:

- **Drug use disorders**
- **Diabetes mellitus**
- **Chronic obstructive pulmonary disease**

IHD occurred as a comorbidity for 60 primary diagnoses. The top 10 primary diagnoses remained the same as those listed in the previous example box.

Modeling risk of excess spending

A log-linear regression model was used to generate estimates of the risk of excess spending due to comorbidities. Log-linear regression is one of the most commonly used methods for modeling health care spending data. A log-linear regression was estimated separately for each primary condition and age category, with the expenditure for a health system encounter as the dependent variable and all of the relevant comorbidities as binary independent variables indicating whether a patient was co-diagnosed with these comorbidities. The simplest form of the model is illustrated by Equation (1):

$$\log(expenditure_i) = \beta_{i0} + \sum_{j=1}^{J} \beta_{ij} comorbidity_{ij} + \varepsilon_i \qquad (1)$$

In this equation, excess spending was estimated independently for each primary diagnosis *i*, using age category-specific encounter-level data, and included the set of comorbidities that spanned from *j* to *J*. Binary indicators were included to control for the effects of heterogeneity between sexes and in spending across time. The relative risk of excess spending for *i* induced by comorbidity *j* was given by the coefficient on the respective primary diagnosis-comorbidity pair (β_{ij}). Only statistically significant pairs ($p < 0.05$) were included in the final comorbidity adjustment.

The presence of a comorbidity generally led to increased health spending for a given primary diagnosis. In these cases, $\beta_{ij} > 0$ and, on average, the comorbid condition raised the cost of managing the primary condition. However, a relative risk less than zero was a possible regression outcome. This result implied that the costs of managing the primary condition were lowered due to the coexistence of a given comorbid condition. While empirically rare, this would occur when a comorbid condition rendered standard treatment for the primary condition ineffective, unsafe, or poorly tolerated, necessitating less aggressive, intensive, or complex, and therefore less expensive treatment.

EXAMPLE. Understanding regression results

Among 45-64 year olds, IHD appeared as both a primary diagnosis and comorbidity with diabetes mellitus. After regression, the IHD-diabetes pair had a coefficient of 0.052. The presence of diabetes as a comorbidity made IHD more expensive to treat. The diabetes-IHD pair had a coefficient of 0.006. The presence of IHD as a comorbidity made diabetes more expensive to treat, but less so than the opposite pairing.

Calculating attributable fractions

The relative risk of excess spending due to comorbidities was then used to calculate the attributable fraction for each primary diagnosis-comorbidity pair. Attributable fractions are the proportions of disease expenditure attributable from the primary diagnosis to each comorbidity. The share of total expenditure for primary condition *i* attributable to comorbidity *j* is the product of the pair-specific relative risk of excess expenditure and the conditional probability of *i* and *j* co-occurring. This is illustrated by Equation (2):

$$AF_{ij} = p_{ij}\left(e^{\beta_{ij}} - 1\right) \qquad (2)$$

EXAMPLE. Calculating attributable fractions

As seen in previous examples, the IHD-diabetes pair for 45-64 year olds has a probability of occurrence of 0.318 and a regression coefficient of 0.052. The attributable fraction for this pair is as follows:

$$\boldsymbol{AF_{IHD-diabetes} = 0.318\left(e^{0.052} - 1\right)}$$

or

$$\boldsymbol{AF_{IHD-diabetes} = 0.017}$$

Thus 1.7% of the total expenditure for IHD among 45-64 year olds should be redistributed to diabetes mellitus.

Generating flows and adjustment scalars

The attributable fractions for all primary diagnosis-comorbidity pairs were then used to reallocate spending from primary diagnoses to comorbidities.

The comorbidity adjustment was applied to spending data that had been mapped from ICD-9 codes to GBD conditions and had gone through redistribution and post-redistribution cleaning. However, the data had not yet been smoothed over age and sex. The spending data were disaggregated by five-year age groups, sex, year, condition, and source. Conversely, attributable fractions were calculated at the age category-condition-

source level. Expenditure fractions for condition *i,* age group a_5, sex *s*, and time *t* within condition *i*, age category a_{cat} were calculated as shown in Equation (3):

$$expenditure\ fraction_{ia_5st} = \frac{expenditure_{ia_5st}}{expenditure_{ia_{cat}}} \quad (3)$$

After calculating expenditure fractions, the total spending was collapsed down to the age category-condition level. This aggregated expenditure was used to calculate the comorbidity-adjusted spending. After adjustment, the expenditure fractions were used to disaggregate the age category-condition-specific expenditure to the age group-sex-year-condition level.

The outflows are the resources transferred away from the primary condition to comorbidities. The outflow from primary diagnosis *i* to comorbidity *j* is the product of the attributable fraction AF_{ij} and the total spending of *i*. The total outflow of resources from primary condition *i* due to all comorbidities is the sum of the outflows from *i* to all comorbidities under consideration (vector of *j*), illustrated in Equation (4):

$$outflow_i = total\ expenditure_i * \sum_j AF_{ij} \quad (4)$$

Within this framework, a primary diagnosis for one health system encounter can be, and generally is, a comorbidity for another primary diagnosis for a different health system encounter. Thus, it was important to not only calculate the share of primary diagnosis *i* attributable to comorbidity *j*, but also to calculate the share of primary diagnosis *j* attributable to comorbidity *i*. These funds are inflows, or the resources transferred to *i* when it is listed as a comorbidity for each of the *j* other conditions. The total inflow of resources from all comorbidities to primary diagnosis *i* is the sum of the product of the total spending for *j* and the attributable fractions. Equation (5) illustrates the calculation of inflows:

$$inflow_i = \sum_j (total\ expenditure_j * AF_{ij}) \quad (5)$$

Because the comorbidity adjustment was a true redistribution of resources, the total outflows across all conditions in an age category should have been equal to the total inflows in that age category. That is, the same amount of money should have been flowing out of the primary diagnoses as was flowing into the comorbidities. This assumption was used to check the calculations of outflows and inflows by age category.

The netflow of resources for a primary condition is the net transfer of resources to and from that condition. That is, the netflow for condition *i* is the difference between the total inflows and total outflows for *i*, as illustrated in Equation (6). The netflow can be positive or negative. A positive netflow meant that the given

condition had more inflow than outflow. Conditions with positive netflows generally appeared often as comorbidities and saw increases in spending as a result of comorbidity adjustment. A negative netflow indicated that the given condition had less inflow than outflow. Conditions that appeared often as primary diagnoses, but rarely as comorbidities, often had negative netflows. These conditions saw decreases in spending after comorbidity adjustment, relative to their pre-adjustment spending.

$$netflow_i = inflow_i - outflow_i \quad (6)$$

The final, comorbidity-adjusted expenditure for condition *i* was the sum of the pre-comorbidity adjusted expenditure for *i* and its corresponding netflow, as shown in Equation (7):

$$adjusted\ expenditure_i = total\ expenditure_i + netflow_i \quad (7)$$

Relative increases and decreases in spending are described using comorbidity adjustment scalars. The scalar for condition *i* is defined as the netflow for *i* as a percent of the total spending on *i*. This is shown by Equation (8):

$$scalar_i = \frac{netflow_i}{total\ expenditure_i} + 1 \quad (8)$$

For a given condition, a scalar greater than 1 represented an increase in spending, while a scalar less than 1 represented a decrease in spending. The value of the scalar represented the percent change in expenditure for that condition. The scalars provided a common metric for comparing comorbidity adjustments between conditions and across age categories and sources.

EXAMPLE. Calculating outflows, inflows, netflows, and adjusted spending

The attributable fractions for 45-64 year olds with a primary diagnosis of IHD were:

Comorbidity	Attributable fraction
Diabetes mellitus	0.017
Drug use disorders	0.011
Chronic obstructive pulmonary disease	0.010

Total pre-comorbidity adjustment for this group was $593.0 billion. The pair-specific outflow for each comorbidity was:

Comorbidity		Outflow
Diabetes mellitus	$243.2 billion * 0.017 =	$4.2 billion
Drug use disorders	$243.2 billion * 0.011 =	$2.7 billion
Chronic obstructive pulmonary disease	$243.2.0 billion * 0.010 =	$2.5 billion

Thus, the total outflow from IHD to other conditions was the sum of these three outflows, or approximately $9.4 billion.

The inflow for IHD was the sum of the outflows from the 60 diseases for which IHD was a comorbidity to IHD. The inflow to IHD was $15.3 billion.

Thus, the netflow for IHD was $15.3 billion - $9.4 billion, or $5.9 billion. The final spending for IHD among 45-64 year olds was $249.1 billion, after adjusting for all comorbidities. There was a slight increase in spending on IHD in this age group after comorbidity adjustment of about 2%:

$$scalar_{IHD} = \frac{5.9}{243.2} + 1 = 1.02$$

Because IHD occurred frequently as a comorbidity, it had a net increase in spending due to comorbidity adjustment.

In two instances comorbidity pairs did not have associated attributable fractions and therefore were not adjusted for comorbidities. These cases were for:

1. Encounters for individuals under 65 years old that appeared in the CMS data; these encounters were not included due to data sparseness; and
2. Conditions that were restricted so they did not appear as comorbidities (intermediate conditions, "other" residual conditions, risk factors, etc.)

For comorbidity pairs that did not have associated attributable fractions, it was assumed that the netflows were zero and that the pre- and post-comorbidity spending values were the same. That is, if there were missing attributable fractions, the conditions were considered to have no associated comorbidities and therefore no adjustment.

Applying attributable fractions to other spending sources

Attributable fractions were only calculated for the NIS and the CMS datasets because these were the only two sources of health spending that included a large enough set of multiple diagnoses. However, this methodology is flexible enough to be applied to any health spending data for age-condition-specific spending estimates. Although the attributable fractions are dependent on the observed patterns of comorbidities in the test data, the final comorbidity adjustment is a function of both these comorbidity patterns and the pre-adjustment spending. Therefore, by assuming that the comorbidity patterns observed in the NIS and the CMS reflect the patterns in other health spending sources, the attributable fractions from those two sources can

be applied to spending estimates from other sources that lack multiple diagnoses. This assumption was utilized to adjust most spending sources used in the wider study for the effects of comorbidities.

Because the presence of comorbidities differs across health care settings, each of the sources was matched with the attributable fractions with underlying comorbidity patterns that most accurately reflected the given health care study. The attributable fractions used to adjust each source are given in Table 5a-5.

Table 5a-5: Application of attributable fractions for comorbidity adjustment

Attributable fractions from …	Were used in the comorbidity adjustment of…
NIS	NIS
	MEPS AM
	MEPS ER
CMS	CMS
	NNHS

In order to assess the sensitivity of the comorbidity adjustment, the entire series of adjustments and modeling used to produce estimates was performed without the comorbidity adjustment in order to compare to our baseline spending results. Across all conditions the final 2013 spending (in 2013 dollars) estimates were on average 2.6 million dollars more across all ages with a standard deviation of 1.21 billion. The largest absolute decreases were in the conditions lower respiratory infections (5.4 billion), septicemia (4.7 billion) and sense organ diseases (3.4 billion). The largest absolute increases were in the conditions low back and neck pain (6.2 billion), chronic obstructive pulmonary disease (4.7 billion)), and Ischemic heart disease (4.3 billion). The full results are listed in table 5a-6.

Table 5a-6: Differences in modeled spending with and without Comorbidity adjustment

Condition	2013 Spending with comorbidity adjust	2013 Spending w/o comorbidity adjust	Difference
Low back and neck pain	87.6	81.4	6.2
Chronic obstructive pulmonary disease - Chronicchronic bronchitis, emphysema	53.8	49.1	4.7
Ischemic heart disease	88.1	83.8	4.3
Chronic kidney diseases	13.5	9.5	4.0
Atrial fibrillation and flutter	27.7	23.8	3.9
Heart Failurefailure	28.5	25.8	2.7
Osteoarthritis	47.9	45.4	2.5
Alcohol use disorders - Alcoholalcohol dependence and harmful use	9.3	6.9	2.4
Gallbladder and biliary diseases	15.2	14	1.2
Peripheral vascular disease	2.5	1.5	1.0
Cardiomyopathy and myocarditis	1.8	1.2	0.6
Congenital anomalies	10.7	10.2	0.5

Table 5a-6: Differences in modeled spending with and without Comorbidity adjustment, continued

Condition	2013 Spending with comorbidity adjust	2013 Spending w/o comorbidity adjust	Difference
Other unintentional injuries - Overexertionoverexertion, other accidents	25.6	25.1	0.5
Other mental and behavioral disorders - Insomniainsomnia	5.1	4.6	0.5
Alzheimer's disease and other dementias	36.7	36.3	0.4
Preterm birth complications - Respiratoryrespiratory distress, extreme immaturity	4.9	4.6	0.3
Conduct disorder	0.8	0.5	0.3
Colon and rectum cancers	18.5	18.2	0.3
Cerebrovascular disease	43.8	43.5	0.3
Bipolar disorder	13.1	12.9	0.2
Other neoplasms	11.6	11.4	0.2
Counseling services - Medicalmedical consultation	2.1	1.9	0.2
Cirrhosis of the liver	4.2	4	0.2
Uterine cancer	5.6	5.4	0.2
Brain and nervous system cancers	5.7	5.5	0.2
Well newborn	27.9	27.7	0.2
Trachea, bronchus, and lung cancers	13.1	13	0.1
Anxiety disorders	29.7	29.6	0.1
Non-Hodgkin lymphoma	2.9	2.8	0.1
Leukemia	3.9	3.8	0.1
Liver cancer	2.4	2.3	0.1
Pancreatic cancer	2.7	2.6	0.1
Mouth cancer	1.2	1.1	0.1
Complications of abortion - Miscarriagemiscarriage included	2	1.9	0.1
Gallbladder and biliary tract cancer	1.2	1.1	0.1
Hemolytic disease in fetus and newborn and other neonatal jaundice - Jaundicejaundice, hemolytic disease	0.3	0.2	0.1
Mesothelioma	0.9	0.8	0.1
Sexually transmitted diseases excluding HIV	2.1	2	0.1
Obesity - Treatmenttreatment of morbid obesity including bariatric surgery	5	4.9	0.1
Bladder cancer	2.8	2.7	0.1

Table 5a-6: Differences in modeled spending with and without Comorbidity adjustment, continued

Condition	2013 Spending with comorbidity adjust	2013 Spending w/o comorbidity adjust	Difference
Other maternal disorders - 2nd and 3rd degree tears	5.2	5.1	0.1
Asthma	32.5	32.4	0.1
Multiple myeloma	0.9	0.9	0.0
Malignant skin melanoma	1.3	1.3	0.0
Exposure to mechanical forces - Fallingfalling object, striking other object, cuts, being crushed	30	30	0.0
Other nutritional deficiencies	0.9	0.9	0.0
Maternal sepsis and other pregnancy related infection - Majormajor puerperal infection	0.1	0.1	0.0
Tension-type headache	0.1	0.1	0.0
Tobacco - Tobaccotobacco use disorder, cessation	0.1	0.1	0.0
Measles	0	0	0.0
Depressive disorders	71.1	71.1	0.0
Protein-energy malnutrition - Nutritionalnutritional marasmus	0.4	0.4	0.0
Social services - Servicesservices for family members	0	0	0.0
Diphtheria	0	0	0.0
Donor - Organorgan donation	0.7	0.7	0.0
Maternal hemorrhage - Antepartumantepartum and postpartum hemorrhage	1.1	1.1	0.0
Self-harm	2.8	2.8	0.0
Rheumatic heart disease	1.9	1.9	0.0
Drowning	0.1	0.1	0.0
Vitamin A deficiency	0	0	0.0
Neonatal encephalopathy (birth asphyxia and birth trauma)	0.4	0.4	0.0
Non-melanoma skin cancer	8.2	8.2	0.0
Well dental - General exam & cleaning, x-rays, orthodontia	48.7	48.7	0.0
Other pharynx cancer	1.2	1.2	0.0
Idiopathic intellectual disability	0.7	0.7	0.0
Leprosy	0	0	0.0
Tetanus	0	0	0.0
Indirect maternal deaths	6.4	6.4	0.0
Cervical cancer	2.1	2.1	0.0
Collective violence and legal intervention	1.3	1.3	0.0
Hemoglobinopathies and hemolytic anemias	2.6	2.6	0.0

Table 5a-6: Differences in modeled spending with and without Comorbidity adjustment, continued

Condition	2013 Spending with comorbidity adjust	2013 Spending w/o comorbidity adjust	Difference
Kidney cancer	3	3	0.0
Maternal hypertensive disorders	3	3	0.0
Thyroid cancer	0.6	0.6	0.0
Other transport injuries - Ridingriding animals, vehicles other than auto (buses, planes, trains)	0.8	0.8	0.0
Ovarian cancer	1.5	1.5	0.0
Encephalitis	0.3	0.3	0.0
Meningitis	0.9	0.9	0.0
Animal contact - Snakessnakes, dog	2.1	2.1	0.0
Testicular cancer	0.1	0.1	0.0
Tuberculosis	0.3	0.3	0.0
Family planning	5.1	5.1	0.0
Parkinson'sParkinson's disease	4.9	4.9	0.0
Exposure to forces of nature - Excessiveexcessive cold or heat, hurricanes, tornado, earthquake	0.2	0.2	0.0
Stomach cancer	3.9	3.9	0.0
Multiple sclerosis	4.4	4.4	0.0
Nasopharynx cancer	0.8	0.8	0.0
Whooping cough	0.3	0.3	0.0
Hodgkin lymphoma	0.2	0.2	0.0
Intestinal infectious diseases - E. coli, giardiasis, typhoid fever	0	0	0.0
Prostate cancer	5.4	5.4	0.0
Pneumoconiosis	0.2	0.2	0.0
Interpersonal violence - Raperape, assault	5.2	5.2	0.0
Obstructed labor	2.1	2.1	0.0
Iodine deficiency - Iodineiodine hypothyroidism	0.1	0.1	0.0
Esophageal cancer	0.7	0.7	0.0
Eating disorders - Anorexiasnorexia, bulimia	0.9	0.9	0.0
Acute glomerulonephritis	0	0	0.0
Paralytic ileus and intestinal obstruction	8	8	0.0
Inflammatory bowel disease	6.8	6.8	0.0
Larynx cancer	0.8	0.8	0.0
Oral disorders - Oraloral surgery and caries, including fillings, crowns, extraction, & dentures	66.4	66.5	-0.1
Diabetes mellitus	101.4	101.5	-0.1
Breast cancer	12.1	12.2	-0.1
Gastritis and duodenitis	3.4	3.5	-0.1

Table 5a-6: Differences in modeled spending with and without Comorbidity adjustment, continued

Condition	2013 Spending with comorbidity adjust	2013 Spending w/o comorbidity adjust	Difference
Rheumatoid arthritis	2.4	2.5	-0.1
Migraine	7.3	7.4	-0.1
Foreign body - Eyeeye & airway obstruction	1.2	1.3	-0.1
Hepatitis	0.3	0.4	-0.1
Sepsis and other infectious disorders of the newborn baby	0.2	0.3	-0.1
Poisonings	0.9	1	-0.1
Hypertensive heart disease	0.5	0.6	-0.1
Inguinal or femoral hernia	1.8	1.9	-0.1
Fire, heat, and hot substances - including burns	1.4	1.5	-0.1
Varicella	1	1.1	-0.1
Gout	0.7	0.8	-0.1
Road injuries - auto, cycle, motorcycle, and pedestrian	20	20.1	-0.1
Endocrine, metabolic, blood, and immune disorders - other diseases of thyroid, von Willebrand's disease	19.6	19.7	-0.1
Schizophrenia	17.6	17.8	-0.2
Attention-deficit/hyperactivity disorder	23.2	23.4	-0.2
Aortic aneurysm	9.5	9.7	-0.2
Other infectious diseases - viral & chlamydial infection, streptococcal	12.1	12.3	-0.2
Epilepsy	4.3	4.5	-0.2
Endocarditis	0.6	0.8	-0.2
Autistic spectrum disorders	3	3.2	-0.2
Treatment of hyperlipidemia	51.8	52.1	-0.3
Skin and subcutaneous diseases - cellulitis, sebaceous cyst, acne, eczema	55.7	56	-0.3
HIV/AIDS	4.8	5.1	-0.3
Other neonatal disorders - feeding problems, temperature regulation	0.4	0.7	-0.3
Appendicitis	7.8	8.1	-0.3
Vascular intestinal disorders	1.3	1.7	-0.4
Neglected tropical diseases and malaria - Lyme disease, rabies, cysticerosis, dengue	5.1	5.5	-0.4
Urinary diseases and male infertility - urinary tract infection, cyst of kidney	**54.9**	**55.4**	**-0.5**
Acute renal failure	12.7	13.2	-0.5
Upper respiratory infections	14.7	15.2	-0.5
Interstitial lung disease and pulmonary sarcoidosis	10.9	11.4	-0.5

Table 5a-6: Differences in modeled spending with and without Comorbidity adjustment, continued

Condition	2013 Spending with comorbidity adjust	2013 Spending w/o comorbidity adjust	Difference
Peptic ulcer disease	6.7	7.2	-0.5
Diarrheal diseases	9.2	9.7	-0.5
Other digestive diseases - diseases of the esophagus, diverticulitis of colon	38.8	39.4	-0.6
Pregnancy and postpartum care - normal pregnancy, including cesarean	55.6	56.2	-0.6
Iron-deficiency anemia - anemia	6.5	7.2	-0.7
Other neurological disorders - pain syndromes, muscular dystrophy	43.7	44.4	-0.7
Well person	15.4	16.1	-0.7
Otitis media	8.8	9.6	-0.8
Drug use disorders - cocaine, opioid, amphetamines, and cannabis dependence	13.5	14.6	-1.1
Gynecological diseases - menopausal & postmenopausal disorders, endometriosis	19.8	21.1	-1.3
Other chronic respiratory diseases - Sleep apnea, allergic rhinitis, chronic sinusitis	34.7	36.1	-1.4
Treatment of hypertension	83.9	85.4	-1.5
Other cardiovascular and circulatory diseases - paroxysmal tachycardia, unspecified dysrhythmias	26	27.7	-1.7
Pancreatitis	9.5	11.3	-1.8
Other musculoskeletal disorders - disorders of joints, muscular, & connective tissue	44.9	46.8	-1.9
Falls	76.3	78.8	-2.5
Sense organ diseases - cataracts, vision correction, adult hearing loss, macular degeneration	59	62.4	-3.4
Septicemia	33.9	38.6	-4.7
Lower respiratory infections	37.1	42.5	-5.4

Section 5b: Adjusting charge data

Much of the microdata used in this study reports on the charges for an encounter. In order to fully understand the landscape of US health care spending, charge data needed to be adjusted into payment data. An adjustment was developed to enable the use of the National Inpatient Sample (NIS) dataset over the MEPS Inpatient dataset. NIS is very large but contains only data on charges, while MEPS Inpatient provides information on both payments and charges but is substantially smaller. A regression-based framework was used to model total payment to total charge ratios in the inpatient setting. A similar regression was run to model facility charge to total charge ratios. Both regressions were run on MEPS Inpatient data. These ratios were combined to create facility charge to total payment conversion factors. The conversion factors were applied to facility charge data in NIS to produce nationally representative inpatient spending estimates. This charges to payments adjustment is documented in greater detail in other research.[4]

Data processing

Both MEPS Inpatient and NIS data were processed before making these adjustments. NIS was processed according to the methodology described in Section 3. MEPS Inpatient was processed differently, because the regression used for this adjustment requires encounter-level data. For MEPS Inpatient, ages were aggregated into 5-year bins, and ICD-9 codes were mapped to GBD conditions (see Section 3), but the data did not go through redistribution. Consequently, MEPS Inpatient still contained N-codes for injuries, as well as garbage codes. N-codes were removed using the probabilistic replacement method described in Section 5b. Garbage codes were dropped.

MEPS Inpatient data were categorized by three payer strata: public insurance, private insurance, and out-of-pocket. This strata variable was defined to be the primary payer. For example, if Medicare paid 75% of a patient's total payment and the other 25% was out-of-pocket, the observation was assigned to the public insurance stratum. In addition, facility charges were taken from NIS, and both spending and charge information were taken from MEPS Inpatient. These MEPS spending and charge data were then disaggregated into facility spending, doctor spending, facility charges, and doctor charges. When a patient receives treatment at an inpatient facility, they receive two bills: a facility bill and a doctor bill. Facility charges and spending cover basic hospital expenses and most professional fees. Doctor charges and spending cover services for certain doctors who bill separately. These bills generally come from anesthesiologists, radiologists, and pathologists.[19]

Total charges to total payments regression

The ratio of payments to charges was calculated for each encounter. Observations in which payments were greater than charges (<2% of all observations) were considered to be errors, and charges were re-coded to be equal to payments. By inspection, the ratios were found to be invariant by age and sex, as seen in Figures 5d-1 and 5d-2. Data were grouped by broader conditions (GBD condition Level 2), in order to increase the number of observations for each condition and payer combination. A model of the charge to payment ratio was run separately for each condition and bootstrap draw, with a binary indicator for payer and an interaction term for payer and year. The equation was as follows:

$$\left(\frac{payments}{charges}\right)_i = \beta_0 \cdot public + \beta_1 \cdot private + \beta_2 \cdot oop + \beta_3 \cdot public \cdot year + \beta_4 \cdot private \cdot year + \beta_5 \cdot oop \cdot year$$

The above equation defines the payment to charge ratio as a function of condition, payer, and time. However, inspecting trends in the underlying data suggested that total charge itself also has an important influence on the payment to charge ratio, as a person is more likely to pay a smaller proportion of a large charge (see Figure 5d-3). In this analysis, conversion factors were applied to data that were aggregated to the age and sex level and had garbage codes redistributed. Consequently, there was no longer information on the amount an individual was charged. To incorporate the effect of charges on the payment to charge ratio at the population level, the total weighted charge was assigned to be the regression weight using the frequency weight option in Stata. The decision to use frequency weights was motivated by the fact that the regression was run to find the percentage paid for each dollar charged. Under this conceptualization, a charge of $100 with a ratio of 0.80 would be equivalent to a ratio of 0.80 for 100 separate $1 charges. By definition, a frequency weight of 100 is treated as if an observation occurred 100 times, so this weighting choice is valid.

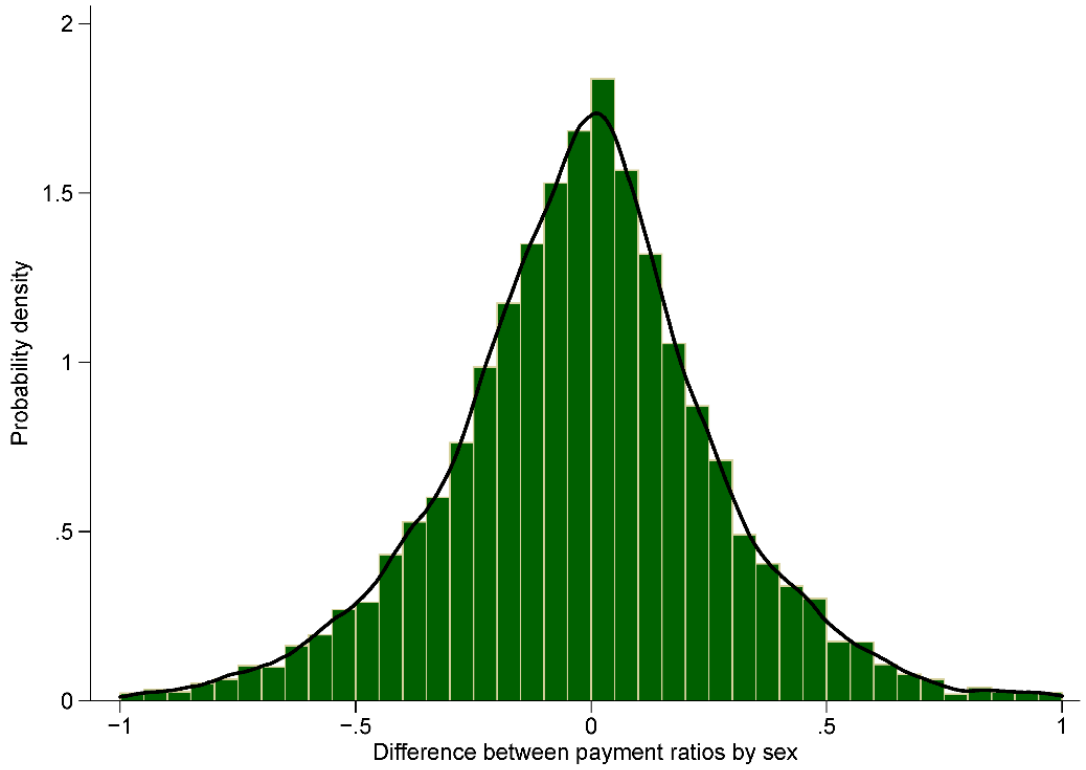


Figure 5b-1. The average payment to charge ratio was taken for every age, sex, year, payer, and condition combination. Averages that had the same age, year, payer, and condition but different sex were then paired. The difference between the payment to charge ratio was taken for each pairing. This figure shows the distribution of these differences and suggests sex is unimportant in determining payment to charge ratios.

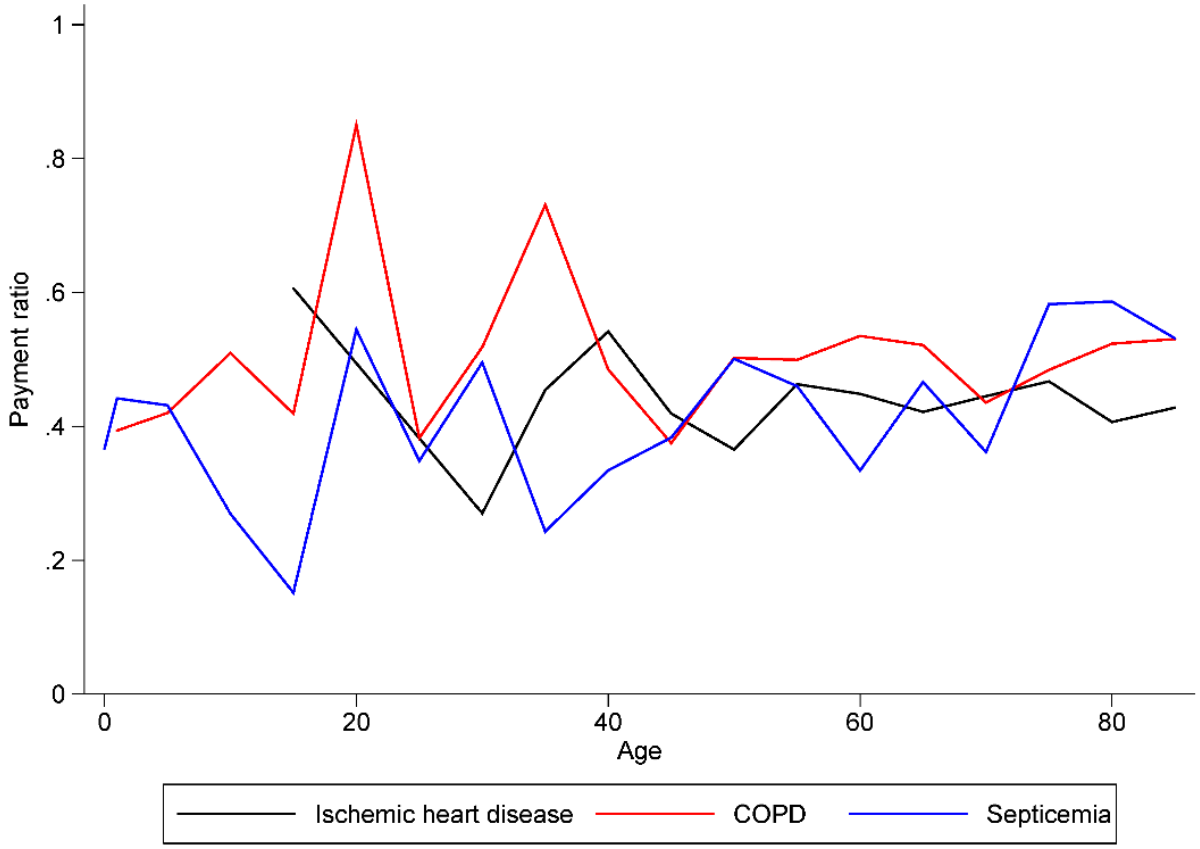


Figure 5b-2. Mean payment to charge ratios for public payer were plotted by age for three conditions. The ratios do not appear to be dependent on age.

For a given condition and draw combination, the regression was run as shown when all payers had more than 200 observations. When a condition, draw, and payer combination did not meet the 200-observation threshold, the corresponding payer-year interaction term was dropped. There are conflicting opinions concerning the number of observations needed to run a multivariate linear regression.[20] [21] Several thresholds were tried, and the final decision to set the threshold at 200 best combines goodness-of-fit, trust in the data, and the literature.

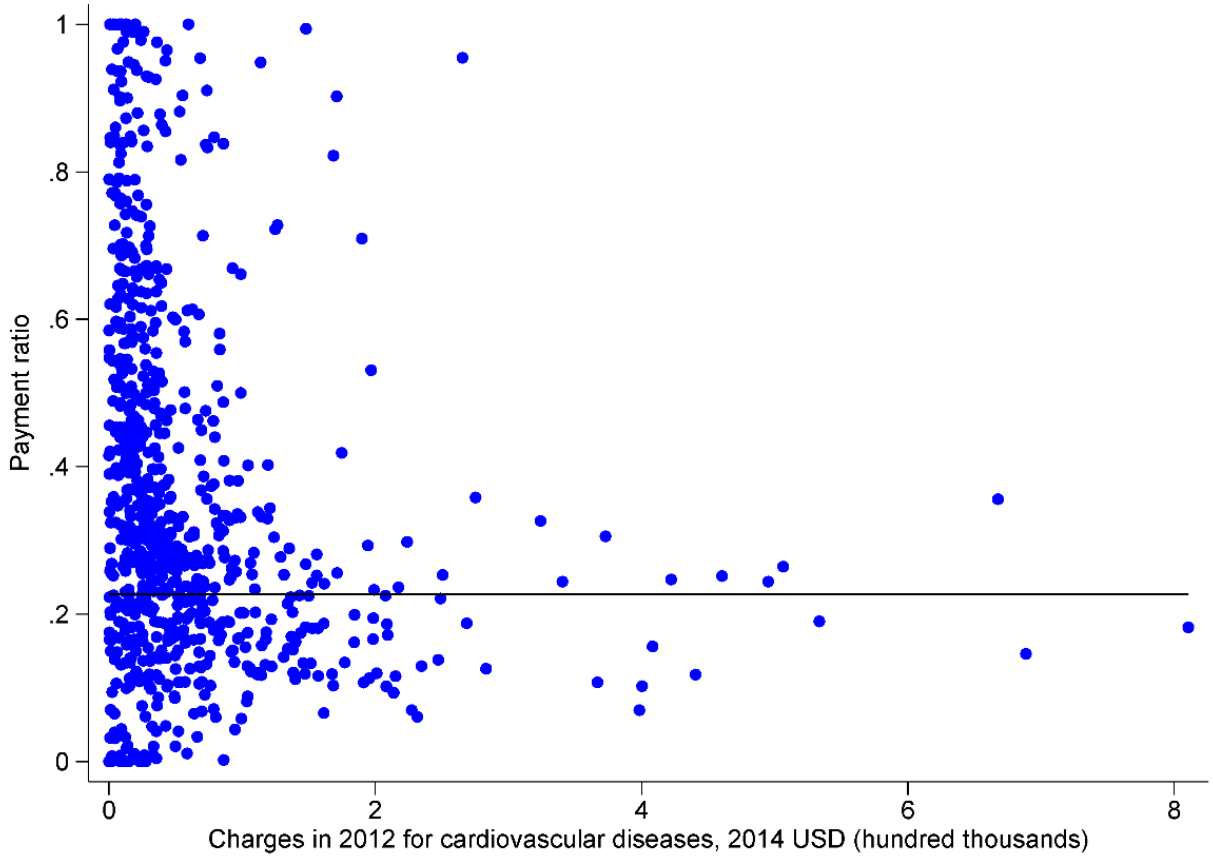


Figure 5b-3. Payment to charge ratios were taken for patients who received treatment for cardiovascular diseases that was covered by a public payer in 2012. These ratios were plotted against the total amount charged. The line is the average payment to charge ratio for all points shown. The downward trend shows that there is a systematic bias toward lower payment to charge ratios for visits with larger total charges.

Running the regression produced estimates of the payment to charge ratios by year and payer for each Level 2 GBD condition. A weighted average of these ratios was taken over payer to get year- and condition-specific estimates. The weights were year-specific proportions of spending on a given Level 3 GBD condition from each payer. These proportions were calculated using data from NIS. The averaging resulted in a single condition payment to charge ratio for each year and condition combination.

Facility charges to total charges regression

An additional regression was needed to apply the estimated payment to charge ratios to NIS. Hospital charges are often split into two components: facility charges and professional charges. MEPS Inpatient reports both types of charges, whereas NIS reports facility charges only. This paper addresses the cost of receiving inpatient care from the perspective of the patient, so total charges and total payments are the metrics of interest. These totals are equivalent to the sum of facility charges and professional charges, or the sum of facility payments and professional payments, respectively. The payment to charge regression detailed above estimates the ratio of *total* payments to *total* charges. Therefore, a facility charge to total charge conversion was needed in order to estimate the total payments in NIS. This second conversion follows a

similar form. The ratio of facility charges to total charges was the dependent variable. This ratio was considered to be a function of condition and time. Inspection of the data showed that this ratio was unrelated to age, sex, and payer. Further, the listed price for a given treatment – what are considered "charges" in this study – are known to be independent of payer within a hospital. The regression was run for each condition-draw combination, with weighted total charges as the regression weight.

$$\left(\frac{facility\ charges}{total\ charges}\right)_i = \beta_0 + \beta_1 year$$

The accuracy of the second model is limited by differences in how the two data sources define facility charges. MEPS Inpatient defines facility charges as the amount a hospital charges a patient. This number often includes fees for a physician's work, in addition to those for the use of the facility, such as bedding or cleaning. However, some physicians charge separately from the hospital, and these separate charges are labeled as professional charges. In contrast, NIS separates all physician charges from hospital charges when possible, even if they were both billed through the hospital.[22] This definitional difference means that "facility charges" in MEPS should tend to be a higher proportion of total charges than they would in NIS. Consequently, our model overestimates the ratio of facility charge to total charge.

Adjusting NIS facility charges

Finally, a condition- and payer-specific facility-charge to total-expenditure conversion factor was calculated:

$$\text{Conversion factor} = \left(\frac{total\ charges}{facility\ charges}\right)\left(\frac{total\ payment}{total\ charges}\right)$$

Conversion factors are condition- and payer-specific. A weighted average across payer was taken in order to obtain a single conversion factor for each condition-draw combination. The weights were calculated as the draw- and condition-specific proportions of facility charges for each payer at GBD condition Level 3 NIS. The weighted average resulted in the final conversion factor, which was applied to NIS after NIS had gone through all of the processing procedures described in Section 3.

Adjusting National Health Expenditure Account estimate for comparison

One way to evaluate the validity of the adjustment is by comparing the adjusted NIS spending data to the National Health Expenditure Accounts (NHEA) envelope. This comparison is shown in Figure 5d-4, which contrasts the time trends in charges and payments, stratified by condition. The reported charges from NIS are shown adjacent to the adjusted payment estimates in each year. The line running near the top of the payments bars represents a separate yearly estimate for inpatient care, which is derived from the NHEA estimate for hospital spending. To align the NHEA hospital spending with our definition of inpatient care, we applied an adjustment used in previous research and explained in more detail there.[1] We subtracted out spending attributed to "garbage conditions" from this NHEA estimate. The proximity of the NHEA estimate to the adjusted NIS estimates serves as an external validation of our methods. Further, the gap between these two estimates is readily explained by the fact that the NHEA estimate includes non-operating revenue, which is out of scope of NIS. Therefore, we expect our adjusted NIS spending estimates to be below the NHEA line. The NIS adjusted spending estimates presented in this graph confirm this hypothesis.

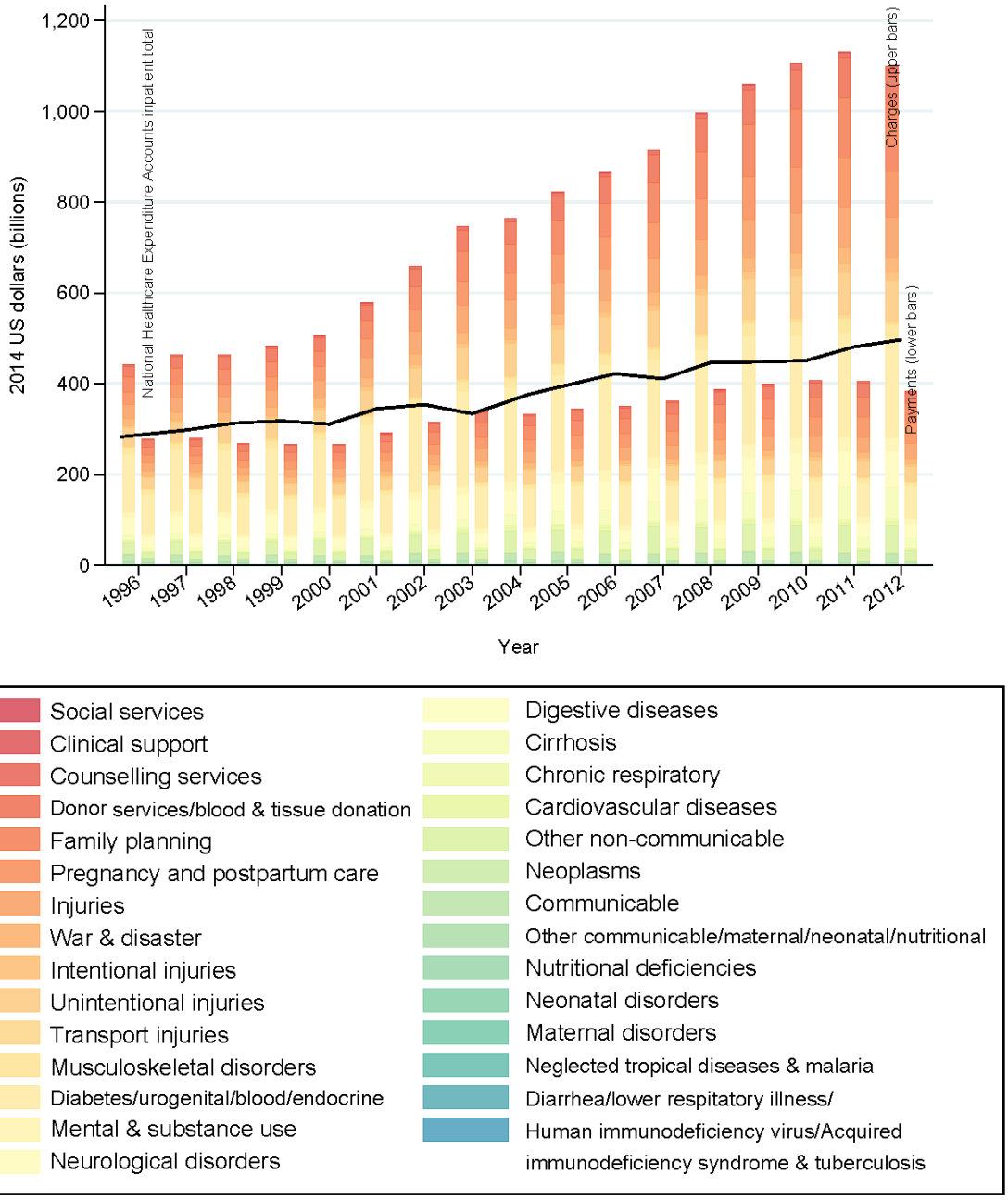


Figure 5b-4. Conversion factors were applied to NIS facility charge data to calculate NIS predicted total expenditure. These predicted payment values are plotted along with facility charges and the NHE-A envelope.

Section 5c: Nursing facilities adjustment

Data from NNHS, CMS-SNF, and MCBS were used to estimate spending and volume for the nursing care type of service. All three data sources have limitations. NNHS is nationally representative, but it is sparse and only covers three years between 1996 and 2013. CMS-SNF is more comprehensive for short-term nursing home visits but not nationally representative, as it only tracks patients at skilled-nursing facilities (SNFs) who are Medicare-eligible. MCBS covers all nursing home care received by Medicare beneficiaries, so it includes spending at facilities other than SNFs and thus tracks a larger portion of nursing home spending than CMS-SNF, but it is still not nationally representative of all nursing home spending and volume. The goal of combining these three data sources is to apply the time trends found in CMS-SNF and MCBS to the sparse yet nationally representative estimates of NNHS. Short-term and long-term stays are known to have different disease profiles, and they are also known to have changed differently over the past 15 years. Consequently, nursing care spending was estimated separately for short-term and long-term stays.[23] The results were then aggregated to estimate all health spending in nursing homes from 1996 to 2013. Summary statistics for the three sources are shown in Table 5c-1.

Table 5c-1

Summary of data sources

This table describes the strengths and shortcomings of the data sources used to estimate nursing care spending.

	CMS-SNF	NNHS	MCBS
Years	1999-2002, 2004, 2006, 2008, 2010, 2012	1997, 1999, 2004	1999-2011
Observations	25,449,745	29,172	**16,506**
Observations with stays > 100 days	401,903 (2%)	23,396 (80%)	**11,719 (71%)**
Payers	Medicare	All	All payers for Medicare beneficiaries

Short-term stays at nursing facilities

Most nursing home care is for people with chronic illnesses that need treatment for the indefinite future.[24] The NNHS finds that 95.5% of all nursing home spending in 2004 was for long-term visits, where people had been in the facility for more than 100 days.[25] This number may be an exaggeration of reality, since the NNHS is known to undersample short visits, but it confirms the current understanding of who spends the most in nursing homes. While long-term care makes up a significant majority of nursing care spending, nursing home care for acute conditions in SNFs has become more common in recent years.[23] These SNFs often aim to have a person leave the nursing home within 100 days, as Medicare coverage only contributes to SNF stays of 100 days or fewer.[26]

In this study, short-term stays at nursing facilities were defined as stays of fewer than 100 days. This threshold was chosen to align with that of Medicare's funding policy. Additionally, in tracking nursing care spending, it was assumed that care received at SNFs and captured by CMS-SNF is comprehensive of all nursing care stays shorter than 100 days. The 2004 NNHS finds that 2.8% of all nursing home spending was for stays shorter than 100 days and for which Medicare did not contribute. Consequently, this 2.8% of

spending was not accounted for in this study. Additionally, Medicare does not cover all spending for short-term stays at SNFs.[26] Analysis of the 2004 MCBS finds that Medicare covers 75% of all money spent for short-term stays. However, CMS-SNF provides charges data rather than spending so all charges for this population will be captured, even if Medicare does not cover the entirety of every claim. In other words, the entire charge of a service in a skilled-nursing facility will be included in CMS-SNF, even if Medicare only covers a portion of the cost and the rest must be paid out-of-pocket. However, the fact that CMS-SNF tracks charges itself is a limitation, as charges represent pre-negotiated prices, which are known not to be equal to actual spending.

To properly estimate short-term spending and volume from CMS-SNF, the data were processed similarly to all other data sources, as discussed in detail in previous sections. However, placing patients into the five-year age bins used in this study required additional methodology. For those aged 65 and older, CMS-SNF data files categorize patients into the same five-year age bins used in this study. However, due to privacy concerns, CMS-SNF places younger patients into broader age bins. For years 1999 to 2001, all patients in CMS-SNF data under 65 are aggregated into one age bin. Starting in 2002, CMS-SNF files changed the format. These files have more granular estimates, with three age bins for those under 65 years old: ages less than 25, ages 25 to 44, and ages 45 to 64. The assumption was made that, for a given sex and condition, the breakdown of spending and volume across ages is similar for all payers. Therefore, spending and volume for these younger ages were disaggregated into five-year age bins using age-specific proportions of treated prevalence in the long-term health care setting, which was estimated by MarketScan.

Data on the number of treated cases in each age, sex, and condition were extracted from MarketScan for the years 2010 and 2012. These data were available for all of the five-year age bins of interest. The number of people within an age and sex group who were treated for a specific condition was summed over the two years. Next, proportions were calculated that described the age distribution of these treated-case data within the wider age bins found in CMS-SNF. The CMS-SNF spending and volume estimates for the wide younger age bins were then broken out into more granular age groups using these age-specific proportions. Each proportion was also matched by condition and sex.

In review, CMS-SNF is a good source to estimate spending in short-term nursing care visits, as it is a census of all claims received by Medicare beneficiaries at SNFs, and it covers many years, However, CMS-SNF is not perfect. It requires the assumption that Medicare beneficiaries at SNFs constitute the entirety of nursing care visits of fewer than 100 days. CMS-SNF tracks charges and not spending, and the assumption that they are equal is known not to be true.[4] Additionally, CMS-SNF requires an extra step of processing, in which younger aggregate age bins are split into the five-year bins used in this study.

Long-term stays at nursing facilities

MCBS and NNHS were used to estimate long-term stays at nursing facilities. Medicaid and out-of-pocket spending make up the majority of spending in long-term nursing home visits.[24] Any Medicare beneficiary spending out-of-pocket or through Medicaid is tracked in MCBS. However, those not eligible for Medicare are out of scope of MCBS. NNHS, on the other hand, is nationally representative of all nursing home visits. However, NNHS was only run in 1997, 1999, and 2004. Consequently, long-term stays in NNHS were regressed on long-term stays in MCBS to estimate all long-term nursing care spending and volume for the entire period of this study.

NNHS was processed similarly to all other data sources, except that it was not smoothed across time (see Section four). It was not smoothed across time because the only years of the study for which it exists are 1997, 1999, and 2004, which meant there were not enough data available for the smoothing model to make valid predictions.

MCBS did not require the same processing steps as the other data sources. MCBS was obtained from the Bureau of Economic Analysis in tabulated form.[23] It was tabulated by age, sex, year, and condition. Ages were aggregated to the five-year age bins used in this study. However, the conditions were coded as Clinical Classification Software (CCS) codes rather than GBD conditions. Similarly to GBD conditions, CCS codes are an aggregated coding of ICD-9 diagnoses. There are 260 mutually exclusive CCS codes. The tabulated MCBS spending and volume estimates were put through the same smoothing machinery as the other data sources and as described in Section four. However, in order to use MCBS as a time trend for NNHS, NNHS's estimates, stratified by GBD condition, had to be mapped to MCBS estimates stratified by CCS code. GBD conditions do not perfectly align with CCS codes. A CCS code might be made up of ICD-9 diagnoses that map to multiple GBD conditions. Similarly, a GBD condition might be made up of ICD-9 diagnoses that map to multiple CCS codes. For each GBD condition present in NNHS, each CCS code that shared a common ICD-9 code was found. Then each GBD condition and sex combination in NNHS was analyzed individually. First, spending for a given GBD condition and sex was compared to spending for each CCS condition and sex mapped to it. If the spending between the two was positively correlated across time, the CCS code was considered to be appropriately mapped to the GBD condition. If the spending between the two was negatively correlated across time, the CCS code was considered to be poorly mapped to the GBD condition, and this CCS code time trend was not used. For example, if a GBD condition and CCS code only shared one ICD-9 diagnosis that appears rarely in the nursing care setting, these time trends would not necessarily be correlated, and the CCS code would be dropped from the analysis.

A regression was run for each CCS code that shared an ICD-9 diagnosis with a GBD condition and was positively correlated with the time trend for a given GBD condition and sex. Specifically, a sex- and GBD condition-specific mixed effects regression was run on NNHS to estimate nationally representative spending and volume for long-term nursing care visits across the entire time period of interest. The regression was given by:

$$NNHS_{age,sex,i} = \beta_0 + \beta_1 MCBS_{sex,j} + \mu_{age} MCBS_{sex,j} + \varepsilon_i$$

where *i* is a GBD condition and *j* is a CCS code that maps to it. If the regression did not converge after 200 iterations, a linear regression was run. In this linear regression, condition- and sex-specific NNHS spending was regressed on MCBS spending and fixed effects on age. If no CCS codes were associated with a given condition, an average was taken across time, with random intercepts on age. If multiple CCS codes were associated with a GBD condition, multiple regressions were run.The root-mean-square error for each regression was calculated. Then a weighted average of the different outputs was calculated, with the weights being the normalized inverse of the root-mean-square error. In this way, the most weight was given to the CCS codes that best predict the NNHS data. Figure 5c-1 shows a schematic of the entire adjustment – from selecting CCS codes to taking the weighted average. Figure 5c-2 shows the results for spending on diabetes among 80-year-old men.

Figure 5c-1: National Nursing Home Survey raw data to estimates flow diagram

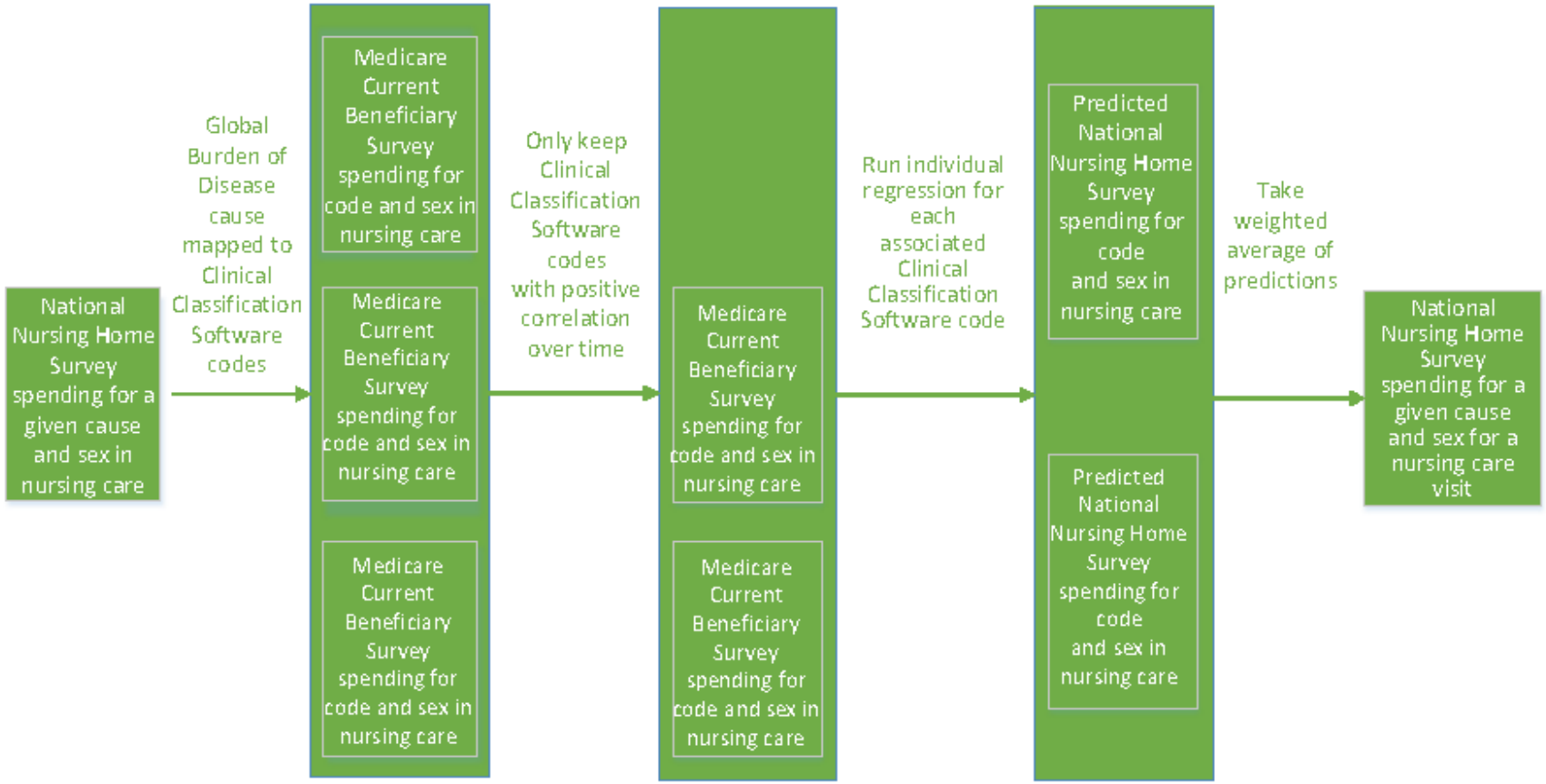


Figure 5c-2: Nursing care adjust raw data to estimates

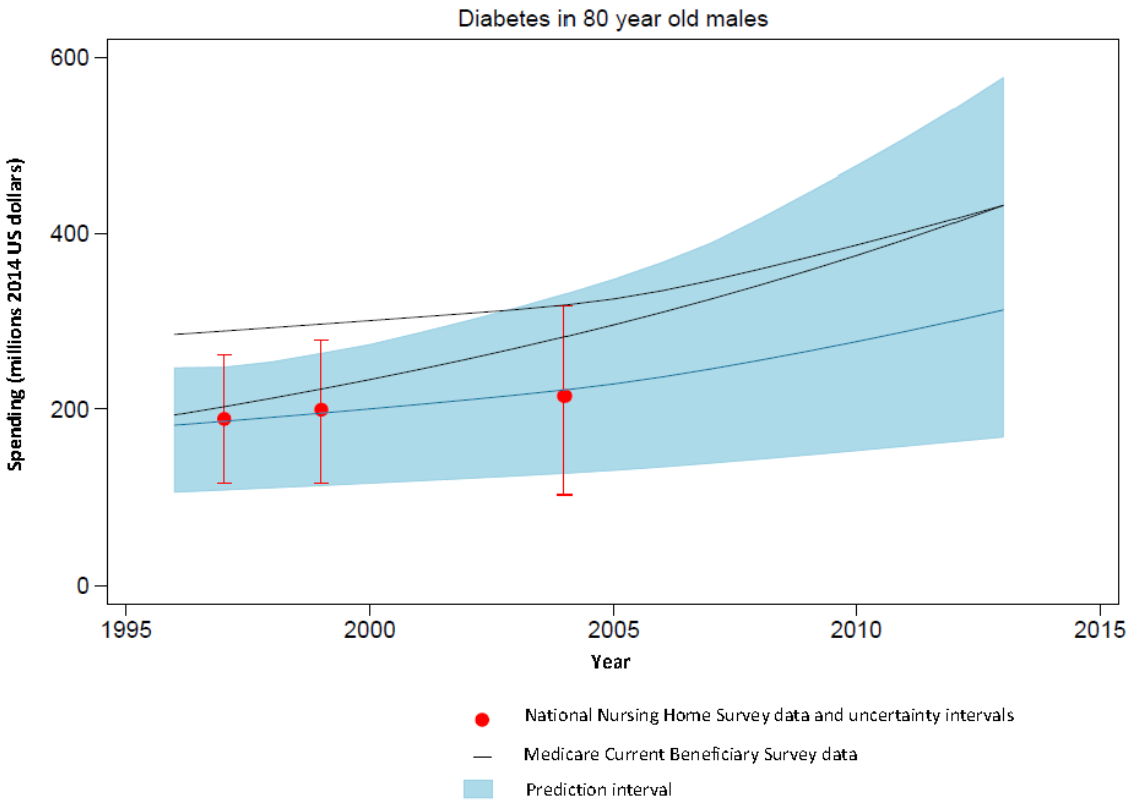


Figure 5c-2 shows the data and prediction interval that contributed to the nursing care adjustment. The two black lines on the graph reflect the categories in Medicare Current Beneficiary Survey's condition typology that correspond to this condition. The red dots in the figure are National Nursing Home Survey values that have been smoothed across this age-profile. The red bars corresponding to each are their uncertainty intervals.

Section 5d: Adjusting mental health data

Spending data from the Substance Abuse and Mental Health Services Administration (SAMHSA) were used to adjust our estimates for populations and care settings that are included in the NHEA estimates but out of scope of the surveys used. Inpatient and ambulatory estimates were adjusted.

Data gaps

Goods and services provided at specialty mental health and substance abuse clinics are not accounted for in the sampling schemes of NIS and MEPS. To correct for this, two documents from the Substance Abuse and Mental Health Services Administration (SAMHSA) were used to account for the spending on visits to specialty clinics:

> National Expenditures for Mental Health Services and Substance Abuse Treatment, 1986–2005
>
> National Expenditures for Mental Health Services and Substance Abuse Treatment, 1986–2009

SAMHSA reports spending at specialty mental health centers (MHCs) and specialty substance abuse centers (SACs) broken up by type: inpatient, outpatient, and residential. The SAMHSA reports provide spending estimates by MHCs and SACs across inpatient, outpatient, and residential settings for the following years: 1986, 1992, 1998, 2002, 2004, 2005, and 2009. As the NHEA nursing care type excludes MHCs and SACs, only the inpatient and outpatient estimates from SAMHSA were included in the adjustment.

SAMHSA expenditures were converted to real 2014 USD in millions. Spending was imputed using linear regression to fill in estimates for all years from 1996 to 2013. SAMHSA estimates are reported scaled to correspond to the NHEA envelopes, so no adjustment was necessary to line up SAMHSA and the NHEA.

Applying adjustment

As covered in Section 5a, the SAMHSA expenditures were first subtracted from the total NHEA envelope for each given type and year. For example, the inpatient expenditure was parsed out into “inpatient expenditure excluding specialty mental health and substance abuse expenditure” and “inpatient specialty mental health and substance abuse expenditure.” The ambulatory type was divided in the same manner. Microdata estimates were scaled to the “inpatient expenditure excluding specialty mental health and substance abuse expenditure.”

In order to disaggregate the specialty envelopes, condition-, year-, age-, sex-, type-proportions were created from the scaled data. First, scaled spending data were summed by year, type, and whether or not the care was for mental health or substance abuse to mirror the breakdown of the SAMHSA estimates. Then individual scaled spending estimates were divided by them to create scalars. These scalars were used to disaggregate the SAMHSA envelopes to arrive at age-, sex-, and condition Level 3-specific spending estimates proportional to the distribution of mental health and substance abuse conditions in non-specialty settings.

Volume of care is not reported in SAMHSA by specialty status. In order to account for the volume of care in specialty settings, volume was back-calculated from the newly disaggregated specialty expenditure. First, age, sex-, year-, type-, and condition-specific ratios of spending to volume were created using scaled data. After specialty spending was disaggregated, these ratios were used to back-calculate specialty volume.

A few assumptions had to be made to perform this adjustment. We assume that the distribution of conditions, ages, and sexes treated at specialty clinics is the same as the distribution treated at non-specialty settings and captured in our microdata. We also assume that expenditure per visit or bed-day at specialty

and non-specialty clinics is the same in order to back-calculate volume. It is difficult to know the direction of the bias introduced by these assumptions. Assuming an equal distribution of conditions, ages, and sexes in specialty clinics and non-specialty clinics most likely leads to underestimates of spending on illnesses that more often condition hospitalizations, such as schizophrenia.

Section 5e: Scaling spending estimates to the NHEA

Spending estimates derived from microdata were scaled to official estimates of yearly health spending published in the National Health Expenditure Accounts (NHEA). Before this scaling, the NHEA estimates were adjusted to fit into the types of services used in the study.

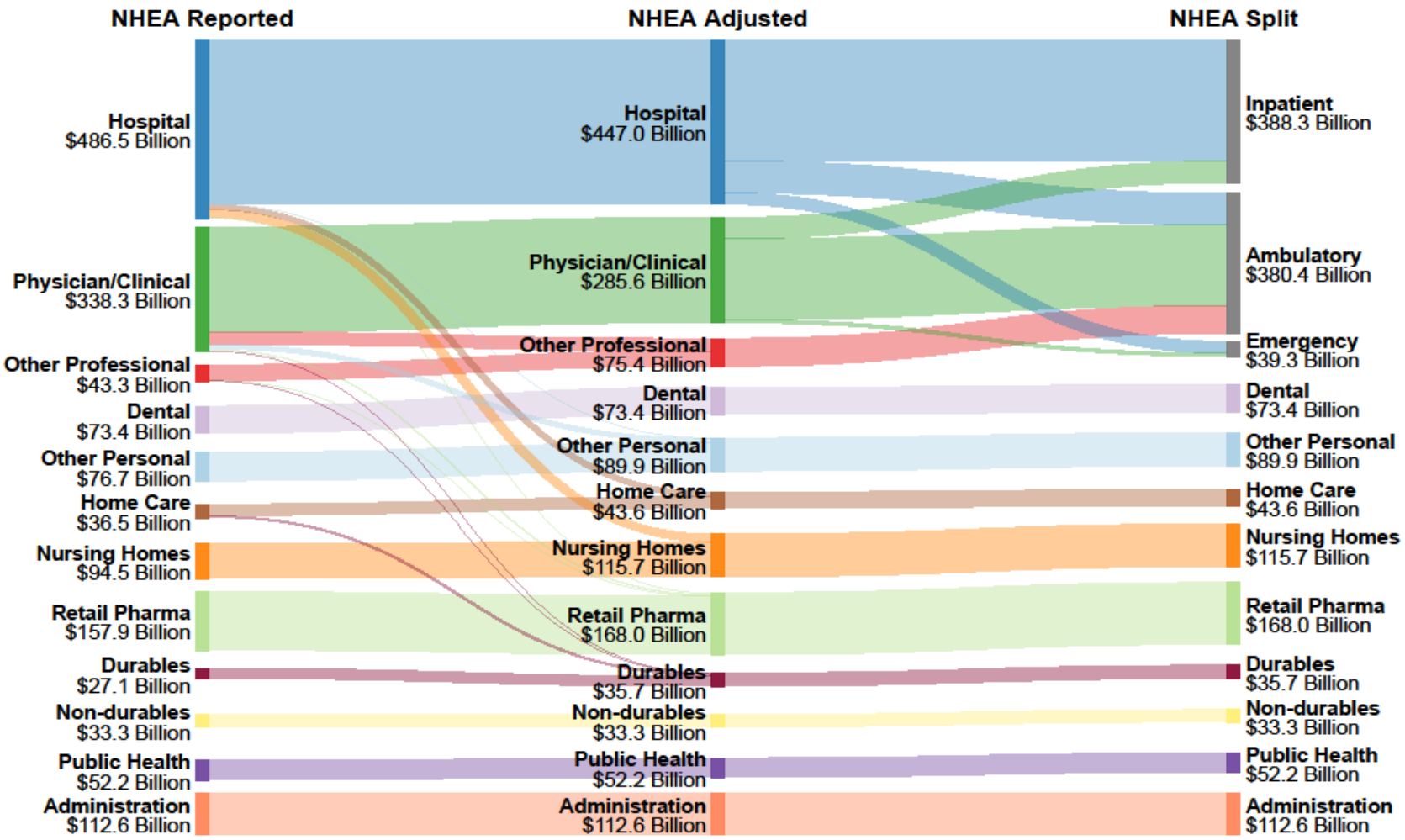
The NHEA

The NHEA provide official estimates of US health care spending.[27] Published annually by the Centers for Medicare & Medicaid Services, the NHEA estimates are generally stratified by type of good or service and by source of funds. The types of service included in the NHEA are Hospital Care; Physician and Clinical Services; Other Professional Services; Dental Services; Other Health, Residential, and Personal Care; Home Health Care; Nursing care Facilities and Continuing Care Retirement Communities; Prescription Drugs; Durable Medical Equipment; Other Non-durable Medical Products; Administrative Spending; and Public Health Activities. Recent accounts have also disaggregated personal health spending by sex and age groups.[28,29]

Adjusting NHEA data for scaling

First, the NHEA spending estimates were adjusted to line up with the types of services captured by the microdata. The NHEA do not distinguish between ambulatory spending and spending on emergency department visits that do not result in inpatient expenditure. This distinction was introduced to match our microdata sources, by using yearly nationally weighted payment estimates in MEPS. MEPS-weighted spending estimates were summed by year, and the fraction of ambulatory care spending in emergency departments was calculated and smoothed over time with a lowess regression. The smoothed fraction was used to disaggregate the NHEA Outpatient envelope into ambulatory and emergency department care. The figure below illustrates the process of adjusting and parsing NHEA reported totals in 2002:

Figure 5e-1: NHEA adjustments



The second adjustment to the NHEA envelopes was related to the Mental Health adjustment (see Section 5c for details). Specialty mental health and substance abuse clinics were out-of-scope for the surveys used to derive spending and volume estimates for three types of goods and services: inpatient, ambulatory, and long-term care. To adjust estimates for these two types of goods and services, specialty clinic spending numbers were extracted from SAMHSA by year and type of service. SAMHSA reports spending already scaled to the NHEA. As such, the extracted SAMHSA amounts were subtracted from their corresponding NHEA totals to prevent double counting and produce altered spending envelopes.

Scaling

Spending estimates were converted to millions of dollars to match the units of the NHEA envelopes. Age-, sex-, condition-, year-, and type-specific spending estimates were summed by year and type of good or service for each draw to create yearly spending totals that parallel the NHEA envelopes. These totals were then divided by the corresponding NHEA envelopes to generate year-, type-, and draw-specific scalars.

$$\boldsymbol{Scalar_{type,year,draw} = \frac{Unscaled\ spending_{type,year,draw}}{NHEA\ envelope_{type,year}}}$$

Each year-, type-, age-, sex-, condition-specific spending estimate was then divided by its type-, year-specific scalar to generate a spending estimate scaled to the NHEA.

$$\boldsymbol{Scaled\ spending_{type,year,draw,age,sex,cause} = \frac{Unscaled\ spending_{type,year.draw.age.sex.cause}}{Scalar_{type,year,draw}}}$$

See the example box below for an illustration of these calculations.

EXAMPLE. Scaling microdata to the NHEA envelope

In 2005, $527 billion was spent in the ambulatory care setting according to the modified NHEA envelope. The sum of spending calculated using microdata for that year in draw 1 was $207 billion.

$$\boldsymbol{Scalar_{AM,2005,draw1} = \frac{\$207\ billion}{\$527\ billion} = 0.393}$$

To determine scaled spending on females, aged 60–64 with IHD, the microdata estimate of $250 million was adjusted:

$$\boldsymbol{Scaled\ spending_{AM,2005,draw1,age60,female,IHD} = \frac{\$250\ million}{0.393} = \$635\ million}$$

Section 6: Uncertainty

Bootstrapping

To obtain uncertainty, all data sources were bootstrapped 1,000 times at the beginning of the analysis. Encounters was bootstrapped stratified by year and data source, creating 1,000 individual samples on which to run analysis. Complex survey design was taken into consideration for bootstrapping by using the user-written *bsweights* command in Stata 13.1[31]. This command ensured that the bootstrapped data resembled the original sampling scheme by resampling the whole primary sampling unis with each strata.

All statistical analyses were performed at the bootstrap draw level. This includes redistribution of garbage code, the three-digit ICD9 -codes in the MEPS adjustment, the comorbidity regression, the charges-to-payment regression, the Bayesian hierarchical model, the long-term adjustment, and scaling to the National Health Expenditure Account envelopes.

Final estimates and uncertainty intervals

After the data were fully adjusted, final estimates and uncertainty intervals were calculated across the one thousand draws. Final estimates were the mean of spending or volume for each age, sex, condition, year, and type combination. Uncertainty intervals were taken to be the 2.5th and 97.5th percentiles.

Section 7: Public Health

Overview of Strategy

Public health spending is spending by the government on activities such as epidemiological surveillance, disease prevention programs, and public health laboratories. The National Health Expenditure Accounts (NHEA) estimates federal public health spending using federal budget documents. Most federal spending comes from the Department of Health and Human Services (DHHS), in particular the Centers for Disease Control (CDC) and the Food and Drug Administration (FDA). The NHEA estimates local and state public health spending using the Census of Governments conducted by the U.S. Census Bureau every five years. We build upon the strategy used by the NHEA for estimating federal public health spending, and currently leave the state and local public health revenue unallocated.

The data for allocating federal public health spending were collected from budgets of four agencies within the US Department of Health and Human Services: the Centers for Disease Control and Prevention (CDC), the Food and Drug Administration (FDA), the Health Resources and Services Administration (HRSA), and the Substance Abuse and Mental Health Services Administration (SAMHSA). These agencies were selected for three reasons: 1) together they represent the majority of federal public health spending, 2) they cover the complete range of public health activities including biosecurity, public health preparedness, and occupational health and safety which may be captured in other federal programs, and 3) these agencies disperse large amounts of money to state and local governments.

Non-federal public health spending was not allocated. Currently no comprehensive or representative data source exists for tracking non-federal public health spending. There are four challenges in analyzing state and local health department budgets. First, budgets for the entire time period of this study are not usually accessible; only the latest five years of data are typically available if any archive exists. Second, federal spending given to states or local governments is already accounted for in federal budgets, leading to the danger of double counting if state budgets, which don't always track the funding source for each program, are also included. Third, the budgets available from state and local health departments often do not include enough detail about program spending. Health departments are often involved in activities that fall outside of the NHEA definition of public health. These include things like environmental health initiatives and Medicaid programs which provide clinical care. These programs would need to be removed for this analysis. Additionally, without detailed program data it is impossible to map programs to GBD categories. Fourth, there are hundreds of state and local public health offices, and a unified, comprehensive reporting system or set of standards does not exist. For these reasons, non-federal spending was not allocated. Federal public health spending, which was channeled through state and local governments, was tracked as federal spending.

Once the data were collected, the strategy for allocating federal public health spending involves two components. The first component tracks government spending on public health programs from 1996 to 2013 by program, estimating where necessary. The second component involves mapping the spending from these programs to conditions of health care spending and disaggregating it by demographic groups. A special procedure developed for mapping immunization spending is also described later in detail.

Data Sources

Three types of federal budgets were collected: 1) Justifications of Estimates for Appropriation Committees, which will subsequently be referred to as Justifications of Estimates, 2) reports accompanying Congressional bills, which will be referred to as Congressional Appropriations, and 3) appendices to the President's Budget. Justifications of Estimates were available through each agency's website or the DHHS website (including archived content). Congressional reports and the President's Budget were available through the Government Printing Office. Table 7.1 summarizes the documents available for each agency.

Table 7.1: Availability of federal budget documents by fiscal year and agency.

Year	President's Budget Appendix				Congressional Reports				Justifications of Estimates			
Year	CDC	FDA	HRSA	SAMHSA	CDC	FDA	HRSA	SAMHSA	CDC	FDA	HRSA	SAMHSA
1996	X	X	X	X								
1997	X	X	X	X	X	X	X	X				
1998	X	X	X	X	X	X	X	X				
1999	X	X	X	X								
2000	X	X	X	X	X	X	X	X				
2001	X	X	X	X	X	X	X	X				
2002	X	X	X	X	X	X	X	X				
2003	X	X	X	X	X	X	X	X				
2004	X	X	X	X	X	X	X	X	X			
2005	X	X	X	X	X	X	X	X	X	X		
2006	X	X	X	X	X	X	X	X	X	X		
2007	X	X	X	X	X	X	X	X	X	X		
2008	X	X	X	X	X	X	X	X	X	X		X
2009	X	X	X	X	X	X	X	X	X	X		X
2010	X	X	X	X	X	X	X	X	X	X		X
2011	X	X	X	X	X	X	X	X	X	X	X	X
2012	X	X	X	X	X	X	X	X	X	X	X	X
2013	X	X	X	X	X	X	X	X	X	X	X	X
2014	X	X	X	X	X	X	X	X	X	X	X	X
2015	X	X	X	X	X	X	X	X	X	X	X	X

Across the different sources, there were three general types of spending estimates. The first is prospective spending. In the Justification of Estimates these are the amounts requested by each agency for the upcoming fiscal year. In the Congressional Appropriations and President's Budgets these are the amount appropriated and budgeted, respectively. The second type of spending estimate is the current year estimate. In the Congressional Appropriations these are the amounts appropriated in the previous year. The third type of spending is past year spending. These only appear in the Justification of Estimates and the President's Budget, and are usually audited totals of what was actually spent. The prospective spending and current year spending estimates are highly informative, but are generally less reliable. Unexpected events, including war, pandemics, government shutdowns and government bailouts, occasionally make current or prospective estimate different than the actual spending.

The President's Budget reports between four and twenty highly aggregated line items for each agency. These documents capture budget authority instead of total program spending for the reported line items. Total program level includes budget authority, user fees and transfer funds from other programs. Some of this spending is occasionally aggregated in a line item called 'Reimbursable program' However, this does not give adequate information about the actual distribution of programs within this line item. Other times, this spending is listed under the original fund. For example, the CDC receives regular funding from the Public Health Services fund (PHS) and, in the more recent years, from the Public Health and Social Services Emergency Fund (PHSSEF) and the Prevention and Public Health Fund (PPHF) (created by the Patient Protection and Affordable Care Act (PPACA)). These transferred funds are not always captured in the President's Budget under the CDC, and usually go only to specific programs.

Congressional reports provide slightly more detailed information. Reports were collected from the House of Representatives, the Senate, and the Joint Appropriations Conference Committee. When a reconciled Conference report was available, it was prioritized over the initial decision of each chamber. Along with line item totals, Congressional reports give descriptions of the activities for each line item. Congressional reports give two estimates for each item: the amount appropriated for the upcoming fiscal year, and the amount appropriated for the previous year.

Justifications of Estimates provided the most detail in terms of line items. These are usually in units of thousands of dollars. Justifications of Estimates provided information about total program level and funding other than budget authority. Justifications of Estimates provide all three types of spending estimate. For a number of aggregated budget categories, the Justification of Estimates also provides a history of funding going back five or ten years. Along with line item totals, Justifications of Estimates give detailed descriptions of the activities associated with each line item as well as detailed performance measures. These descriptions were used to determine how to map programs to GBD categories.

Estimating Public Health Spending by Program

The original budget documents arrange programs hierarchically. Programs are nested within bureaus or departments within each agency. Occasionally, subprogram or more disaggregated spending categories are listed within programs. Often the more detailed programs correspond more closely to conditions of healthcare spending. For example, the CDC has a line item for "Arthritis and other chronic disease". In some budgets this is further disaggregated into Arthritis, Epilepsy and Lupus. Each of these directly correspond to exactly one condition. For this reason we want to map only the most detailed programs to conditions and risks so that the distribution of conditions matches where the spending actually went. The most detailed programs often do not appear in every type of budget document or in every year of a type of document. It is therefore necessary to construct a complete time series of spending estimates for the most detailed program across the entire period of this study.

To impute missing values we took advantage of the hierarchical arrangement of programs. We assumed that the proportion of spending by a child program within a parent program evolves, in most cases, gradually over time. In addition to this, we considered biases in the different types of data. The types of spending estimates present in each data source have different degrees of reliability. The most reliable estimates are the past year spending estimates from the Justification of Estimates. These are audited numbers which reflect what was actually spent, and include user fees and transfer funds for each program. Lastly, our modelling strategy takes radical shifts in the agency's budgets into account. These occurred mostly in the CDC and were identified by discontinuities in the President's Budget. These time period shifts often led to a noticeable shift

in the funding level for a program in that year. Also the direction of change of a program budget was inconsistent across the time period. Fiscal year spending was assumed to be the same as calendar year spending.

To model these inconsistencies we included binary indicators for the seven types of spending, an agency-specific binary indicator for regime to capture immediate changes in program level spending due to agency restructuring, and an interaction between regime and time to capture different rates of changes of programs under different regimes. Time was modeled as a series of year indicators. Spending for agency totals were log transformed. The total spending for each agency was modelled as:

$$ln(spending) = \beta_y \times I_{year} + \beta_{tregime} \times I_{regime} + \beta_{regime\ interaction} \times year \times I_{regime} + \beta_{document} \times I_{document}$$

After running the regression, one thousand coefficient estimates were generated from the variance-covariance matrix. The result was then predicted for each year using the past year spending from the Justification of Estimates, the most reliable type of spending estimate. Lastly, the predicted spending was exponentiated to give dollar estimates.

Program spending was modelled starting from the top of the hierarchy working down. Spending by subsequent programs were modelled in a similar fashion. Time periods and types of data were handled in a manner identical to the agency models. If a program had at least one estimate for every year, we modeled time as a fixed effect on each year. If there was at least one year with no estimate of any type we modelled year as a continuous variable. One thousand different proportions were calculated, each using a different estimate of parent spending from the one thousand previous draws. The proportions of spending by a child program was logit transformed and lemon squeezed[30]. Program spending was modelled as:

$$logit(\text{program spending}/\text{parent spending}_i) =$$

$$\beta_y \times [time] + \beta_{regime} \times I_{regime} + \beta_{regime\ interaction} \times year \times I_{regime} + \beta_{document} \times I_{document}$$

where [time] is either *year* or I_{year}

After running the regression, one draw of betas was drawn from the variance-covariance matrix. The result was predicted for each year using the past year's spending from the Justification of Estimates, if available. Lastly, the predicted spending was inverse lemon squeezed and inverse logit transformed to give dollar estimates.

The budget structure of these agencies has changed between 1996 and 2013. The hierarchical arrangement of programs in the budget documents is not always consistent. To properly model the ratio of spending on a child program to its parent program, program groupings need to be consistent across time. Before modelling, the hierarchy was adjusted to reflect a standard budget structure. For example, the 2004 CDC budget includes a line item for the National Center for HIV, STD and TB prevention, which includes the Global AIDS program. In 2008, the CDC budget for this center was expanded to include a program for viral hepatitis, which was previously in the National Center for Infectious Disease. Additionally, the Global AIDS program has been moved to the Coordinating Office for Global Health, an office which did not exist in the 2004 budget. In the standardized budget structure used for modeling, viral hepatitis is always included as a program within Infectious Disease Control and Global AIDS is always included as a program within Global Health. For applicable years, these line items are subtracted from the parent program in which they appear in the original budget, and are added to the parent program of the standardized budget structure. This ensures the

proportions across time are a reflection of changes in program level and not changes in how programs are classified.

Mapping Programs to Conditions

After all missing values were modeled, the most detailed subprograms, containing details on the purpose for which they were created, were mapped to a combination of conditions, risk factors, and custom categories. The program could map to one of six things: 1) a single condition, 2) one aggregated condition category, such as “Maternal disorders” or “Neoplasms”, which are the sum of multiple conditions, 3) multiple conditions that could include aggregated condition categories, 4) one or more risk factors, 5) both a condition and a risk factor, or 6) a custom category.

If the program mapped to only one condition, the spending was allocated to that condition. If a program mapped to an aggregated condition category or to multiple conditions, the spending was split among all associated conditions using fractions of disability adjusted life years (DALYs). Total DALYs for each disease for the US population were extracted from the GBD 2013 study[31]. Years not reported were imputed linearly between existing estimates.

Some programs, such as “Limb Loss” and “Traumatic Brain Injury”, mapped to N-codes. These were transformed to conditions corresponding to E-codes using methods similar to the N-code to E-code adjustment described in section 3. All patient-level observations from NAMCS, NHAMCS, NIS, and CMS were weighted to be nationally representative and pooled together. If multiple N-codes or E-codes were recorded for an observation, then only the first one listed was used. Proportions of conditions corresponding to E-codes were calculated by year for each N-code. Spending on programs which mapped to N-codes were split among the conditions corresponding to E-codes using these proportions.

If a program mapped to risk factors, the spending was allocated to all conditions associated with the given risk factor, proportional to the DALYs attributable to the condition. Population attributable fractions (PAFs) were extracted from the GBD 2013 study. Years not reported were imputed linearly between existing estimates. The attributable DALYs were calculated from the PAFs across age and sex groups and the total DALYs across age and sex groups.

If a program was mapped to both a condition and a risk factor, half the spending was allocated using the strategy for conditions and half using the strategy for risk factors. Examples of these programs include “Domestic Violence Prevention,” “Micronutrient Deficiencies,” and “Excessive Alcohol Use”. This was done so that the bulk of the spending went to the primary condition, but a portion went to secondary conditions. In this way, we can capture the true scope of public health prevention initiatives.

The GBD study does not track burden for every condition used in this analysis. This analysis also tracks direct spending on some impairments, non-disease spending categories, and risk factors. Some public health programs map directly to these conditions. In other cases, programs target some conditions for which there is burden, and some conditions for which GBD does not track burden. In these cases, strategies which use only DALYs or PAFs from GBD would not allocate any public health spending to these conditions.

Six categories were adjusted for one or more risk factors according to Table 7.2. Each of the four risk factor conditions correspond to a risk factor tracked by GBD. Each mapping category was adjusted as follows. First, the DALYs attributable to conditions associated with the GBD risk were calculated. These DALYs were subtracted from the total DALYs for the original GBD condition and reallocated to the risk factor condition. The PAFs for individual risks often sum to more than one. In cases where a mapping category is adjusted for

multiple risk factor conditions, it is possible for DALYs attributable to risk factors to be more than the total DALYs for the original condition if a simple sum is used. To prevent this, when a mapping category was adjusted for multiple risk factor conditions, the total attributable DALYs were constrained by the DALYs attributable to the parent risk factor. Obesity, hyperlipidemia, and hypertension are metabolic risks, whereas smoking is a behavioral risk. Behavioral and metabolic risks are both children of "Total risk." Parent risk factors model all the children risk factors simultaneously to account for the interaction between them. When a mapping category was adjusted for multiple risk factor conditions, first the attributable DALYs were calculated. Next the ratio of the sibling risk factors was calculated. This ratio was applied to the DALYs attributable to the parent risk to calculate the adjusted attributable DALYs for each risk factor condition. For behavioral risk factors, first behavioral and metabolic risks were adjusted to fit within total risk, then the individual metabolic risks were adjusted to fit within the adjusted metabolic risk envelope.

Table 7.2: Correcting mapping categories for risk factor conditions

Focus Area	Risk Factor Condition
Behavioral risk factors	Smoking Obesity Hyperlipidemia Hypertension
Dietary risk factors	Obesity Hyperlipidemia Hypertension
Low physical activity	Obesity
Cardiovascular disease	Obesity Hyperlipidemia Hypertension
Chronic Kidney disease	Hypertension
Diabetes	Obesity

After all spending was allocated to level three conditions it was further disaggregated into age and sex categories using population fractions from the GBD 2013 study. The population distribution was determined to be more informative than measures of burden or healthcare utilization. Public health programs tend to have a wide scope and focus on prevention. They therefore focus on different populations than only those suffering from the condition. The age and sex restrictions for each condition were applied so that money was not allocated to demographics that could not have that condition. Program-specific age and sex restrictions were also applied. These restrictions were based on the target of the program. Examples of these include restricting a program for "Elderly Falls" to the ages 65 and older and restricting "School Health" to ages 5 to 19. Breast cancer prevention programs were restricted to females, because, even though both sexes can have the disease, it was assumed that they targeted females almost exclusively. Vaccination programs were not restricted even though the target was primarily children, because herd immunity benefits all ages, and the effect of vaccination spans many years.

Septicemia, which is not included in the GBD results, is important for programs related to patient safety and health care acquired infections. Such programs were mapped to a custom category in which a portion of the spending went to septicemia. Immunizations also mapped to a custom category, described in detail below.

Mapping Vaccine Spending

Mapping immunization spending to conditions required special attention. Although it would be possible to use the distribution of DALYs to split immunization spending among vaccine-preventable disease, this would not lead to sensible results. Many vaccine preventable diseases are largely prevented and have very little burden in the United States. Other diseases targeted by vaccinations, such as influenza and pneumococcal infection, are mitigated but not entirely prevented. Using burden fractions to disaggregate immunization spending would lead to allocating the majority of spending to lower respiratory infection and not to the true conditions targeted by these programs.

Spending on immunizations was allocated using information about the cost and coverage rates of vaccines. Coverage estimates for children 19 to 35 months at Vaccine for Children (VFC) eligible facilities were collected from the CDC. There was no estimate for VFC facilities for 1996, so the national estimate of coverage for all facilities was used. Coverage estimates for DTP and DTaP were combined to create a complete time series. Spending was only allocated to vaccine series for which the CDC estimated coverage in a given year.

Archived vaccine price lists from the Vaccines for Children program were collected from the CDC. If multiple lists were available, the list closest to July 1 was used for consistency with data which only reported mid-year prices. The price of the cheapest vaccine which exactly matched the series tracked by the CDC was extracted. There was no attempt to combine vaccines across series to reduce the price. Rotarix was extracted for the rotavirus vaccine, which is consistent with a three dose series. ActHIB and Hiberix were priced almost identically so no distinction was made between the primary series vaccine and the booster for the full series. Prices for missing years were imputed linearly between known prices.

The amount spent on a given vaccine was calculated as the product of the coverage rate, the population between ages one and four, the number of doses, and the price per dose. If a series corresponded to multiple conditions, the spending was split evenly among the conditions. Table 7.3 shows how vaccines map to conditions. Fractions of spending for each condition were calculated by year. Total vaccine spending was allocated to conditions using these fractions.

Table 7.3: Mapping vaccine series to conditions

Vaccine	Conditions
MMR	Measles, Other infectious diseases (x2)
Varicella	Varicella
DTP/DTaP	Diphtheria, Tetanus, Pertussis
Hep B	Hepatitis B
Hib	HiB pneumonia, HiB meningitis
Polio	Other infectious diseases
Hep A	Hepatitis A
Rotavirus	Rotaviral enteritis
PCV	Pneumococcal pneumonia

Section 8: Condition Maps

Table 8.1 – map of all conditions of personal healthcare spending

Condition	Condition name	ICD Codes	Sexes allowed	Ages allowed
A.1.1	Tuberculosis	010–019.9, 137–137.9, 138.0–138.9, 139.9, 320.4, 730.4–730.6, V01.1, V03.2, V12.01, V71.2, V74.1	both	0–85
A.1.2	HIV/AIDS	042–044.9, 112.4–118.9, 136.3–136.5, 279.2–279.3, 279.8–279.9, V08	both	0–85
A.2.1	Diarrheal diseases	001–001.9, 003–006.9, 007.4–007.8, 008.01–008.02, 008.04, 008.2–009.9, 787.91, V01.0, V01.83, V02.0, V02.2–V02.3, V03.0, V74.0	both	0–85
A.2.2	Intestinal infectious	002.0–002.9, 007–007.3, 007.9–008.00, 008.03, 008.09–008.1, V02.1, V03.1	both	0–85
A.2.3	Lower respiratory infections	466–469, 470.0, 480–482.89, 483.0–483.9, 484.1–484.2, 484.6–484.7, 487–489, V01.82, V03.81–V03.82, V04.7, V04.81–V04.82, V12.61	both	0–85
A.2.4	Upper respiratory infections	460–465.9, 475–475.9, 476.9	both	0–85
A.2.5	Otitis media	381–384.9	both	0–85
A.2.6	Meningitis	036–036.40, 036.5, 036.8–036.9, 047–049.9, 320.0–320.3, 320.5–320.89, 321–321.4, 321.6–322.9, V01.84	both	0–85
A.2.7	Encephalitis	062–064.9, 139.0, 323–323.9, V05.0–V05.1, V12.42	both	0–85
A.2.8	Diphtheria	032–032.9, V02.4, V03.5, V74.3	both	0–55
A.2.9	Pertussis	033–033.9, 484.3, V03.6	both	0–55
A.2.10	Tetanus	037–037.9, 771.3, V03.7	both	0–85
A.2.11	Measles	055–055.9, 484.0, V04.2, V73.2	both	0–55
A.2.12	Varicella	052–053.9, V01.71, V05.4	both	0–85
A.3	Neglected tropical diseases & malaria	060–061.8, 065–066.9, 071–071.9, 076–076.1, 076.6, 076.9, 080, 080.2–084.9, 085.0–085.5, 086–088.9, 120–130.9, 139.1, V01.5, V04.4–V04.5, V05.2, V12.03, V73.4–V73.6, V75.1–V75.3, V75.5–V75.8	both	0–85
A.4.1	Maternal hemorrhage	640–641.93, 665–665.34, 666–666.9	female	10–45
A.4.2	Maternal sepsis	659.3–659.33, 670–670.9	female	10–45
A.4.3	Maternal hypertension	642–642.94	female	10–45
A.4.4	Maternal obstructed labor	660–660.93	female	10–85
A.4.5	Maternal abortive	630–636.92, 638–638.92, 646.3–646.33	female	10–50

Table 8.1 – map of all conditions of personal healthcare spending continued

Condition	Condition name	ICD Codes	Sexes allowed	Ages allowed
A.4.6	Maternal indirect	646–646.24, 646.4–649, 649.00–649.9, 674–674.94	female	10–45
A.4.9	Other maternal disorders	643–644.00, 644.1–644.20, 645–645.10, 645.13–645.23, 652.0–652.20, 652.23–652.50, 652.53–652.60, 652.63–652.80, 652.83–653.40, 653.43–654.20, 654.23–655.70, 655.73–655.80, 655.83–656.10, 656.13–656.40, 656.43–656.50, 656.53–656.60, 656.63–656.80, 656.83–657.00, 657.03–658.00, 658.03–658.10, 658.13–658.20, 658.23–658.40, 658.43–659.10, 659.13–659.23, 659.4–659.40, 659.43–659.50, 659.53–659.60, 659.63–659.70, 659.73–659.80, 659.83–659.93, 661–661.00, 661.03–661.20, 661.23–661.30, 661.33–663.10, 663.13–663.20, 663.23–663.30, 663.33–663.80, 663.83–664.00, 664.04–664.80, 664.84–664.94, 665.4–665.94, 667–669.61, 669.70, 669.8–669.80, 669.82–669.94, 671–673.9, 675–679.14, 768.0–768.1, V13.1, V15.21–V15.22	female	10–50
A.5.1	Neonatal preterm birth	761.0–761.1, 765–765.9, 769–769.9, 770.2–770.9, 776.6, 777.5–777.6	both	0
A.5.2	Neonatal encephalopathy	761.7–763.9, 767–768, 768.2–768.9, 770.1–770.18, 772.1–772.9, 779.0–779.2	both	0
A.5.3	Neonatal sepsis	771.4–771.9	both	0
A.5.4	Neonatal hemolytic	773–774.9	both	0
A.5.5	Other neonatal	760–760.70, 760.72–761, 761.2–761.6, 764–764.99, 766–766.9, 770, 771, 772–772.0, 775, 775.4–776.5, 776.7–777.4, 777.7–779, 779.3–779.34, 779.6–779.89	both	0
A.6.1	Protein-energy malnutrition	260–263.9	both	0–85
A.6.2	Iodine deficiency	244.2	both	1–85
A.6.3	Vitamin A deficiency	264–264.9	both	1–85
A.6.4	Iron-deficiency anemia	280–281, 285–285.9, V18.2, V78.0–V78.1	both	0–85
A.6.5	Other nutritional	265–269.9, 281.0–281.9, 716.0–716.09	both	0–85

Table 8.1 – map of all conditions of personal healthcare spending continued

Condition	Condition name	ICD Codes	Sexes allowed	Ages allowed
A.7.1	Sexually transmitted diseases	054.1, 090–099.9, 131–131.9, 614–614.9, V01.6, V02.7–V02.9, V73, V73.8, V73.88, V73.9–V73.98, V74.5–V74.6	both	0–85
A.7.2	Hepatitis	070–070.21, 070.3–070.31, 070.4–070.43, 070.49–070.53, 070.59–070.9, V02.6–V02.69, V05.3	both	0–85
A.7.3	Leprosy	030–030.9, V74.2	both	1–85
A.7.4	Other infectious	020–029, 031–031.9, 034–034.9, 039–039.4, 039.8–040, 040.1–041.89, 045–046.9, 050–051.9, 054–054.0, 054.10–054.9, 056–059.9, 072–075.9, 076.5, 076.8, 078.5–079.99, 080.0, 100–104.9, 112–112.0, 112.3, 136–136.29, 138, 139, 321.5, 357.0, 390–390.9, 391.4, 392, 392.9, 484.4–484.5, 730.7–730.99, 771.0–771.2, V01, V01.2–V01.4, V01.7, V01.79–V01.81, V01.89–V02, V02.5–V02.59, V03, V03.3–V03.4, V03.8, V03.9–V04.1, V04.3, V04.6, V04.8, V04.89–V05, V05.8–V06.8, V09–V09.91, V12.0–V12.00, V12.02, V12.04–V12.09, V18.8, V71.82–V71.83, V73.0–V73.1, V73.3, V73.81, V73.89, V73.99, V74.8–V74.9, V75.4, V75.9	both	0–85
A.7.5	Septicemia	038–038.9, 995.91–995.92	both	0–85
B.1.1	Esophageal cancer	150–150.9, 211.0, 230.1, V10.03	both	15–85
B.1.2	Stomach cancer	151–151.9, 209.23, 209.63, 211.1, 230.2, V10.04, V55.1	both	15–85
B.1.3	Liver cancer	155–155.3, 211.5, V10.07	both	5–85
B.1.4	Larynx cancer	161–161.9, 162.1, 212.1, 231.0, 235.6, V10.21	both	15–85
B.1.5	Lung cancer	162–162.0, 162.2–162.9, 163.5, 209.21, 209.61, 212.2–212.3, 231.1–231.2, 235.7, V10.1–V10.20, V16.1–V16.2, V76.0	both	15–85
B.1.6	Breast cancer	174–175.9, 217–217.8, 233.0, 238.3, 239.3, 610–610.9, V10.3, V16.3, V50.41, V51.0, V52.4, V76.1–V76.19	both	15–85
B.1.7	Cervical cancer	180–180.9, 219.0–219.1, 233.1, 622–622.2, V10.41, V13.22, V67.01, V72.32, V76.2, V88.0–V88.03	female	15–85
B.1.8	Uterine cancer	182–182.8, 218–218.9, 233.2, 621.0–621.35, V10.42	female	15–85

Table 8.1 – map of all conditions of personal healthcare spending continued

Condition	Condition name	ICD Codes	Sexes allowed	Ages allowed
B.1.9	Prostate cancer	185–185.9, 222.2, 236.5, V10.46, V16.42, V76.44	male	15–85
B.1.10	Colorectal cancer	153–154.9, 155.5–155.9, 209.1–209.17, 209.5–209.57, 211.3–211.4, 230.3–230.6, 569.0, 569.43–569.44, 569.84–569.85, V10.05–V10.06, V55.3, V76.41, V76.5–V76.52	both	15–85
B.1.11	Mouth cancer	140–145.9, 210.0–210.6, 235.0, V10.01–V10.02, V76.42	both	15–85
B.1.12	Nasopharynx cancer	147–147.9, 210.7, 210.9	both	5–85
B.1.13	Other pharynx cancer	146–146.9, 148–148.9, 210.8	both	15–85
B.1.14	Gallbladder cancer	156–156.9, 209.25–209.27, 209.65–209.67	both	15–85
B.1.15	Pancreatic cancer	157–157.9, 211.6–211.7, V88.1–V88.12	both	15–85
B.1.16	Melanoma	172–172.9	both	15–85
B.1.17	Skin cancer	173–173.99, 209.31–209.36, 214–214.1, 215–216.9, 222.4, 232–232.9, 238.2, V76.43	both	15–85
B.1.18	Ovarian cancer	183–183.0, 236.2, V10.43, V16.41, V50.42, V76.46	female	15–85
B.1.19	Testicular cancer	186–186.9, 222.0, 222.3, 236.4, V10.47–V10.48, V16.43, V76.45	male	15–85
B.1.20	Kidney cancer	189.0–189.1, 209.24, 209.64, 223.0–223.1, 236.91, V10.52–V10.59, V16.51	both	1–85
B.1.21	Bladder cancer	188–188.9, 223.3, 233.7, 236.7, 239.4, V10.51, V16.52, V43.5, V55.5–V55.6, V76.3	both	15–85
B.1.22	Brain cancer	191–192.9, 225–225.9, 237–237.9, 239.6, V10.85–V10.86, V12.41	both	1–85
B.1.23	Thyroid cancer	193–193.9, 226–226.9, V10.87	both	10–85
B.1.24	Mesothelioma	163–163.3, 163.8–163.9	both	15–85
B.1.25	Hodgkin disease	201–201.98, V10.72	both	0–85
B.1.26	Lymphoma	200–200.9, 202–202.98, V10.7–V10.71, V10.79, V16.7	both	1–85
B.1.27	Myeloma	203–203.9	both	15–85
B.1.28	Leukemia	204–208.92, V10.6–V10.69, V16.6	both	1–85

Table 8.1 – map of all conditions of personal health care spending continued

Condition	Condition name	ICD Codes	Sexes allowed	Ages allowed
B.1.29	Other neoplasms	152–152.9, 158–158.9, 160–160.9, 164–164.9, 170–171.9, 181–181.9, 182.9, 183.2–183.8, 184.0–184.4, 184.8, 187.1–187.8, 189.2–189.8, 190–190.9, 194–194.8, 209.0–209.03, 209.22, 209.4–209.43, 211.2, 211.8, 212.0, 212.4–212.8, 213–213.9, 214.2–214.9, 221.0–221.8, 222.1, 222.8, 223.2, 223.8–223.89, 224–224.9, 227–228.9, 229.0, 229.8, 230.7–230.8, 233.31–233.32, 233.4–233.5, 234.0–234.8, 235.4, 235.8, 236.1, 236.99, 238.0–238.1, 238.4–238.8, 239.2, 623.0–623.1, 623.7, V10.22–V10.29, V10.4–V10.40, V10.44–V10.45, V10.49–V10.50, V10.8–V10.84, V10.88–V10.89, V55.2, V58.0, V58.11, V67.1–V67.2, V76.4, V76.47–V76.49	both	0–85
B.2.1	Rheumatic heart disease	391–391.2, 391.8–391.9, 392.0, 393–398.99	both	1–85
B.2.2	Ischemic heart disease	410–414.9, V17.3, V81.0	both	1–85
B.2.3	Cerebrovascular disease	430–435.9, 437.0–437.2, 437.5–437.8, V12.54, V17.1	both	1–85
B.2.4	Hypertensive heart disease	402–402.91	both	1–85
B.2.5	Cardiomyopathy	036.43, 036.6, 422–422.99, 425–425.9, 429.0–429.1	both	1–85
B.2.6	Atrial fibrillation	427.3–427.32	both	30–85
B.2.7	Aortic aneurysm	441–441.9	both	15–85
B.2.8	Peripheral vascular	440.20–440.29, 443.0–443.9	both	40–85
B.2.9	Endocarditis	036.42, 421–421.9, 424.9–424.91	both	0–85
B.2.10	Other cardiovascular	036.41, 417–417.9, 420–420.99, 423, 423.1–424.8, 424.99, 427–427.2, 427.6–427.89, 442–443, 444–445.89, 447–454.9, 456, 456.3–457.9, 459, 459.1–459.39	both	0-85
B.2.11	Heart Failure	428-428.9	both	0-85
B.3.1	Chronic obstructive pulmonary disease	490–492.9, 494–494.9, 496–499	both	1–85
B.3.2	Pneumoconiosis	500–504.9, V15.84	both	1–85
B.3.3	Asthma	493–493.92, V17.5	both	1–85
B.3.4	Interstitial lung disease	135–135.9, 136.6, 515, 516–516.9	both	1–85

Table 8.1 – map of all conditions of personal health care spending continued

Condition	Condition name	ICD Codes	Sexes allowed	Ages allowed
B.3.5	Other chronic respiratory	327.2–327.8, 470, 470.9–474.9, 476–476.1, 477–479, 495–495.9, 506–506.9, 508–509, 517–517.8, 518.6, 518.9, 519.1–519.8, 713.4, 780.57, 786.03, V07.1, V13.81, V14–V15.09, V19.6	both	1–85
B.4	Cirrhosis	070.22–070.23, 070.32–070.33, 070.44, 070.54, 456.0–456.21, 571–571.9, 572.3–572.9, 573.0–573.3, 573.8–573.9, V42.7	both	0–85
B.5.1	Peptic ulcer disease	531–534.91, V12.71	both	1–85
B.5.2	Gastritis & duodenitis	535–535.9	both	1–85
B.5.3	Appendicitis	540–542.9	both	1–85
B.5.4	Ileus & obstruction	560–560.39, 560.8–560.9	both	0–85
B.5.5	Hernia	550–551.1, 551.3–552.1, 552.3–553.03, 553.6, 555.3	both	1–85
B.5.6	Inflammatory bowel	555–555.2, 555.9–556.9, 558–558.9, 569.5, V12.72	both	1–85
B.5.7	Vascular intestinal	557–557.9	both	Jan-85
B.5.8	Gallbladder & biliary	574-576.9	both	Jan-85
B.5.9	Pancreatitis	577-577.9, 579.4	both	Jan-85
B.5.10	Other digestive	455–455.9, 530–530.9, 536–536.1, 537–537.6, 537.8–537.84, 538, 543–543.9, 553.1–553.3, 562–562.13, 564–564.1, 564.5–564.7, 565–566.9, 569.1–569.42, 569.7–569.71, 573.4, 579–579.2, 579.8–579.9, 713.1, 787.1	both	1–85
B.6.1	Alzheimer disease	290–290.9, 294.1–294.9, 331–331.2	both	40–85
B.6.2	Parkinson disease	332–332.9	both	20–85
B.6.3	Epilepsy	345–345.91	both	0–85
B.6.4	Multiple sclerosis	340–340.9	both	5–85
B.6.5	Migraine	346–346.93	both	5–85
B.6.6	Tension headache	307.81, 339–339.12, 339.20–339.89	both	5–85
B.6.8	Other neurological	330–330.9, 331.5–331.9, 333–338.4, 341–341.9, 349, 349.2–349.8, 350–353.0, 353.5–355, 355.1–356.9, 357.1, 357.3–357.4, 357.7, 358–359.9, 713.5, 725–725.9, 728–728.11, 728.13–728.81, 728.83–729.5, 729.7–729.90, 729.92–729.99, 775.2	both	0–85
B.7.1	Schizophrenia	295–295.95, 301.0, 301.2–301.22, V11.0	both	10–85

Table 8.1 – map of all conditions of personal health care spending continued

Condition	Condition name	ICD Codes	Sexes allowed	Ages allowed
B.7.2	Alcohol use disorders	291–291.9, 303–303.93, 305.0–305.03, 357.5, 760.71, 790.3, E86.0–E86.019, V11.3, V79.1	both	0–85
B.7.3	Drug use disorders	292–292.9, 304.0–304.83, 305, 305.2–305.93, E85.0–E85.029, E85.09–E85.439, V15.85–V15.86	both	10–85
B.7.4	Depressive disorders	296.2–296.36, 300.4, 311–311.9, V11.1–V11.2, V79.0	both	1–85
B.7.5	Bipolar disorder	296–296.16, 296.4–296.99, 301.1–301.13	both	10–85
B.7.6	Anxiety disorders	300.0–300.09, 300.2–300.3, 301.4, 308–309.9, 313.0	both	1–85
B.7.7	Eating disorders	307.1, 307.51, 307.54	both	5–45
B.7.8	Autistic spectrum	299.0–299.01, 299.8–299.81	both	0–85
B.7.9	Attention deficit/hyperactivity disorder	314.0–314.01	both	1–85
B.7.10	Conduct disorder	301, 301.3, 301.5–301.89, 312–312.9, V71.02	both	5–20
B.7.11	Intellectual disability	317–319.9, V18.4	both	0–85
B.7.12	Other mental & substance	298–298.4, 299, 299.1–299.11, 299.9–300, 300.1–300.15, 300.5–300.89, 302–302.9, 306–306.9, 307.0, 307.2–307.49, 307.6–307.7, 313, 313.1–313.83, 314, 314.1–314.2, 315–315.5, 327–327.09, 347–347.9, 780.5–780.52, 780.59, V71.01	both	1–85
B.8.1	Diabetes	250–250.39, 250.5–250.99, 357.2, 362.0–362.07, 366.41, 775.0–775.1, 790.2–790.22, V12.21, V18.0, V45.85, V53.91, V58.67, V77.1	both	0–85
B.8.2	Acute glomerulonephritis	580–580.9	both	0–85
B.8.3	Chronic kidney disease	250.4–250.49, 403–404.93, 581–583.9, 585–585.9, 589–589.9, V13.03–V13.09, V18.6, V18.69, V42.0, V45.1–V45.12, V45.73, V56–V56.8, V81.5–V81.6	both	0–85

Table 8.1 – map of all conditions of personal health care spending continued

Condition	Condition name	ICD Codes	Sexes allowed	Ages allowed
B.8.4	Urinary diseases	588–588.9, 590–590.9, 592–593.89, 594–596.81, 596.89–598.1, 598.8–599.6, 599.8–599.89, 600–608.89, 788.0, 788.3–788.39, V13.0–V13.02, V26.5, V26.52, V45.74, V47.4, V58.76	both	0–85
B.8.5	Gynecological diseases	112.1–112.2, 220–220.9, 256.4, 611–612.1, 615–618.9, 620–620.9, 621.4–621.9, 622.3–622.7, 623, 623.2–623.6, 623.8–624.9, 625.4, 627–629.81, V07.4–V07.59, V13.2, V13.29, V18.7, V26–V26.32, V26.34–V26.39, V26.42–V26.49, V26.51, V26.8–V26.9, V43.82, V45.71, V45.83, V47.5, V49.81, V59.70–V59.74, V72.3–V72.31, V84.04	female	10–85
B.8.6	Hemoglobinopathies	282–284.9, 713.2, V12.3, V18.3, V78, V78.2–V78.9, V83.0–V83.02	both	0–85
B.8.7	Endocrine/metabolism/blood/immune disorders	240–243.9, 245–246.9, 251–251.2, 251.4–253.6, 253.8–256.39, 256.8–259.9, 270–271.9, 273–273.9, 275–276, 277–277.2, 277.30–277.9, 278.2–279.19, 279.4–279.49, 279.6, 286–286.5, 286.7–289.9, 713.0, 775.3, V12.2, V12.29, V12.4–V12.40, V18.1–V18.19, V29.3, V77–V77.0, V77.3–V77.4, V77.6–V77.7, V77.9, V77.99, V83.81, V84.81	both	0–85
B.8.8	Renal failure	584–584.9, 586–586.9	both	0–85
B.9.1	Rheumatoid arthritis	714–714.33, 714.8–714.9	both	5–85
B.9.2	Osteoarthritis	715–715.98, 717–718.99, 731–731.9	both	30–85
B.9.3	Low back & neck pain	353.1–353.4, 355.0, 720–721.1, 721.3, 721.5–721.6, 721.8–724.9, 737–737.9	both	5–85
B.9.4	Gout	274–274.9	both	15–85

Table 8.1 – map of all conditions of personal health care spending continued

Condition	Condition name	ICD Codes	Sexes allowed	Ages allowed
B.9.5	Other musculoskeletal	416.1–416.2, 446–446.9, 695.4–695.59, 710–712.99, 716.2–716.39, 719.2–719.39, 719.8–719.89, 721.2, 721.4–721.42, 726–727.9, 730–730.39, 732–734.2, 739–739.9, V82.81	both	0–85
B.10.1	Congenital anomalies	740–758.9, 759.0–759.89, V13.6–V13.69, V18.61, V18.9, V19.5, V19.7–V19.8, V55.7, V82.3	both	0–85
B.10.2	Skin diseases	035–035.9, 078–078.4, 110–111.9, 132–134.9, 680–695.3, 695.8–709.3, 709.8–709.9, 713.3, V13.3, V19.4, V43.83, V58.77, V82.0	both	0–85
B.10.3	Sense organ diseases	077–077.99, 360–360.44, 360.8–362, 362.1–366.19, 366.3–366.4, 366.42–374.85, 374.87–376.52, 376.8–380.9, 385–385.82, 385.89–389.9, V19.0–V19.3, V41–V41.5, V42.5, V43.0–V43.1, V45.6–V45.69, V45.78, V48.4–V48.5, V52.2, V53.1–V53.2, V58.71, V59.5, V72.0–V72.19, V74.4, V80, V80.1–V80.3	both	0–85
B.10.4	Oral disorders	520–529.9, V07.31, V45.84, V49.82, V52.3, V53.4, V58.5, V72.2	both	1–85

Table 8.1 – map of all conditions of personal health care spending continued

Condition	Condition name	ICD Codes	Sexes allowed	Ages allowed
B.9.5	Other musculoskeletal	416.1–416.2, 446–446.9, 695.4–695.59, 710–712.99, 716.2–716.39, 719.2–719.39, 719.8–719.89, 721.2, 721.4–721.42, 726–727.9, 730–730.39, 732–734.2, 739–739.9, V82.81	both	0–85
C.1.1	Road injuries	E80.03, E80.13, E80.23, E80.33, E80.43, E80.53, E80.63, E80.73, E81.00–E81.06, E81.10–E81.17, E81.20–E81.27, E81.30–E81.37, E81.40–E81.47, E81.50–E81.57, E81.60–E81.67, E81.70–E81.77, E81.80–E81.87, E81.90–E81.97, E82.00–E82.06, E82.10–E82.16, E82.20–E82.27, E82.30–E82.37, E82.40–E82.47, E82.50–E82.57, E82.60–E82.61, E82.63–E82.64, E82.70, E82.73–E82.74, E82.80, E82.84, E82.90–E82.94	both	0–85
C.1.2	Other transport injuries	E80.0–E80.02, E80.1–E80.12, E80.2–E80.22, E80.3–E80.32, E80.4–E80.42, E80.5–E80.52, E80.6–E80.62, E80.7–E80.72, E81.07, E82.07, E82.17, E82.62, E82.72, E82.82, E83.1–E83.19, E83.3–E83.89, E84.0–E84.8, E92.91	both	0–85
C.2.1	Falls	E88.0–E88.699, E88.8–E88.89, E92.93, V15.88	both	0–85
C.2.2	Drowning	E83.0–E83.09, E83.2–E83.29, E91.0–E91.099	both	0–85
C.2.3	Fire & heat	E89.0–E89.909, E92.4–E92.499, E92.94	both	0–85
C.2.4	Poisonings	E85.03–E85.089, E85.48–E85.899, E86.02–E86.939, E86.940–E86.999, E92.92, V15.6, V87.0–V87.39	both	0–85
C.2.5	Mechanical forces	E91.3–E91.319, E91.6–E92.299, E92.81–E92.87	both	0–85
C.2.7	Animal contact	E90.5–E90.699, V90.31	both	0–85

Table 8.1 – map of all conditions of personal health care spending continued

Condition	Condition name	ICD Codes	Sexes allowed	Ages allowed
C.2.8	Foreign body	360.5–360.69, 374.86, 376.6, 385.83, 709.4, 728.82, 729.6, E91.1–E91.209, E91.38–E91.509, V15.53, V90–V90.3, V90.32–V90.9	both	0–85
C.2.9	Other unintentional	E00.0–E03.0, E90.01–E90.019, E90.11–E90.119, E90.2–E90.4, E90.41–E90.499, E91.32–E91.339, E92.3–E92.399, E92.5–E92.809, E92.88–E92.889	both	0–85
C.3.1	Self-harm	E95.0–E95.9	both	5–85
C.3.2	Interpersonal violence	E90.40–E90.409, E96.0–E96.9, V15.41, V71.5, V71.81	both	0–85
C.4.1	Forces of nature	E90.0–E90.009, E90.09–E90.109, E90.18–E90.199, E90.7–E90.99	both	0–85
C.4.2	War & legal intervention	E97.0–E97.99, E99.0–E99.91	both	0–85
D.1	Well person	V20.1–V21.9, V30–V39.2, V70–V70.0, V70.3–V70.6, V70.8–V70.9, V72, V72.5–V72.8, V72.83–V72.9, V82, V82.5–V82.8, V82.89–V83, V83.8, V83.89–V84, V84.01–V84.03, V84.8, V84.89, V86–V86.1	both	0–85
D.1	Well dental	V20.1–V21.9, V30–V39.2, V70–V70.0, V70.3–V70.6, V70.8–V70.9, V72, V72.5–V72.8, V72.83–V72.9, V82, V82.5–V82.8, V82.89–V83, V83.8, V83.89–V84, V84.01–V84.03, V84.8, V84.89, V86–V86.1	both	0–85
D.1	Well newborn	V20.1–V21.9, V30–V39.2, V70–V70.0, V70.3–V70.6, V70.8–V70.9, V72, V72.5–V72.8, V72.83–V72.9, V82, V82.5–V82.8, V82.89–V83, V83.8, V83.89–V84, V84.01–V84.03, V84.8, V84.89, V86–V86.1	both	0

Table 8.1 – map of all conditions of personal health care spending continued

Condition	Condition name	ICD Codes	Sexes allowed	Ages allowed
D.2	Well pregnancy	644.03, 644.21, 645.11, 650–652, 652.21, 652.51, 652.61, 652.81, 653.41, 654.21, 655.71, 655.81, 656.11, 656.41, 656.51, 656.61, 656.81, 657.01, 658.01, 658.11, 658.21, 658.41, 659.11, 659.41, 659.51, 659.61, 659.71, 659.81, 661.01, 661.21, 661.31, 663.11, 663.21, 663.31, 663.81, 664.01, 664.81, 669.7, 669.71, 669.81, V13.21, V20–V20.0, V22–V24.2, V27–V28.9, V72.4–V72.42, V82.4, V91–V91.99	female	15–50
D.4	Family planning	V15.7, V25–V25.9, V26.33, V26.41, V45.5–V45.59	both	0–85
D.5	Donor services	V59–V59.4, V59.6–V59.7, V59.8–V59.9	both	0–85
D.6	Counselling services	V26.4, V61.1, V61.11–V62.9, V65–V65.9, V69–V69.9	both	0–85
C.2.8	Foreign body	360.5–360.69, 374.86, 376.6, 385.83, 709.4, 728.82, 729.6, E91.1–E91.209, E91.38–E91.509, V15.53, V90–V90.3, V90.32–V90.9	both	0–85

The categorization scheme included in Table 8.1 is part of the Global Burden of Disease study condition hierarchy. Table 8.1 only includes the 155 conditions of personal health care spending that were estimated in this study. Aggregated condition categories were used in figures throughout this paper and are included in Table 8.2 for reference.

Table 8.2 – aggregated condition of personal healthcare spending categories

Condition	Condition name
A	Communicable, maternal, neonatal, and nutritional diseases
A.1	HIV/AIDS and tuberculosis
A.2	Diarrhea, lower respiratory, and other common infectious diseases
A.3	Neglected tropical diseases and malaria
A.4	Maternal disorders
A.5	Neonatal disorders
A.6	Nutritional deficiencies
A.7	Other communicable, maternal, neonatal, and nutritional diseases
B	Non-communicable diseases
B.1	Neoplasms
B.2	Cardiovascular diseases
B.3	Chronic respiratory diseases
B.4	Cirrhosis and other chronic liver diseases
B.5	Digestive diseases
B.6	Neurological disorders
B.7	Mental and substance use disorders
B.8	Diabetes, urogenital, blood, and endocrine diseases
B.9	Musculoskeletal disorders
B.10	Other non-communicable diseases
C	Injuries
C.1	Transport injuries
C.2	Unintentional injuries
C.3	Self-harm and interpersonal violence
C.4	Forces of nature, war, and legal intervention

Section 9: Results

Table 9.1: Personal health care spending results by function

Rank	Condition	2013 spending (billions of US dollars)	Percent of 2013 spending that is:					
			Ambulatory care	Inpatient care	Retail pharmaceuticals	Emergency department care	Nursing care	Dental care
	All conditions	$2,100.1 ($2,100.1-$2,100.1)	33.6% (33.6%-33.6%)	33.2% (33.2%-33.2%)	13.7% (13.7%-13.7%)	4.9% (4.9%-4.9%)	9.3% (9.3%-9.3%)	5.4% (5.4%-5.4%)
1	Diabetes mellitus	$101.4 ($96.7-$106.5)	23.5% (21.7%-25.4%)	9.5% (8.4%-10.8%)	57.6% (55.4%-60.1%)	0.4% (0.3%-0.5%)	9.1% (8.0%-10.2%)	0.0% (0.0%-0.0%)
2	Ischemic heart disease	$88.1 ($82.7-$92.9)	23.9% (21.3%-26.7%)	56.5% (53.4%-59.1%)	11.3% (10.0%-12.6%)	0.9% (0.7%-1.3%)	7.3% (5.9%-8.6%)	0.0% (0.0%-0.0%)
3	Low back and neck pain	$87.6 ($67.5-$94.1)	60.5% (49.3%-63.8%)	28.8% (25.7%-37.0%)	4.1% (3.5%-5.1%)	4.2% (3.4%-5.4%)	2.5% (2.1%-3.1%)	0.0% (0.0%-0.0%)
4	Hypertension	$83.9 ($80.2-$88.8)	45.8% (43.6%-49.0%)	1.3% (1.1%-1.6%)	41.2% (38.7%-43.3%)	1.8% (1.4%-2.1%)	9.9% (8.7%-11.2%)	0.0% (0.0%-0.0%)
5	Falls	$76.3 ($70.8-$83.1)	29.7% (25.9%-35.5%)	34.3% (30.5%-37.3%)	0.6% (0.5%-0.8%)	22.7% (20.5%-24.7%)	12.7% (10.5%-15.0%)	0.0% (0.0%-0.0%)
6	Depressive disorders	$71.1 ($66.1-$75.9)	53.1% (49.9%-56.0%)	11.6% (10.7%-12.7%)	32.1% (28.8%-35.0%)	0.5% (0.2%-0.8%)	2.8% (2.2%-3.3%)	0.0% (0.0%-0.0%)

Table 9.1: Personal health care spending results by function continued

Rank	Condition	2013 spending (billions of US dollars)	Percent of 2013 spending that is:					
			Ambulatory care	Inpatient care	Retail pharmaceuticals	Emergency department care	Nursing care	Dental care
7	Oral disorders	$66.4 ($64.8-$68.2)	1.0% (0.8%-1.2%)	1.5% (1.2%-1.8%)	0.4% (0.4%-0.5%)	1.2% (1.0%-1.4%)	0.1% (0.1%-0.2%)	95.8% (95.4%-96.2%)
8	Sense organ diseases	$59.0 ($54.5-$65.7)	85.4% (83.9%-87.4%)	2.3% (1.9%-2.9%)	8.6% (7.2%-9.8%)	2.1% (1.6%-2.6%)	1.6% (1.1%-2.1%)	0.0% (0.0%-0.0%)
9	Skin and subcutaneous diseases	$55.7 ($52.9-$59.4)	52.0% (49.1%-55.9%)	20.7% (18.1%-23.6%)	12.6% (11.4%-14.1%)	6.0% (5.1%-6.9%)	8.6% (7.4%-9.5%)	0.0% (0.0%-0.0%)
10	Pregnancy and postpartum care	$55.6 ($52.5-$59.8)	47.6% (44.9%-51.0%)	50.5% (47.2%-53.2%)	0.6% (0.5%-0.8%)	1.3% (0.9%-1.7%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)
11	Urinary diseases and male infertility	$54.9 ($51.5-$58.3)	37.0% (34.1%-39.6%)	21.9% (19.8%-24.8%)	9.5% (8.0%-11.1%)	13.4% (11.5%-15.4%)	18.3% (16.0%-20.7%)	0.0% (0.0%-0.0%)
12	Chronic obstructive pulmonary disease	$53.8 ($50.1-$58.2)	19.2% (17.1%-21.6%)	34.8% (30.9%-39.6%)	18.9% (16.1%-21.9%)	6.1% (4.9%-7.4%)	21.1% (18.5%-23.6%)	0.0% (0.0%-0.0%)
13	Hyperlipidemia	$51.8 ($48.9-$54.6)	20.9% (18.9%-23.0%)	0.0% (0.0%-0.0%)	78.5% (76.4%-80.5%)	0.0% (0.0%-0.0%)	0.6% (0.4%-1.0%)	0.0% (0.0%-0.0%)

Table 9.1: Personal health care spending results by function continued

Rank	Condition	2013 spending (billions of US dollars)	Percent of 2013 spending that is:					
			Ambulatory care	Inpatient care	Retail pharmaceuticals	Emergency department care	Nursing care	Dental care
14	Well dental	$48.7 ($47.1-$50.3)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	100.0% (100.0%-100.0%)
15	Osteoarthritis	$47.9 ($44.7-$51.1)	23.5% (21.4%-25.7%)	63.8% (61.1%-65.9%)	5.8% (5.0%-6.5%)	0.1% (0.0%-0.1%)	6.9% (6.0%-8.1%)	0.0% (0.0%-0.0%)
16	Other musculoskeletal disorders	$44.9 ($42.4-$47.2)	49.4% (46.9%-52.3%)	25.4% (23.2%-27.4%)	9.2% (7.8%-10.6%)	5.0% (4.3%-5.8%)	11.0% (9.6%-12.4%)	0.0% (0.0%-0.0%)
17	Cerebrovascular disease	$43.8 ($41.0-$46.1)	5.2% (4.3%-6.1%)	54.0% (51.4%-56.9%)	2.6% (2.1%-3.3%)	1.4% (1.0%-1.8%)	36.7% (33.8%-39.2%)	0.0% (0.0%-0.0%)
18	Other neurological disorders	$43.7 ($41.0-$46.2)	50.9% (47.9%-53.9%)	12.1% (10.2%-14.4%)	15.8% (13.6%-18.1%)	5.2% (4.2%-6.2%)	16.0% (13.7%-18.3%)	0.0% (0.0%-0.0%)
19	Other digestive diseases	$38.8 ($36.0-$41.5)	39.0% (35.6%-42.8%)	36.2% (33.3%-39.1%)	12.5% (10.7%-14.4%)	7.7% (6.3%-9.1%)	4.6% (3.9%-5.5%)	0.0% (0.0%-0.0%)
20	Lower respiratory infections	$37.1 ($32.5-$41.7)	12.5% (10.8%-14.7%)	48.6% (42.5%-55.0%)	1.5% (1.2%-1.8%)	6.3% (4.8%-7.7%)	31.1% (24.4%-38.0%)	0.0% (0.0%-0.0%)

Table 9.1: Personal health care spending results by function continued

Rank	Condition	2013 spending (billions of US dollars)	Percent of 2013 spending that is:					
			Ambulatory care	Inpatient care	Retail pharmaceuticals	Emergency department care	Nursing care	Dental care
21	Alzheimer's disease and other dementias	$36.7 ($30.5-$43.1)	1.9% (1.4%-2.4%)	5.1% (4.0%-6.6%)	4.5% (3.1%-6.6%)	0.2% (0.0%-0.4%)	88.4% (84.8%-90.4%)	0.0% (0.0%-0.0%)
22	Other chronic respiratory diseases	$34.7 ($32.7-$37.1)	68.4% (65.4%-71.3%)	3.1% (2.6%-3.8%)	25.1% (22.2%-28.0%)	2.9% (2.4%-3.4%)	0.5% (0.4%-0.6%)	0.0% (0.0%-0.0%)
23	Septicemia	$33.9 ($28.2-$41.3)	0.0% (0.0%-0.1%)	96.1% (94.9%-97.3%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	3.9% (2.7%-5.0%)	0.0% (0.0%-0.0%)
24	Asthma	$32.5 ($29.7-$34.8)	21.6% (19.7%-23.9%)	13.8% (12.0%-16.2%)	57.5% (53.8%-60.6%)	6.0% (4.9%-7.2%)	1.1% (0.7%-1.8%)	0.0% (0.0%-0.0%)
25	Exposure to mechanical forces	$30.0 ($27.4-$32.0)	47.2% (43.0%-51.3%)	7.3% (6.4%-8.2%)	1.0% (0.8%-1.2%)	44.3% (40.2%-48.6%)	0.2% (0.1%-0.3%)	0.0% (0.0%-0.0%)
26	Anxiety disorders	$29.7 ($27.2-$31.9)	71.4% (67.5%-74.9%)	3.9% (3.5%-4.4%)	19.7% (16.9%-22.9%)	2.5% (1.7%-3.2%)	2.6% (1.2%-4.5%)	0.0% (0.0%-0.0%)
27	Heart Failure	$28.5 ($26.0-$31.4)	4.2% (3.3%-5.0%)	71.0% (67.5%-75.1%)	0.7% (0.5%-0.8%)	0.6% (0.2%-0.9%)	23.7% (19.7%-27.1%)	0.0% (0.0%-0.0%)

Table 9.1: Personal health care spending results by function continued

Rank	Condition	2013 spending (billions of US dollars)	Percent of 2013 spending that is:					
			Ambulatory care	Inpatient care	Retail pharmaceuticals	Emergency department care	Nursing care	Dental care
28	Well newborn	$27.9 ($24.2-$32.2)	0.0% (0.0%-0.0%)	100.0% (100.0%-100.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)
29	Atrial fibrillation and flutter	$27.7 ($26.4-$29.1)	32.3% (29.9%-34.8%)	41.0% (38.4%-43.5%)	5.9% (5.0%-6.9%)	11.2% (9.5%-13.1%)	9.6% (8.3%-10.9%)	0.0% (0.0%-0.0%)
30	Other cardiovascular and circulatory diseases	$26.0 ($24.4-$27.4)	24.6% (21.7%-27.5%)	62.4% (59.4%-65.4%)	4.4% (3.5%-5.3%)	1.3% (1.0%-1.7%)	7.3% (6.2%-8.4%)	0.0% (0.0%-0.0%)
31	Other unintentional injuries	$25.6 ($21.6-$28.8)	65.6% (59.4%-70.3%)	14.7% (12.3%-17.3%)	0.9% (0.7%-1.1%)	18.5% (14.9%-22.1%)	0.4% (0.2%-0.8%)	0.0% (0.0%-0.0%)
32	Attention-deficit/hyperactivity disorder	$23.2 ($19.8-$26.2)	62.6% (55.4%-69.4%)	0.6% (0.5%-0.8%)	36.8% (30.0%-43.9%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)
33	Road injuries	$20.0 ($17.1-$23.8)	12.6% (9.2%-16.8%)	67.3% (60.9%-72.7%)	0.2% (0.2%-0.3%)	18.0% (15.1%-21.5%)	1.8% (1.2%-2.7%)	0.0% (0.0%-0.0%)
34	Gynecological diseases	$19.8 ($17.7-$22.9)	68.3% (63.7%-73.3%)	19.6% (16.4%-22.8%)	4.0% (3.1%-5.0%)	7.0% (5.2%-9.6%)	1.1% (0.6%-2.4%)	0.0% (0.0%-0.0%)
35	Endocrine, metabolic, blood, and immune disorders	$19.6 ($18.0-$21.1)	36.1% (32.5%-39.3%)	33.1% (29.4%-36.7%)	24.4% (20.5%-27.6%)	1.0% (0.5%-1.7%)	5.4% (4.1%-9.6%)	0.0% (0.0%-0.0%)

Table 9.1: Personal health care spending results by function continued

Rank	Condition	2013 spending (billions of US dollars)	Percent of 2013 spending that is:					
			Ambulatory care	Inpatient care	Retail pharmaceuticals	Emergency department care	Nursing care	Dental care
36	Colon and rectum cancers	$18.5 ($16.7-$20.1)	41.7% (37.7%-46.5%)	52.0% (47.0%-56.2%)	0.7% (0.5%-1.0%)	0.6% (0.4%-0.8%)	5.0% (4.2%-5.8%)	0.0% (0.0%-0.0%)
37	Schizophrenia	$17.6 ($12.5-$38.1)	10.1% (4.3%-13.5%)	54.3% (22.8%-67.2%)	1.6% (0.6%-2.8%)	0.5% (0.0%-1.0%)	33.6% (17.9%-71.8%)	0.0% (0.0%-0.0%)
38	Well person	$15.4 ($13.5-$17.9)	98.0% (97.4%-98.7%)	0.0% (0.0%-0.0%)	2.0% (1.4%-2.6%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)
39	Gallbladder and biliary diseases	$15.2 ($14.1-$16.4)	20.6% (16.9%-24.3%)	71.9% (67.7%-75.5%)	0.1% (0.1%-0.2%)	4.2% (2.8%-5.9%)	3.2% (2.6%-3.9%)	0.0% (0.0%-0.0%)
40	Upper respiratory infections	$14.7 ($13.5-$16.2)	69.2% (64.6%-73.6%)	5.1% (4.3%-6.1%)	3.3% (2.7%-3.8%)	19.6% (16.0%-23.0%)	2.8% (0.4%-6.7%)	0.0% (0.0%-0.0%)
41	Drug use disorders	$13.5 ($12.3-$14.9)	56.4% (52.5%-60.7%)	32.6% (29.1%-35.9%)	0.3% (0.2%-0.4%)	2.7% (2.0%-3.6%)	8.0% (6.6%-9.3%)	0.0% (0.0%-0.0%)
42	Chronic kidney diseases	$13.5 ($12.1-$15.3)	18.1% (13.0%-22.4%)	68.0% (62.8%-73.9%)	3.3% (1.7%-5.3%)	0.0% (0.0%-0.0%)	10.7% (8.1%-13.4%)	0.0% (0.0%-0.0%)
43	Trachea, bronchus, and lung cancers	$13.1 ($11.8-$14.2)	48.6% (44.0%-53.3%)	46.0% (40.9%-50.5%)	0.9% (0.6%-1.3%)	0.5% (0.3%-0.6%)	4.1% (3.6%-4.8%)	0.0% (0.0%-0.0%)

Table 9.1: Personal health care spending results by function continued

Rank	Condition	2013 spending (billions of US dollars)	Percent of 2013 spending that is:					
			Ambulatory care	Inpatient care	Retail pharmaceuticals	Emergency department care	Nursing care	Dental care
44	Bipolar disorder	$13.1 ($12.3-$14.0)	29.6% (26.4%-32.5%)	60.7% (57.8%-63.7%)	5.7% (3.8%-7.7%)	0.1% (0.0%-0.2%)	3.9% (2.5%-5.1%)	0.0% (0.0%-0.0%)
45	Acute renal failure	$12.7 ($9.7-$15.4)	27.0% (8.3%-39.2%)	63.8% (52.6%-80.6%)	0.4% (0.2%-0.7%)	0.0% (0.0%-0.0%)	8.8% (6.4%-12.1%)	0.0% (0.0%-0.0%)
46	Other infectious diseases	$12.1 ($11.0-$13.3)	52.5% (48.1%-56.8%)	13.0% (10.8%-15.2%)	6.6% (5.4%-7.7%)	14.0% (11.5%-16.5%)	13.9% (9.9%-18.5%)	0.0% (0.0%-0.0%)
47	Breast cancer	$12.1 ($10.8-$13.5)	71.1% (67.1%-74.9%)	23.5% (20.3%-26.5%)	2.7% (1.9%-3.6%)	0.0% (0.0%-0.0%)	2.7% (1.5%-5.5%)	0.0% (0.0%-0.0%)
48	Other neoplasms	$11.6 ($10.1-$12.9)	28.9% (24.0%-33.6%)	69.0% (64.3%-73.8%)	0.4% (0.2%-0.6%)	0.0% (0.0%-0.0%)	1.8% (1.4%-2.2%)	0.0% (0.0%-0.0%)
49	Interstitial lung disease and pulmonary sarcoidosis	$10.9 ($8.9-$13.5)	0.0% (0.0%-0.0%)	99.2% (99.0%-99.4%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	0.8% (0.6%-1.0%)	0.0% (0.0%-0.0%)
50	Congenital anomalies	$10.7 ($9.2-$12.2)	23.6% (18.1%-29.0%)	72.6% (66.9%-78.4%)	0.1% (0.0%-0.1%)	0.0% (0.0%-0.0%)	3.6% (2.4%-5.2%)	0.0% (0.0%-0.0%)
51	Pancreatitis	$9.5 ($8.6-$10.2)	0.4% (0.3%-0.6%)	78.4% (74.8%-81.9%)	0.6% (0.4%-0.7%)	3.3% (2.5%-4.0%)	17.3% (14.0%-20.9%)	0.0% (0.0%-0.0%)

Table 9.1: Personal health care spending results by function continued

Rank	Condition	2013 spending (billions of US dollars)	Percent of 2013 spending that is:					
			Ambulatory care	Inpatient care	Retail pharmaceuticals	Emergency department care	Nursing care	Dental care
52	Aortic aneurysm	$9.5 ($9.0-$10.0)	17.2% (15.1%-19.2%)	60.9% (58.2%-63.6%)	3.0% (2.4%-3.7%)	12.4% (10.4%-14.4%)	6.5% (5.6%-7.5%)	0.0% (0.0%-0.0%)
53	Alcohol use disorders	$9.3 ($7.1-$11.3)	43.3% (34.2%-53.4%)	38.6% (30.9%-47.9%)	0.0% (0.0%-0.0%)	14.0% (0.1%-26.2%)	4.2% (2.0%-6.2%)	0.0% (0.0%-0.0%)
54	Diarrheal diseases	$9.2 ($8.4-$10.1)	24.2% (20.8%-27.5%)	50.5% (45.6%-55.7%)	4.3% (3.4%-5.3%)	11.4% (9.1%-14.4%)	9.6% (7.2%-12.2%)	0.0% (0.0%-0.0%)
55	Otitis media	$8.8 ($7.8-$10.0)	82.6% (78.7%-85.7%)	1.4% (1.2%-1.7%)	5.9% (4.8%-7.3%)	10.1% (7.7%-13.3%)	0.1% (0.1%-0.1%)	0.0% (0.0%-0.0%)
56	Non-melanoma skin cancer	$8.2 ($7.2-$9.3)	96.8% (96.1%-97.3%)	2.5% (2.0%-3.0%)	0.3% (0.2%-0.4%)	0.0% (0.0%-0.0%)	0.5% (0.3%-0.6%)	0.0% (0.0%-0.0%)
57	Paralytic ileus and intestinal obstruction	$8.0 ($7.3-$8.8)	0.4% (0.0%-0.7%)	91.9% (90.1%-93.7%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.1%)	7.6% (6.0%-9.5%)	0.0% (0.0%-0.0%)
58	Appendicitis	$7.8 ($7.1-$8.4)	0.3% (0.0%-0.7%)	95.6% (94.4%-96.9%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	4.1% (2.9%-5.2%)	0.0% (0.0%-0.0%)
59	Migraine	$7.3 ($6.5-$8.1)	35.0% (30.7%-39.2%)	9.9% (7.5%-12.5%)	39.3% (33.9%-43.8%)	15.8% (12.5%-19.8%)	0.0% (0.0%-0.1%)	0.0% (0.0%-0.0%)

Table 9.1: Personal health care spending results by function continued

Rank	Condition	2013 spending (billions of US dollars)	Percent of 2013 spending that is:					
			Ambulatory care	Inpatient care	Retail pharmaceuticals	Emergency department care	Nursing care	Dental care
60	Inflammatory bowel disease	$6.8 ($5.9-$7.8)	17.9% (14.5%-21.8%)	53.8% (46.2%-61.0%)	5.5% (3.6%-8.7%)	16.3% (6.8%-26.3%)	6.5% (4.3%-8.6%)	0.0% (0.0%-0.0%)
61	Peptic ulcer disease	$6.7 ($6.1-$7.2)	2.7% (2.1%-3.4%)	74.3% (70.5%-77.9%)	0.4% (0.2%-0.6%)	8.9% (5.5%-13.0%)	13.7% (11.4%-16.1%)	0.0% (0.0%-0.0%)
62	Iron-deficiency anemia	$6.5 ($5.8-$7.3)	28.4% (23.1%-32.7%)	46.3% (41.4%-52.6%)	1.9% (1.5%-2.5%)	0.3% (0.0%-0.8%)	23.1% (18.8%-27.7%)	0.0% (0.0%-0.0%)
63	Indirect maternal deaths	$6.4 ($5.8-$7.1)	8.1% (6.3%-10.2%)	87.7% (84.4%-90.4%)	0.4% (0.2%-0.7%)	3.8% (1.8%-6.1%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)
64	Brain and nervous system cancers	$5.7 ($5.0-$6.2)	24.4% (19.3%-28.9%)	65.4% (60.6%-70.6%)	1.7% (1.0%-2.5%)	0.0% (0.0%-0.0%)	8.5% (6.1%-10.7%)	0.0% (0.0%-0.0%)
65	Uterine cancer	$5.6 ($4.9-$6.2)	25.1% (20.0%-29.8%)	71.6% (67.1%-76.7%)	0.6% (0.4%-0.8%)	1.3% (0.8%-1.9%)	1.4% (1.1%-1.7%)	0.0% (0.0%-0.0%)
66	Prostate cancer	$5.4 ($4.8-$6.0)	55.2% (50.2%-60.1%)	35.9% (31.2%-40.2%)	2.7% (1.7%-3.9%)	0.5% (0.2%-0.7%)	5.7% (4.2%-7.5%)	0.0% (0.0%-0.0%)
67	Other maternal disorders	$5.2 ($4.6-$5.9)	4.7% (3.1%-6.7%)	92.4% (89.8%-94.7%)	0.2% (0.1%-0.3%)	2.7% (1.4%-4.5%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)

Table 9.1: Personal health care spending results by function continued

Rank	Condition	2013 spending (billions of US dollars)	Percent of 2013 spending that is:					
			Ambulatory care	Inpatient care	Retail pharmaceuticals	Emergency department care	Nursing care	Dental care
68	Interpersonal violence	$5.2 ($4.5-$6.0)	5.0% (3.0%-7.0%)	65.6% (60.2%-70.8%)	0.1% (0.1%-0.1%)	29.3% (24.7%-34.0%)	0.1% (0.0%-0.1%)	0.0% (0.0%-0.0%)
69	Other mental and behavioral disorders	$5.1 ($3.5-$6.0)	71.9% (59.5%-77.3%)	9.8% (8.1%-14.3%)	17.3% (12.7%-25.5%)	0.0% (0.0%-0.0%)	1.0% (0.6%-1.5%)	0.0% (0.0%-0.0%)
70	Neglected tropical diseases and malaria	$5.1 ($1.7-$8.5)	1.0% (0.4%-2.5%)	88.7% (71.5%-94.9%)	0.5% (0.2%-1.3%)	0.0% (0.0%-0.0%)	9.8% (4.3%-25.2%)	0.0% (0.0%-0.0%)
71	Family planning	$5.1 ($4.5-$5.6)	24.4% (20.0%-28.9%)	0.3% (0.2%-0.5%)	75.3% (70.9%-79.7%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)
72	Obesity	$5.0 ($4.0-$6.1)	18.8% (13.9%-23.3%)	74.6% (68.0%-81.0%)	4.3% (1.0%-9.2%)	0.0% (0.0%-0.0%)	2.3% (1.2%-3.9%)	0.0% (0.0%-0.0%)
73	Parkinson's disease	$4.9 ($4.3-$5.4)	6.8% (5.4%-8.4%)	37.3% (30.9%-44.1%)	5.4% (2.9%-8.4%)	0.0% (0.0%-0.0%)	50.5% (41.8%-58.0%)	0.0% (0.0%-0.0%)
74	Preterm birth complications	$4.9 ($4.0-$5.7)	6.0% (4.1%-8.3%)	93.8% (91.4%-95.6%)	0.1% (0.0%-0.1%)	0.2% (0.1%-0.5%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)
75	HIV/AIDS	$4.8 ($4.0-$5.6)	12.6% (10.1%-15.2%)	74.4% (68.2%-80.0%)	6.8% (4.1%-10.2%)	0.0% (0.0%-0.0%)	6.2% (2.2%-12.5%)	0.0% (0.0%-0.0%)

Table 9.1: Personal health care spending results by function continued

Rank	Condition	2013 spending (billions of US dollars)	Percent of 2013 spending that is:					
			Ambulatory care	Inpatient care	Retail pharmaceuticals	Emergency department care	Nursing care	Dental care
76	Multiple sclerosis	$4.4 ($3.8-$4.9)	11.0% (8.4%-13.6%)	46.1% (40.1%-53.0%)	13.1% (8.0%-21.0%)	0.0% (0.0%-0.0%)	29.8% (23.8%-34.8%)	0.0% (0.0%-0.0%)
77	Epilepsy	$4.3 ($3.7-$5.0)	7.2% (5.8%-8.8%)	79.0% (74.6%-83.5%)	5.8% (3.7%-8.0%)	0.8% (0.0%-1.8%)	7.3% (4.1%-11.3%)	0.0% (0.0%-0.0%)
78	Cirrhosis of the liver	$4.2 ($3.5-$5.1)	7.8% (4.6%-10.8%)	88.5% (84.6%-92.3%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	3.6% (2.3%-6.0%)	0.0% (0.0%-0.0%)
79	Stomach cancer	$3.9 ($3.5-$4.3)	20.6% (17.5%-24.3%)	60.9% (56.1%-64.7%)	0.2% (0.1%-0.3%)	0.2% (0.1%-0.3%)	18.1% (15.2%-21.3%)	0.0% (0.0%-0.0%)
80	Leukemia	$3.9 ($3.2-$4.4)	2.3% (1.0%-3.8%)	94.8% (93.0%-96.4%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	2.9% (2.0%-3.9%)	0.0% (0.0%-0.0%)
81	Gastritis and duodenitis	$3.4 ($3.0-$3.7)	12.2% (9.5%-14.9%)	54.6% (49.6%-59.0%)	3.0% (1.9%-4.5%)	19.4% (15.0%-25.2%)	10.7% (8.3%-13.1%)	0.0% (0.0%-0.0%)
82	Kidney cancer	$3.0 ($2.6-$3.4)	30.6% (25.9%-35.6%)	67.7% (62.6%-72.4%)	0.1% (0.1%-0.2%)	0.0% (0.0%-0.0%)	1.6% (1.3%-1.9%)	0.0% (0.0%-0.0%)
83	Maternal hypertensive disorders	$3.0 ($2.7-$3.4)	1.2% (0.6%-2.1%)	98.8% (97.9%-99.4%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)

Table 9.1: Personal health care spending results by function continued

Rank	Condition	2013 spending (billions of US dollars)	Percent of 2013 spending that is:					
			Ambulatory care	Inpatient care	Retail pharmaceuticals	Emergency department care	Nursing care	Dental care
84	Autistic spectrum disorders	$3.0 ($1.6-$4.5)	95.6% (91.3%-97.6%)	2.1% (1.2%-3.8%)	2.4% (0.8%-5.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)
85	Non-Hodgkin lymphoma	$2.9 ($2.4-$3.3)	20.1% (12.4%-26.9%)	76.5% (69.8%-83.9%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	3.5% (2.7%-4.3%)	0.0% (0.0%-0.0%)
86	Bladder cancer	$2.8 ($2.4-$3.2)	50.7% (44.2%-57.2%)	45.6% (39.3%-51.9%)	0.1% (0.1%-0.2%)	0.0% (0.0%-0.0%)	3.5% (2.8%-4.4%)	0.0% (0.0%-0.0%)
87	Self-harm	$2.8 ($2.3-$3.3)	0.0% (0.0%-0.0%)	97.7% (97.0%-98.5%)	0.0% (0.0%-0.0%)	2.0% (1.2%-2.6%)	0.3% (0.1%-0.7%)	0.0% (0.0%-0.0%)
88	Pancreatic cancer	$2.7 ($2.4-$2.9)	28.0% (24.4%-32.3%)	65.2% (60.2%-69.2%)	1.6% (1.1%-2.1%)	2.2% (1.5%-2.9%)	3.1% (2.5%-3.7%)	0.0% (0.0%-0.0%)
89	Hemoglobinopathies and hemolytic anemias	$2.6 ($2.4-$3.0)	1.2% (0.4%-2.1%)	97.3% (96.3%-98.1%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	1.6% (1.2%-1.9%)	0.0% (0.0%-0.0%)
90	Peripheral vascular disease	$2.5 ($2.3-$2.8)	38.0% (31.7%-43.4%)	37.1% (33.2%-40.8%)	1.2% (0.8%-1.7%)	0.3% (0.0%-0.6%)	23.4% (18.2%-28.7%)	0.0% (0.0%-0.0%)
91	Liver cancer	$2.4 ($2.1-$2.6)	6.6% (4.3%-8.6%)	61.1% (54.6%-65.5%)	3.5% (2.5%-4.7%)	12.5% (9.4%-15.9%)	16.3% (12.3%-21.5%)	0.0% (0.0%-0.0%)

Table 9.1: Personal health care spending results by function continued

Rank	Condition	2013 spending (billions of US dollars)	Percent of 2013 spending that is:					
			Ambulatory care	Inpatient care	Retail pharmaceuticals	Emergency department care	Nursing care	Dental care
92	Rheumatoid arthritis	$2.4 ($2.1-$2.7)	33.6% (28.4%-40.3%)	21.2% (18.4%-24.4%)	29.3% (23.5%-35.2%)	0.0% (0.0%-0.0%)	15.9% (10.5%-21.6%)	0.0% (0.0%-0.0%)
93	Cervical cancer	$2.1 ($1.6-$3.2)	39.8% (25.8%-50.0%)	40.9% (29.3%-50.2%)	0.3% (0.1%-0.5%)	0.1% (0.0%-0.1%)	18.9% (4.2%-44.5%)	0.0% (0.0%-0.0%)
94	Obstructed labor	$2.1 ($1.8-$2.4)	0.2% (0.0%-0.5%)	93.2% (88.7%-96.9%)	0.1% (0.0%-0.2%)	0.0% (0.0%-0.0%)	6.5% (2.9%-10.9%)	0.0% (0.0%-0.0%)
95	Animal contact	$2.1 ($1.8-$2.4)	40.6% (34.0%-47.6%)	15.0% (12.7%-17.8%)	2.1% (1.7%-2.7%)	42.0% (35.7%-48.2%)	0.3% (0.1%-0.9%)	0.0% (0.0%-0.0%)
96	Sexually transmitted diseases excluding HIV	$2.1 ($1.8-$2.4)	8.2% (5.6%-10.8%)	72.4% (66.6%-77.5%)	0.9% (0.6%-1.3%)	7.3% (3.6%-11.2%)	11.2% (9.1%-14.0%)	0.0% (0.0%-0.0%)
97	Counselling services	$2.1 ($1.6-$2.5)	84.9% (74.3%-91.4%)	0.7% (0.4%-1.1%)	9.7% (6.5%-13.4%)	0.0% (0.0%-0.0%)	4.7% (0.1%-16.1%)	0.0% (0.0%-0.0%)
98	Complications of abortion	$2.0 ($1.7-$2.2)	30.8% (23.9%-37.4%)	43.6% (37.8%-49.4%)	0.4% (0.2%-0.6%)	25.3% (17.3%-31.3%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)
99	Rheumatic heart disease	$1.9 ($1.7-$2.1)	0.0% (0.0%-0.0%)	97.2% (96.7%-97.8%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	2.8% (2.3%-3.3%)	0.0% (0.0%-0.0%)

Table 9.1: Personal health care spending results by function continued

Rank	Condition	2013 spending (billions of US dollars)	Percent of 2013 spending that is:					
			Ambulatory care	Inpatient care	Retail pharmaceuticals	Emergency department care	Nursing care	Dental care
100	Inguinal or femoral hernia	$1.8 ($1.6-$2.0)	15.7% (10.6%-22.8%)	80.9% (74.1%-86.2%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	3.4% (2.5%-4.6%)	0.0% (0.0%-0.0%)
101	Cardiomyopathy and myocarditis	$1.8 ($1.6-$2.0)	4.1% (2.7%-5.7%)	89.1% (86.7%-91.1%)	0.6% (0.1%-1.7%)	0.0% (0.0%-0.0%)	6.2% (5.1%-7.4%)	0.0% (0.0%-0.0%)
102	Ovarian cancer	$1.5 ($1.3-$1.7)	26.2% (22.3%-30.9%)	69.8% (64.8%-73.8%)	0.3% (0.2%-0.5%)	0.0% (0.0%-0.1%)	3.6% (2.9%-4.6%)	0.0% (0.0%-0.0%)
103	Fire, heat and hot substances	$1.4 ($1.2-$1.6)	3.7% (2.0%-5.5%)	83.7% (79.3%-88.1%)	0.1% (0.0%-0.1%)	9.9% (7.1%-13.4%)	2.7% (1.6%-4.1%)	0.0% (0.0%-0.0%)
104	Vascular intestinal disorders	$1.3 ($1.2-$1.4)	0.0% (0.0%-0.0%)	95.8% (94.9%-96.6%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	4.2% (3.4%-5.1%)	0.0% (0.0%-0.0%)
105	Collective violence and legal intervention	$1.3 ($0.9-$1.7)	0.0% (0.0%-0.0%)	99.6% (99.3%-99.8%)	0.0% (0.0%-0.0%)	0.4% (0.2%-0.7%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)
106	Malignant skin melanoma	$1.3 ($1.2-$1.5)	71.6% (67.9%-75.4%)	26.5% (22.8%-30.0%)	0.3% (0.1%-0.4%)	0.0% (0.0%-0.0%)	1.6% (1.2%-2.1%)	0.0% (0.0%-0.0%)
107	Mouth cancer	$1.2 ($1.0-$1.3)	30.4% (26.2%-35.1%)	65.3% (60.4%-69.7%)	0.2% (0.1%-0.3%)	0.0% (0.0%-0.1%)	4.0% (3.2%-5.0%)	0.0% (0.0%-0.0%)

Table 9.1: Personal health care spending results by function continued

Rank	Condition	2013 spending (billions of US dollars)	Percent of 2013 spending that is:					
			Ambulatory care	Inpatient care	Retail pharmaceuticals	Emergency department care	Nursing care	Dental care
108	Gallbladder and biliary tract cancer	$1.2 ($1.0-$1.3)	25.9% (21.1%-30.6%)	67.0% (61.6%-71.9%)	1.4% (0.9%-2.0%)	3.3% (2.2%-4.5%)	2.5% (1.8%-3.3%)	0.0% (0.0%-0.0%)
109	Other pharynx cancer	$1.2 ($1.0-$1.4)	28.1% (23.0%-33.1%)	24.5% (20.0%-28.6%)	1.6% (1.1%-2.1%)	44.0% (35.9%-51.7%)	1.8% (1.4%-2.3%)	0.0% (0.0%-0.0%)
110	Foreign body	$1.2 ($1.1-$1.4)	21.1% (15.2%-26.2%)	40.3% (34.2%-46.9%)	0.4% (0.2%-0.6%)	37.6% (30.6%-44.2%)	0.7% (0.2%-1.0%)	0.0% (0.0%-0.0%)
111	Maternal hemorrhage	$1.1 ($0.8-$1.4)	1.8% (0.9%-3.1%)	73.3% (58.3%-96.5%)	0.0% (0.0%-0.0%)	24.9% (0.8%-40.2%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)
112	Varicella	$1.0 ($0.7-$1.4)	36.1% (25.4%-46.6%)	30.9% (19.7%-40.5%)	10.0% (5.4%-15.5%)	1.4% (0.0%-3.3%)	21.6% (6.5%-44.4%)	0.0% (0.0%-0.0%)
113	Meningitis	$0.9 ($0.8-$1.0)	2.2% (0.0%-5.5%)	95.1% (91.8%-97.6%)	0.1% (0.0%-0.3%)	0.0% (0.0%-0.0%)	2.5% (2.0%-3.1%)	0.0% (0.0%-0.0%)
114	Multiple myeloma	$0.9 ($0.8-$1.1)	0.0% (0.0%-0.0%)	94.9% (93.8%-95.9%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	5.1% (4.1%-6.2%)	0.0% (0.0%-0.0%)
115	Other nutritional deficiencies	$0.9 ($0.6-$1.3)	28.0% (14.7%-40.6%)	12.8% (8.7%-19.3%)	15.0% (8.5%-25.6%)	0.0% (0.0%-0.0%)	44.2% (20.8%-64.3%)	0.0% (0.0%-0.0%)

Table 9.1: Personal health care spending results by function continued

Rank	Condition	2013 spending (billions of US dollars)	Percent of 2013 spending that is:					
			Ambulatory care	Inpatient care	Retail pharmaceuticals	Emergency department care	Nursing care	Dental care
116	Poisonings	$0.9 ($0.8-$1.1)	0.5% (0.2%-0.8%)	84.1% (76.5%-88.9%)	0.0% (0.0%-0.0%)	9.7% (6.8%-12.7%)	5.7% (2.1%-14.1%)	0.0% (0.0%-0.0%)
117	Eating disorders	$0.9 ($0.7-$1.0)	2.7% (1.3%-4.2%)	85.7% (81.0%-90.2%)	0.2% (0.0%-0.4%)	10.9% (6.4%-15.5%)	0.5% (0.3%-0.9%)	0.0% (0.0%-0.0%)
118	Mesothelioma	$0.9 ($0.8-$0.9)	11.2% (9.0%-13.7%)	74.8% (71.0%-77.9%)	0.2% (0.1%-0.3%)	0.9% (0.5%-1.4%)	12.9% (10.7%-15.2%)	0.0% (0.0%-0.0%)
119	Conduct disorder	$0.8 ($0.6-$1.0)	66.6% (56.3%-74.5%)	32.8% (25.1%-42.9%)	0.6% (0.0%-1.5%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)
120	Nasopharynx cancer	$0.8 ($0.7-$0.9)	43.7% (37.3%-49.2%)	21.9% (18.1%-26.1%)	5.5% (3.8%-7.3%)	26.2% (20.7%-32.2%)	2.6% (1.5%-4.1%)	0.0% (0.0%-0.0%)
121	Other transport injuries	$0.8 ($0.7-$0.9)	26.8% (16.9%-37.5%)	62.2% (52.1%-72.4%)	0.3% (0.1%-0.5%)	8.5% (6.0%-11.3%)	2.3% (0.5%-7.1%)	0.0% (0.0%-0.0%)
122	Larynx cancer	$0.8 ($0.7-$0.9)	20.1% (16.5%-24.4%)	71.1% (66.3%-75.3%)	0.1% (0.1%-0.2%)	0.0% (0.0%-0.0%)	8.6% (6.5%-10.6%)	0.0% (0.0%-0.0%)
123	Gout	$0.7 ($0.7-$0.8)	25.2% (20.5%-29.8%)	27.1% (23.9%-30.6%)	27.7% (23.2%-32.5%)	12.3% (5.3%-17.9%)	7.7% (6.3%-9.3%)	0.0% (0.0%-0.0%)

Table 9.1: Personal health care spending results by function continued

Rank	Condition	2013 spending (billions of US dollars)	Percent of 2013 spending that is:					
			Ambulatory care	Inpatient care	Retail pharmaceuticals	Emergency department care	Nursing care	Dental care
124	Donor	$0.7 ($0.3-$1.0)	0.0% (0.0%-0.0%)	99.9% (99.4%-100.0%)	0.0% (0.0%-0.6%)	0.0% (0.0%-0.0%)	0.1% (0.0%-0.1%)	0.0% (0.0%-0.0%)
125	Idiopathic intellectual disability	$0.7 ($0.4-$0.9)	2.5% (0.6%-5.0%)	0.6% (0.4%-0.9%)	0.6% (0.0%-2.3%)	0.0% (0.0%-0.0%)	96.4% (93.1%-98.5%)	0.0% (0.0%-0.0%)
126	Esophageal cancer	$0.7 ($0.6-$0.8)	0.0% (0.0%-0.0%)	91.5% (89.6%-92.9%)	0.0% (0.0%-0.0%)	2.6% (1.7%-3.8%)	5.9% (4.8%-7.1%)	0.0% (0.0%-0.0%)
127	Endocarditis	$0.6 ($0.6-$0.7)	0.0% (0.0%-0.0%)	89.4% (87.8%-90.9%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	10.7% (9.1%-12.2%)	0.0% (0.0%-0.0%)
128	Thyroid cancer	$0.6 ($0.6-$0.7)	15.9% (11.1%-20.2%)	81.1% (76.4%-85.9%)	0.9% (0.4%-1.4%)	0.0% (0.0%-0.0%)	2.2% (1.5%-3.0%)	0.0% (0.0%-0.0%)
129	Hypertensive heart disease	$0.5 ($0.5-$0.6)	0.0% (0.0%-0.0%)	89.0% (85.2%-92.1%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	11.0% (7.9%-14.9%)	0.0% (0.0%-0.0%)
130	Other neonatal disorders	$0.4 ($0.3-$0.4)	4.5% (2.4%-8.4%)	89.4% (85.2%-92.7%)	0.1% (0.0%-0.3%)	6.0% (3.4%-8.6%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)
131	Protein-energy malnutrition	$0.4 ($0.3-$0.6)	0.0% (0.0%-0.1%)	54.5% (39.5%-68.4%)	0.0% (0.0%-3.0%)	0.0% (0.0%-0.0%)	45.2% (31.3%-60.5%)	0.0% (0.0%-0.0%)

Table 9.1: Personal health care spending results by function continued

Rank	Condition	2013 spending (billions of US dollars)	Percent of 2013 spending that is:					
			Ambulatory care	Inpatient care	Retail pharmaceuticals	Emergency department care	Nursing care	Dental care
132	Neonatal encephalopathy (birth asphyxia and birth trauma)	$0.4 ($0.3-$0.5)	0.1% (0.0%-0.4%)	100.0% (99.6%-100.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)
133	Hemolytic disease in fetus and newborn and other neonatal jaundice	$0.3 ($0.2-$0.3)	6.0% (0.0%-12.0%)	93.0% (86.5%-99.8%)	0.0% (0.0%-0.0%)	1.0% (0.0%-5.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)
134	Encephalitis	$0.3 ($0.2-$0.3)	0.0% (0.0%-0.0%)	94.7% (93.2%-96.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	5.3% (4.0%-6.8%)	0.0% (0.0%-0.0%)
135	Tuberculosis	$0.3 ($0.2-$0.4)	2.1% (0.6%-3.9%)	84.1% (60.2%-96.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	13.8% (2.2%-37.3%)	0.0% (0.0%-0.0%)
136	Whooping cough	$0.3 ($0.3-$0.4)	2.6% (0.4%-4.8%)	96.6% (94.4%-98.8%)	0.5% (0.2%-1.0%)	0.0% (0.0%-0.0%)	0.4% (0.2%-0.6%)	0.0% (0.0%-0.0%)
137	Hepatitis	$0.3 ($0.3-$0.4)	36.2% (25.9%-46.0%)	62.7% (52.9%-73.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	1.1% (0.7%-1.5%)	0.0% (0.0%-0.0%)
138	Sepsis and other infectious disorders of the newborn baby	$0.2 ($0.1-$0.2)	0.0% (0.0%-0.0%)	100.0% (100.0%-100.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)
139	Hodgkin lymphoma	$0.2 ($0.2-$0.3)	0.0% (0.0%-0.0%)	97.6% (96.9%-98.2%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	2.4% (1.8%-3.1%)	0.0% (0.0%-0.0%)

Table 9.1: Personal health care spending results by function continued

Rank	Condition	2013 spending (billions of US dollars)	Percent of 2013 spending that is:					
			Ambulatory care	Inpatient care	Retail pharmaceuticals	Emergency department care	Nursing care	Dental care
140	Pneumoconiosis	$0.2 ($0.2-$0.3)	0.0% (0.0%-0.0%)	98.0% (97.1%-98.8%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	2.0% (1.2%-2.9%)	0.0% (0.0%-0.0%)
141	Exposure to forces of nature	$0.2 ($0.2-$0.2)	0.3% (0.0%-1.0%)	96.3% (92.6%-98.6%)	0.0% (0.0%-0.0%)	1.3% (0.6%-2.1%)	2.1% (0.1%-5.8%)	0.0% (0.0%-0.0%)
142	Drowning	$0.1 ($0.1-$0.1)	10.9% (1.0%-21.3%)	85.6% (74.8%-94.9%)	0.0% (0.0%-0.1%)	3.5% (1.4%-7.5%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)
143	Iodine deficiency	$0.1 ($0.0-$0.1)	0.0% (0.0%-0.0%)	11.3% (0.6%-33.1%)	16.2% (0.1%-42.9%)	0.0% (0.0%-0.0%)	72.5% (40.6%-97.3%)	0.0% (0.0%-0.0%)
144	Tobacco	$0.1 ($0.0-$0.1)	12.1% (0.0%-26.4%)	85.3% (69.3%-96.7%)	0.0% (0.0%-0.0%)	0.1% (0.0%-0.5%)	2.5% (1.1%-5.6%)	0.0% (0.0%-0.0%)
145	Maternal sepsis and other pregnancy related infection	$0.1 ($0.1-$0.1)	0.0% (0.0%-0.0%)	99.9% (99.8%-99.9%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	0.1% (0.1%-0.2%)	0.0% (0.0%-0.0%)
146	Tension-type headache	$0.1 ($0.0-$0.1)	25.8% (11.4%-37.9%)	73.5% (61.5%-88.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	0.7% (0.0%-1.8%)	0.0% (0.0%-0.0%)
147	Testicular cancer	$0.1 ($0.1-$0.1)	19.2% (12.5%-28.3%)	77.9% (69.1%-84.9%)	0.0% (0.0%-0.0%)	2.1% (0.0%-4.0%)	0.7% (0.4%-1.0%)	0.0% (0.0%-0.0%)

Table 9.1: Personal health care spending results by function continued

Rank	Condition	2013 spending (billions of US dollars)	Percent of 2013 spending that is:					
			Ambulatory care	Inpatient care	Retail pharmaceuticals	Emergency department care	Nursing care	Dental care
148	Intestinal infectious diseases	$0.0 ($0.0-$0.0)	0.0% (0.0%-0.0%)	90.0% (86.0%-93.5%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	10.1% (6.5%-14.0%)	0.0% (0.0%-0.0%)
149	Vitamin A deficiency	$0.0 ($0.0-$0.0)	0.0% (0.0%-0.0%)	100.0% (99.9%-100.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.1%)	0.0% (0.0%-0.0%)
150	Social services	$0.0 ($0.0-$0.1)	75.0% (0.1%-94.5%)	16.4% (3.2%-70.8%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	8.6% (1.9%-38.2%)	0.0% (0.0%-0.0%)
151	Diphtheria	$0.0 ($0.0-$0.0)	53.5% (17.5%-75.1%)	29.3% (10.1%-56.4%)	15.5% (6.4%-29.7%)	0.0% (0.0%-0.0%)	1.7% (0.7%-3.4%)	0.0% (0.0%-0.0%)
152	Acute glomerulonephritis	$0.0 ($0.0-$0.0)	0.0% (0.0%-0.0%)	93.5% (91.0%-95.8%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	6.5% (4.2%-9.1%)	0.0% (0.0%-0.0%)
153	Measles	$0.0 ($0.0-$0.0)	1.5% (0.0%-4.3%)	90.0% (82.8%-94.7%)	2.7% (0.2%-6.4%)	0.0% (0.0%-0.1%)	5.8% (3.5%-10.0%)	0.0% (0.0%-0.0%)
154	Leprosy	$0.0 ($0.0-$0.0)	0.0% (0.0%-0.0%)	3.6% (1.5%-6.0%)	1.2% (0.0%-3.5%)	0.0% (0.0%-0.0%)	95.2% (91.4%-98.3%)	0.0% (0.0%-0.0%)
155	Tetanus	$0.0 ($0.0-$0.0)	0.0% (0.0%-0.0%)	82.5% (63.3%-97.1%)	0.0% (0.0%-0.1%)	0.0% (0.0%-0.0%)	17.5% (2.8%-36.7%)	0.0% (0.0%-0.0%)

Note that all estimates contain uncertainty intervals in parentheses.

Table 9.2: Personal health care spending annualized rate of change and spending by age

		Annualized rate of change 1996-2013:			Percent of 2013 spending that is:			
Rank	Condition	All ages	Ages less than 65	Age greater than or equal to 65	Age less than 20	Age greater than or equal to 20 and less than 45	Age greater than or equal to 45 and less than 65	Age greater than or equal to 65
	All conditions	3.5% (3.5%-3.5%)	3.5% (3.4%-3.5%)	3.6% (3.6%-3.7%)	11.1% (10.8%-11.4%)	21.1% (20.8%-21.3%)	29.9% (29.6%-30.1%)	37.9% (37.6%-38.2%)
1	Diabetes mellitus	6.1% (5.3%-7.0%)	6.6% (5.6%-7.5%)	5.6% (4.9%-6.4%)	1.7% (1.4%-1.9%)	11.2% (10.5%-12.2%)	44.4% (42.9%-45.8%)	42.8% (40.8%-44.5%)
2	Ischemic heart disease	0.2% (-0.4%-0.7%)	0.6% (-0.0%-1.1%)	-0.1% (-0.7%-0.5%)	0.2% (0.1%-0.2%)	3.7% (3.5%-3.9%)	34.9% (33.8%-35.9%)	61.2% (60.1%-62.5%)
3	Low back and neck pain	6.5% (5.2%-7.8%)	5.7% (4.5%-7.1%)	8.8% (7.7%-10.0%)	2.0% (1.8%-2.2%)	25.0% (24.0%-26.0%)	44.2% (43.1%-45.1%)	28.8% (27.8%-30.1%)
4	Hypertension	5.1% (4.2%-5.9%)	5.0% (4.0%-6.0%)	5.1% (4.3%-6.0%)	0.7% (0.5%-0.9%)	7.7% (7.2%-8.1%)	38.3% (37.4%-39.4%)	53.4% (52.0%-54.5%)
5	Falls	3.0% (2.4%-3.7%)	3.6% (2.7%-4.5%)	2.5% (1.8%-3.3%)	10.3% (9.4%-11.2%)	17.0% (15.8%-18.3%)	24.6% (23.0%-26.5%)	48.2% (45.6%-50.1%)
6	Depressive disorders	3.4% (2.8%-4.1%)	3.6% (2.9%-4.3%)	2.3% (1.6%-3.1%)	7.1% (6.3%-7.9%)	38.9% (37.3%-40.4%)	40.7% (39.4%-42.0%)	13.3% (12.4%-14.3%)

Table 9.2: Personal health care spending annualized rate of change and spending by age continued

		Annualized rate of change 1996-2013:			Percent of 2013 spending that is:			
Rank	Condition	All ages	Ages less than 65	Age greater than or equal to 65	Age less than 20	Age greater than or equal to 20 and less than 45	Age greater than or equal to 45 and less than 65	Age greater than or equal to 65
7	Oral disorders	2.9% (1.8%-4.2%)	2.6% (1.5%-3.8%)	4.4% (3.1%-5.7%)	13.1% (12.1%-14.0%)	27.7% (26.6%-28.8%)	38.5% (37.5%-39.5%)	20.7% (19.3%-22.3%)
8	Sense organ diseases	2.8% (1.7%-4.1%)	2.9% (1.7%-4.1%)	2.8% (1.6%-4.2%)	9.0% (8.0%-9.8%)	10.4% (9.6%-11.1%)	26.7% (25.7%-27.7%)	54.0% (52.3%-55.7%)
9	Skin and subcutaneous diseases	3.5% (2.6%-4.4%)	3.2% (2.3%-4.2%)	4.3% (3.4%-5.1%)	14.4% (13.6%-15.2%)	26.3% (25.5%-27.1%)	29.5% (28.7%-30.3%)	29.8% (28.6%-30.9%)
10	Pregnancy and postpartum care	2.9% (2.0%-3.8%)	2.9% (2.0%-3.8%)	.% (.%-.%)	6.4% (6.0%-6.8%)	93.4% (93.0%-93.8%)	0.2% (0.2%-0.3%)	0.0% (0.0%-0.0%)
11	Urinary diseases and male infertility	4.8% (4.0%-5.7%)	3.5% (2.6%-4.5%)	6.4% (5.5%-7.3%)	4.5% (4.0%-4.9%)	18.3% (16.9%-19.8%)	26.1% (24.9%-27.2%)	51.1% (49.3%-52.9%)
12	Chronic obstructive pulmonary disease	2.5% (1.9%-3.2%)	1.6% (0.8%-2.4%)	3.1% (2.5%-3.9%)	3.5% (3.2%-3.9%)	6.9% (6.4%-7.4%)	25.1% (24.2%-26.3%)	64.5% (62.9%-65.8%)
13	Hyperlipidemia	10.3% (8.9%-11.6%)	9.0% (7.6%-10.4%)	12.0% (10.4%-13.6%)	0.4% (0.1%-1.2%)	5.6% (5.0%-6.1%)	45.3% (43.7%-46.7%)	48.8% (46.9%-50.5%)

Table 9.2: Personal health care spending annualized rate of change and spending by age continued

		Annualized rate of change 1996-2013:			Percent of 2013 spending that is:			
Rank	Condition	All ages	Ages less than 65	Age greater than or equal to 65	Age less than 20	Age greater than or equal to 20 and less than 45	Age greater than or equal to 45 and less than 65	Age greater than or equal to 65
14	Well dental	2.7% (1.3%-4.3%)	2.4% (1.0%-4.0%)	5.7% (4.0%-7.5%)	37.4% (35.3%-39.4%)	24.7% (23.9%-25.7%)	25.1% (24.2%-26.3%)	12.8% (11.8%-13.9%)
15	Osteoarthritis	5.9% (5.1%-6.7%)	5.9% (4.9%-6.9%)	5.9% (5.1%-6.7%)	0.0% (0.0%-0.0%)	3.6% (3.3%-4.0%)	36.3% (35.3%-37.3%)	60.1% (58.9%-61.3%)
16	Other musculoskeletal disorders	3.8% (2.8%-4.7%)	3.5% (2.4%-4.6%)	4.2% (3.4%-5.0%)	3.7% (3.4%-4.1%)	18.2% (17.2%-19.1%)	37.5% (36.3%-38.7%)	40.6% (39.1%-42.1%)
17	Cerebrovascular disease	1.1% (0.3%-1.5%)	1.0% (0.5%-1.6%)	1.1% (0.1%-1.6%)	2.3% (2.0%-2.6%)	6.2% (5.9%-6.6%)	20.8% (20.1%-21.5%)	70.8% (69.7%-71.9%)
18	Other neurological disorders	7.3% (6.3%-8.3%)	6.2% (5.1%-7.2%)	9.8% (8.7%-10.9%)	2.5% (2.1%-2.8%)	21.1% (19.8%-22.5%)	38.0% (36.8%-39.5%)	38.4% (36.4%-40.4%)
19	Other digestive diseases	3.3% (2.4%-4.2%)	3.6% (2.6%-4.7%)	2.8% (2.0%-3.7%)	5.2% (4.6%-5.9%)	20.2% (19.2%-21.4%)	38.8% (37.6%-40.1%)	35.8% (34.3%-37.3%)
20	Lower respiratory infections	3.1% (1.9%-4.2%)	2.1% (1.1%-3.1%)	4.0% (2.5%-5.4%)	16.6% (14.8%-18.4%)	11.3% (10.2%-12.7%)	16.1% (14.8%-17.5%)	56.0% (52.0%-59.7%)

Table 9.2: Personal health care spending annualized rate of change and spending by age continued

		Annualized rate of change 1996-2013:			Percent of 2013 spending that is:			
Rank	Condition	All ages	Ages less than 65	Age greater than or equal to 65	Age less than 20	Age greater than or equal to 20 and less than 45	Age greater than or equal to 45 and less than 65	Age greater than or equal to 65
21	Alzheimer's disease and other dementias	1.9% (0.7%-3.2%)	1.6% (0.9%-2.5%)	1.9% (0.7%-3.2%)	0.0% (0.0%-0.0%)	0.2% (0.1%-0.2%)	2.5% (2.0%-2.9%)	97.4% (96.9%-97.8%)
22	Other chronic respiratory diseases	3.2% (2.1%-4.4%)	3.1% (2.0%-4.2%)	4.3% (3.1%-5.5%)	23.4% (22.1%-24.9%)	30.6% (29.5%-31.6%)	33.7% (32.4%-34.8%)	12.4% (11.5%-13.2%)
23	Septicemia	8.9% (7.4%-10.7%)	7.9% (6.3%-9.7%)	9.6% (8.1%-11.3%)	2.0% (1.9%-2.2%)	8.2% (7.9%-8.5%)	24.9% (24.4%-25.4%)	64.9% (64.1%-65.5%)
24	Asthma	5.4% (4.3%-6.3%)	5.0% (4.0%-6.0%)	7.1% (5.8%-8.3%)	27.8% (26.1%-29.7%)	21.0% (20.0%-21.9%)	31.4% (30.0%-32.7%)	19.8% (18.4%-21.2%)
25	Exposure to mechanical forces	3.5% (2.4%-4.7%)	3.3% (2.2%-4.5%)	6.7% (5.5%-7.8%)	26.2% (24.6%-27.9%)	41.9% (40.0%-43.6%)	25.1% (23.1%-27.0%)	6.9% (5.7%-8.4%)
26	Anxiety disorders	5.0% (4.0%-6.0%)	5.0% (4.0%-6.0%)	4.5% (3.3%-5.7%)	11.3% (9.9%-12.7%)	43.9% (42.2%-45.5%)	36.5% (34.8%-38.5%)	8.4% (7.4%-9.5%)
27	Heart Failure	1.1% (0.4%-1.8%)	2.2% (1.3%-2.9%)	0.8% (0.1%-1.5%)	1.2% (0.9%-1.5%)	3.4% (3.1%-3.7%)	18.7% (17.8%-19.6%)	76.7% (75.7%-77.8%)

Table 9.2: Personal health care spending annualized rate of change and spending by age continued

		Annualized rate of change 1996-2013:			Percent of 2013 spending that is:			
Rank	Condition	All ages	Ages less than 65	Age greater than or equal to 65	Age less than 20	Age greater than or equal to 20 and less than 45	Age greater than or equal to 45 and less than 65	Age greater than or equal to 65
28	Well newborn	3.8% (3.0%-4.5%)	3.8% (3.0%-4.5%)	.% (.%-.%)	100.0% (100.0%-100.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)
29	Atrial fibrillation and flutter	4.6% (4.1%-5.1%)	4.9% (4.3%-5.6%)	4.4% (3.9%-5.0%)	0.0% (0.0%-0.0%)	7.3% (6.5%-8.3%)	25.3% (24.4%-26.4%)	67.3% (65.7%-68.8%)
30	Other cardiovascular and circulatory diseases	2.4% (1.8%-3.0%)	2.6% (1.9%-3.3%)	2.3% (1.7%-2.9%)	1.1% (1.0%-1.2%)	9.6% (9.0%-10.2%)	28.7% (27.8%-29.8%)	60.6% (59.3%-61.9%)
31	Other unintentional injuries	5.8% (4.6%-6.9%)	5.6% (4.5%-6.9%)	6.8% (5.8%-8.0%)	8.6% (7.4%-9.9%)	39.3% (36.8%-42.5%)	40.9% (37.8%-43.8%)	11.2% (9.7%-13.3%)
32	Attention-deficit/hyperactivity disorder	5.9% (3.7%-7.9%)	5.9% (3.7%-7.9%)	5.3% (1.5%-10.2%)	88.7% (86.6%-90.8%)	8.3% (7.0%-9.7%)	2.4% (1.6%-3.3%)	0.6% (0.3%-1.0%)
33	Road injuries	2.1% (0.3%-3.9%)	1.7% (0.0%-3.5%)	5.2% (3.0%-7.4%)	15.2% (14.1%-16.4%)	43.8% (42.3%-45.1%)	27.2% (25.7%-28.8%)	13.8% (12.8%-14.8%)
34	Gynecological diseases	1.4% (-0.1%-2.9%)	1.3% (-0.3%-2.8%)	2.4% (1.3%-3.8%)	2.9% (2.3%-3.6%)	55.4% (52.9%-57.9%)	32.9% (30.7%-35.1%)	8.8% (7.8%-10.1%)

Table 9.2: Personal health care spending annualized rate of change and spending by age continued

Rank	Condition	Annualized rate of change 1996-2013: All ages	Ages less than 65	Age greater than or equal to 65	Percent of 2013 spending that is: Age less than 20	Age greater than or equal to 20 and less than 45	Age greater than or equal to 45 and less than 65	Age greater than or equal to 65
35	Endocrine, metabolic, blood, and immune disorders	5.4% (4.4%-6.4%)	5.2% (4.1%-6.2%)	5.9% (4.8%-7.0%)	9.6% (8.8%-10.3%)	20.8% (19.6%-22.2%)	34.4% (32.9%-36.0%)	35.3% (33.0%-37.6%)
36	Colon and rectum cancers	2.0% (1.2%-3.0%)	2.8% (1.9%-3.8%)	1.5% (0.7%-2.4%)	0.4% (0.3%-0.4%)	7.3% (6.8%-7.8%)	37.9% (36.3%-39.6%)	54.5% (52.8%-56.1%)
37	Schizophrenia	2.0% (0.2%-7.3%)	0.7% (-0.2%-1.8%)	5.7% (1.6%-17.3%)	1.6% (0.6%-2.3%)	34.3% (14.4%-42.2%)	33.6% (19.7%-38.1%)	30.6% (18.5%-65.3%)
38	Well person	1.7% (0.3%-3.3%)	1.9% (0.4%-3.5%)	0.6% (-1.1%-2.3%)	55.5% (51.1%-59.6%)	17.2% (15.7%-18.7%)	18.3% (16.3%-20.5%)	9.0% (7.5%-10.6%)
39	Gallbladder and biliary diseases	2.7% (1.9%-3.5%)	3.0% (2.1%-3.8%)	2.1% (1.4%-3.0%)	2.4% (2.1%-2.8%)	29.7% (28.2%-31.4%)	31.9% (30.6%-33.2%)	36.0% (34.2%-37.5%)
40	Upper respiratory infections	1.3% (0.1%-2.4%)	1.3% (0.1%-2.5%)	1.1% (-0.1%-2.4%)	57.1% (54.6%-59.4%)	24.4% (23.2%-25.5%)	12.6% (11.6%-13.6%)	6.0% (5.1%-7.0%)
41	Drug use disorders	3.1% (2.3%-3.8%)	2.4% (1.6%-3.2%)	6.8% (5.8%-7.8%)	5.0% (3.8%-6.5%)	48.1% (44.8%-51.4%)	27.2% (24.1%-30.1%)	19.7% (17.7%-21.9%)

Table 9.2: Personal health care spending annualized rate of change and spending by age continued

		Annualized rate of change 1996-2013:			Percent of 2013 spending that is:			
Rank	Condition	All ages	Ages less than 65	Age greater than or equal to 65	Age less than 20	Age greater than or equal to 20 and less than 45	Age greater than or equal to 45 and less than 65	Age greater than or equal to 65
42	Chronic kidney diseases	4.0% (3.1%-5.2%)	3.2% (2.3%-4.3%)	4.9% (3.8%-6.2%)	2.0% (1.6%-2.8%)	12.5% (11.7%-13.4%)	33.0% (31.5%-34.4%)	52.5% (50.2%-54.8%)
43	Trachea, bronchus, and lung cancers	2.0% (1.1%-2.8%)	1.6% (0.7%-2.5%)	2.3% (1.3%-3.2%)	0.4% (0.3%-0.5%)	6.9% (6.2%-7.6%)	38.2% (36.8%-39.9%)	54.5% (52.7%-56.2%)
44	Bipolar disorder	4.0% (3.3%-4.7%)	4.3% (3.6%-5.0%)	1.6% (1.1%-2.2%)	13.6% (12.4%-14.8%)	49.0% (47.6%-50.3%)	28.5% (27.1%-30.1%)	9.0% (7.7%-9.9%)
45	Acute renal failure	8.0% (6.4%-10.4%)	7.0% (5.4%-9.1%)	8.7% (6.7%-11.7%)	3.7% (0.8%-8.3%)	8.0% (5.5%-10.1%)	26.3% (21.9%-31.3%)	62.1% (55.4%-70.7%)
46	Other infectious diseases	2.8% (1.8%-4.0%)	2.4% (1.3%-3.5%)	6.4% (5.1%-8.1%)	48.4% (45.6%-51.6%)	22.3% (21.0%-23.5%)	13.2% (11.9%-14.3%)	16.1% (14.4%-17.9%)
47	Breast cancer	1.0% (-0.4%-2.4%)	0.7% (-0.8%-2.3%)	1.7% (0.3%-3.2%)	0.2% (0.2%-0.3%)	17.3% (15.2%-19.3%)	52.0% (49.9%-54.0%)	30.5% (27.9%-33.3%)
48	Other neoplasms	5.5% (4.5%-6.7%)	5.8% (4.7%-7.0%)	5.1% (3.8%-6.3%)	11.5% (10.7%-12.4%)	18.2% (17.1%-19.5%)	34.4% (33.1%-35.7%)	35.9% (34.1%-37.6%)

Table 9.2: Personal health care spending annualized rate of change and spending by age continued

		Annualized rate of change 1996-2013:			Percent of 2013 spending that is:			
Rank	Condition	All ages	Ages less than 65	Age greater than or equal to 65	Age less than 20	Age greater than or equal to 20 and less than 45	Age greater than or equal to 45 and less than 65	Age greater than or equal to 65
49	Interstitial lung disease and pulmonary sarcoidosis	9.2% (7.8%-11.2%)	8.4% (7.0%-10.3%)	10.0% (8.5%-12.0%)	0.8% (0.7%-0.9%)	9.5% (8.8%-10.1%)	34.5% (33.5%-35.5%)	55.3% (53.8%-56.7%)
50	Congenital anomalies	4.4% (3.0%-6.2%)	4.1% (2.7%-6.0%)	8.5% (6.9%-10.6%)	69.6% (67.4%-71.8%)	11.1% (10.3%-11.8%)	10.9% (9.9%-11.8%)	8.4% (7.5%-9.5%)
51	Pancreatitis	1.9% (1.1%-2.7%)	2.2% (1.4%-3.0%)	1.7% (0.8%-2.5%)	4.3% (4.0%-4.7%)	18.4% (17.5%-19.3%)	28.6% (27.2%-29.9%)	48.7% (46.6%-51.2%)
52	Aortic aneurysm	3.0% (2.4%-3.7%)	4.2% (3.4%-4.9%)	2.3% (1.6%-2.9%)	1.5% (1.2%-1.8%)	13.5% (12.3%-14.6%)	30.6% (29.7%-31.5%)	54.5% (52.9%-56.0%)
53	Alcohol use disorders	2.0% (0.8%-3.1%)	1.9% (0.7%-3.0%)	3.0% (2.0%-4.3%)	2.6% (1.6%-3.7%)	39.1% (35.4%-43.1%)	50.4% (45.6%-54.6%)	7.9% (6.5%-9.6%)
54	Diarrheal diseases	4.1% (2.9%-5.4%)	1.8% (0.6%-3.0%)	9.9% (8.4%-11.3%)	18.9% (16.5%-21.6%)	17.4% (16.1%-18.8%)	18.9% (17.8%-20.1%)	44.8% (41.7%-47.7%)
55	Otitis media	-0.1% (-1.5%-1.5%)	-0.1% (-1.5%-1.5%)	0.8% (-1.0%-2.7%)	83.2% (81.0%-85.2%)	9.0% (8.0%-10.1%)	5.5% (4.7%-6.4%)	2.3% (1.8%-2.8%)

Table 9.2: Personal health care spending annualized rate of change and spending by age continued

		Annualized rate of change 1996-2013:			Percent of 2013 spending that is:			
Rank	Condition	All ages	Ages less than 65	Age greater than or equal to 65	Age less than 20	Age greater than or equal to 20 and less than 45	Age greater than or equal to 45 and less than 65	Age greater than or equal to 65
56	Non-melanoma skin cancer	7.1% (5.4%-8.8%)	5.0% (3.3%-6.6%)	8.1% (6.2%-10.0%)	0.0% (0.0%-0.0%)	2.3% (1.6%-3.0%)	24.2% (21.0%-27.6%)	73.6% (69.8%-77.2%)
57	Paralytic ileus and intestinal obstruction	3.3% (2.3%-4.3%)	3.3% (2.3%-4.3%)	3.3% (2.4%-4.3%)	3.3% (3.0%-3.9%)	10.9% (10.4%-11.5%)	25.9% (25.2%-26.8%)	60.0% (58.5%-61.1%)
58	Appendicitis	3.4% (2.5%-4.4%)	3.3% (2.3%-4.2%)	4.0% (3.1%-5.0%)	19.8% (19.1%-20.6%)	33.8% (33.0%-34.5%)	26.4% (25.9%-26.9%)	20.0% (19.0%-21.0%)
59	Migraine	5.1% (3.5%-6.8%)	5.0% (3.5%-6.8%)	6.7% (4.6%-8.9%)	4.8% (4.0%-5.7%)	51.0% (47.9%-53.9%)	41.3% (38.3%-44.6%)	2.9% (2.5%-3.6%)
60	Inflammatory bowel disease	3.3% (2.5%-4.3%)	2.7% (1.8%-3.8%)	5.7% (4.7%-6.7%)	13.3% (9.4%-18.9%)	32.8% (30.8%-35.3%)	27.2% (24.1%-30.0%)	26.7% (22.9%-30.3%)
61	Peptic ulcer disease	1.7% (0.9%-2.4%)	1.8% (0.9%-2.6%)	1.6% (0.7%-2.4%)	2.0% (1.7%-2.4%)	14.8% (13.1%-16.8%)	27.6% (26.5%-28.7%)	55.6% (53.2%-57.8%)
62	Iron-deficiency anemia	8.1% (7.3%-9.2%)	8.6% (7.3%-9.9%)	8.0% (6.9%-9.0%)	2.4% (1.9%-3.1%)	11.6% (10.6%-12.8%)	19.0% (17.7%-20.4%)	67.0% (64.7%-69.0%)

Table 9.2: Personal health care spending annualized rate of change and spending by age continued

Rank	Condition	Annualized rate of change 1996-2013: All ages	Ages less than 65	Age greater than or equal to 65	Percent of 2013 spending that is: Age less than 20	Age greater than or equal to 20 and less than 45	Age greater than or equal to 45 and less than 65	Age greater than or equal to 65
63	Indirect maternal deaths	6.8% (6.0%-7.5%)	6.8% (6.0%-7.5%)	.% (.%-.%)	10.0% (9.5%-10.6%)	89.7% (89.1%-90.2%)	0.3% (0.2%-0.3%)	0.0% (0.0%-0.0%)
64	Brain and nervous system cancers	3.2% (2.3%-4.1%)	3.1% (2.2%-3.9%)	3.7% (2.6%-4.7%)	9.6% (8.8%-10.2%)	27.1% (25.4%-28.7%)	36.4% (35.2%-37.8%)	26.9% (25.5%-28.6%)
65	Uterine cancer	1.2% (0.3%-2.1%)	1.1% (0.1%-2.0%)	2.0% (1.1%-2.7%)	0.2% (0.1%-0.3%)	36.3% (34.3%-38.0%)	47.3% (45.5%-49.2%)	16.2% (15.2%-17.2%)
66	Prostate cancer	0.8% (-0.6%-2.1%)	1.4% (0.1%-2.5%)	0.6% (-1.0%-2.0%)	0.1% (0.1%-0.2%)	1.0% (0.7%-1.3%)	32.5% (29.8%-35.3%)	66.4% (63.7%-69.3%)
67	Other maternal disorders	0.7% (0.1%-1.3%)	0.7% (0.1%-1.3%)	.% (.%-.%)	9.3% (8.7%-9.9%)	90.5% (89.9%-91.0%)	0.2% (0.2%-0.3%)	0.0% (0.0%-0.0%)
68	Interpersonal violence	3.5% (1.9%-5.0%)	3.4% (1.9%-5.0%)	5.4% (3.4%-7.4%)	16.2% (14.4%-18.0%)	65.0% (63.1%-67.2%)	16.4% (14.9%-17.5%)	2.3% (2.1%-2.6%)
69	Other mental and behavioral disorders	2.2% (0.7%-3.8%)	2.0% (0.4%-3.5%)	3.5% (1.4%-5.6%)	22.0% (17.6%-26.8%)	21.3% (18.1%-24.4%)	38.1% (33.7%-42.7%)	18.6% (15.3%-22.3%)

Table 9.2: Personal health care spending annualized rate of change and spending by age continued

		Annualized rate of change 1996-2013:			Percent of 2013 spending that is:			
Rank	Condition	All ages	Ages less than 65	Age greater than or equal to 65	Age less than 20	Age greater than or equal to 20 and less than 45	Age greater than or equal to 45 and less than 65	Age greater than or equal to 65
70	Neglected tropical diseases and malaria	9.9% (8.5%-10.7%)	8.8% (7.0%-9.8%)	11.8% (10.7%-12.7%)	4.9% (4.4%-5.2%)	17.4% (14.8%-18.6%)	35.6% (29.9%-37.7%)	42.2% (39.0%-50.7%)
71	Family planning	5.7% (4.1%-7.2%)	5.7% (4.2%-7.2%)	5.0% (3.5%-6.5%)	4.5% (3.9%-5.0%)	92.0% (91.0%-92.8%)	2.4% (2.0%-2.7%)	1.3% (1.0%-1.6%)
72	Obesity	9.9% (7.8%-12.1%)	9.9% (7.7%-12.2%)	9.7% (5.9%-14.3%)	2.0% (1.4%-2.8%)	40.9% (38.2%-43.3%)	49.7% (47.0%-51.9%)	7.4% (5.5%-10.7%)
73	Parkinson's disease	0.3% (-0.7%-1.1%)	2.1% (1.1%-3.2%)	0.0% (-1.0%-0.8%)	0.0% (0.0%-0.0%)	4.5% (3.6%-5.4%)	11.5% (10.1%-12.8%)	84.1% (82.1%-85.9%)
74	Preterm birth complications	3.1% (2.7%-3.6%)	3.1% (2.7%-3.6%)	.% (.%-.%)	100.0% (100.0%-100.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)
75	HIV/AIDS	2.4% (1.7%-3.2%)	2.0% (1.4%-2.9%)	5.4% (4.0%-6.7%)	2.8% (1.7%-4.3%)	45.0% (42.8%-47.1%)	39.2% (37.3%-41.1%)	13.1% (12.0%-14.3%)
76	Multiple sclerosis	2.0% (1.2%-2.8%)	2.8% (2.0%-3.6%)	1.0% (-0.1%-2.1%)	2.8% (1.9%-4.5%)	17.0% (14.3%-20.0%)	39.5% (34.9%-44.1%)	40.8% (35.8%-45.3%)

Table 9.2: Personal health care spending annualized rate of change and spending by age continued

Rank	Condition	Annualized rate of change 1996-2013: All ages	Ages less than 65	Age greater than or equal to 65	Percent of 2013 spending that is: Age less than 20	Age greater than or equal to 20 and less than 45	Age greater than or equal to 45 and less than 65	Age greater than or equal to 65
77	Epilepsy	8.5% (7.1%-10.2%)	7.9% (6.7%-9.4%)	11.3% (9.1%-14.3%)	20.9% (19.9%-22.0%)	30.7% (29.6%-31.7%)	25.8% (24.7%-27.1%)	22.7% (21.4%-24.0%)
78	Cirrhosis of the liver	5.1% (4.4%-6.0%)	5.2% (4.4%-6.1%)	4.8% (4.0%-5.7%)	1.3% (1.0%-1.8%)	17.5% (16.4%-18.6%)	61.7% (60.1%-63.0%)	19.6% (18.6%-20.6%)
79	Stomach cancer	2.3% (1.4%-3.2%)	2.4% (1.3%-3.3%)	2.3% (1.4%-3.1%)	0.3% (0.3%-0.3%)	6.1% (5.7%-6.5%)	23.9% (22.8%-25.2%)	69.7% (68.2%-71.1%)
80	Leukemia	2.5% (0.9%-3.7%)	2.2% (0.5%-3.5%)	3.1% (1.9%-4.3%)	18.1% (16.9%-19.3%)	22.9% (21.9%-23.6%)	30.5% (29.8%-31.4%)	28.5% (27.3%-29.9%)
81	Gastritis and duodenitis	2.2% (1.5%-3.0%)	2.4% (1.7%-3.3%)	1.9% (1.1%-2.7%)	6.0% (5.1%-7.3%)	25.9% (23.6%-28.4%)	27.9% (26.3%-29.3%)	40.2% (37.4%-42.9%)
82	Kidney cancer	4.3% (3.3%-5.3%)	4.1% (3.0%-5.1%)	4.6% (3.5%-5.7%)	3.4% (2.9%-3.7%)	8.6% (8.0%-9.3%)	45.1% (43.6%-46.9%)	43.0% (41.2%-44.6%)
83	Maternal hypertensive disorders	6.4% (5.6%-7.1%)	6.4% (5.6%-7.1%)	.% (.%-.%)	9.1% (8.7%-9.4%)	90.4% (90.0%-90.7%)	0.6% (0.5%-0.7%)	0.0% (0.0%-0.0%)

Table 9.2: Personal health care spending annualized rate of change and spending by age continued

Rank	Condition	Annualized rate of change 1996-2013: All ages	Ages less than 65	Age greater than or equal to 65	Percent of 2013 spending that is: Age less than 20	Age greater than or equal to 20 and less than 45	Age greater than or equal to 45 and less than 65	Age greater than or equal to 65
84	Autistic spectrum disorders	17.6% (13.1%-22.0%)	19.8% (15.3%-23.7%)	-10.4% (-20.1%--1.2%)	97.3% (95.5%-98.3%)	2.2% (1.4%-3.7%)	0.3% (0.1%-0.5%)	0.2% (0.1%-0.5%)
85	Non-Hodgkin lymphoma	2.2% (0.9%-3.2%)	1.3% (0.0%-2.2%)	3.1% (1.7%-4.3%)	2.8% (2.4%-3.1%)	10.6% (9.6%-11.7%)	33.7% (31.7%-35.3%)	52.9% (50.6%-55.7%)
86	Bladder cancer	2.7% (1.5%-4.0%)	2.2% (1.0%-3.4%)	3.0% (1.7%-4.3%)	0.1% (0.0%-0.1%)	1.4% (1.2%-1.6%)	24.5% (22.4%-26.8%)	74.0% (71.9%-76.3%)
87	Self-harm	5.1% (3.1%-7.0%)	5.0% (3.0%-7.0%)	6.7% (4.5%-8.7%)	8.6% (7.7%-9.4%)	52.2% (51.0%-53.4%)	32.1% (31.2%-33.1%)	7.1% (6.7%-7.5%)
88	Pancreatic cancer	2.5% (1.6%-3.5%)	3.1% (2.2%-4.1%)	2.1% (1.1%-3.1%)	0.7% (0.5%-0.8%)	10.0% (9.1%-10.9%)	36.4% (35.3%-37.5%)	53.0% (51.5%-54.6%)
89	Hemoglobinopathies and hemolytic anemias	4.3% (3.3%-5.8%)	3.9% (2.9%-5.4%)	6.7% (5.7%-8.2%)	19.9% (19.0%-21.0%)	42.2% (41.3%-43.0%)	18.5% (18.0%-19.0%)	19.4% (18.5%-20.2%)
90	Peripheral vascular disease	1.8% (1.1%-2.6%)	3.7% (2.7%-4.7%)	1.2% (0.2%-2.0%)	0.0% (0.0%-0.0%)	1.6% (1.2%-2.1%)	30.1% (27.2%-33.1%)	68.3% (65.1%-71.3%)

Table 9.2: Personal health care spending annualized rate of change and spending by age continued

		Annualized rate of change 1996-2013:			Percent of 2013 spending that is:			
Rank	Condition	All ages	Ages less than 65	Age greater than or equal to 65	Age less than 20	Age greater than or equal to 20 and less than 45	Age greater than or equal to 45 and less than 65	Age greater than or equal to 65
91	Liver cancer	6.1% (5.1%-6.9%)	6.4% (5.4%-7.3%)	5.8% (4.7%-6.7%)	12.2% (9.7%-15.2%)	11.2% (10.1%-12.2%)	28.3% (26.9%-29.8%)	48.3% (45.7%-50.9%)
92	Rheumatoid arthritis	-0.7% (-1.9%-0.6%)	-0.8% (-2.1%-0.6%)	-0.5% (-1.7%-0.8%)	2.8% (1.9%-3.8%)	10.1% (8.0%-12.5%)	48.8% (45.5%-52.2%)	38.3% (35.2%-41.7%)
93	Cervical cancer	-0.6% (-1.9%-0.7%)	-1.1% (-2.5%-0.5%)	1.4% (0.6%-2.2%)	0.7% (0.4%-1.1%)	44.8% (33.3%-62.2%)	31.3% (21.2%-38.2%)	23.2% (16.0%-29.1%)
94	Obstructed labor	3.9% (3.1%-4.6%)	1.7% (0.9%-2.3%)	9.3% (8.3%-10.4%)	3.6% (2.8%-4.3%)	37.8% (36.7%-39.0%)	15.3% (14.6%-15.9%)	43.3% (42.2%-44.8%)
95	Animal contact	3.8% (2.7%-5.1%)	3.6% (2.5%-4.9%)	6.1% (4.4%-7.7%)	28.1% (24.3%-33.4%)	32.9% (28.8%-37.3%)	30.1% (22.0%-35.8%)	9.0% (7.5%-10.9%)
96	Sexually transmitted diseases excluding HIV	0.9% (-0.5%-2.1%)	-0.1% (-1.5%-1.2%)	3.9% (2.6%-5.3%)	6.8% (5.7%-8.2%)	35.9% (33.7%-38.0%)	26.8% (25.0%-28.5%)	30.6% (28.6%-32.7%)
97	Counselling services	3.8% (1.8%-5.7%)	3.6% (1.7%-5.4%)	5.0% (2.3%-8.4%)	9.8% (7.3%-12.4%)	43.8% (38.6%-49.3%)	33.8% (29.7%-37.9%)	12.6% (9.5%-16.1%)

Table 9.2: Personal health care spending annualized rate of change and spending by age continued

		Annualized rate of change 1996-2013:			Percent of 2013 spending that is:			
Rank	Condition	All ages	Ages less than 65	Age greater than or equal to 65	Age less than 20	Age greater than or equal to 20 and less than 45	Age greater than or equal to 45 and less than 65	Age greater than or equal to 65
98	Complications of abortion	3.8% (2.8%-4.9%)	3.8% (2.8%-4.9%)	.% (.%-.%)	5.7% (4.2%-7.9%)	89.3% (86.9%-91.2%)	5.0% (4.0%-6.7%)	0.0% (0.0%-0.0%)
99	Rheumatic heart disease	0.3% (-0.6%-1.4%)	-0.1% (-1.1%-1.1%)	0.5% (-0.5%-1.6%)	0.6% (0.5%-0.7%)	4.8% (4.4%-5.2%)	23.3% (22.5%-24.2%)	71.3% (70.2%-72.4%)
100	Inguinal or femoral hernia	2.1% (0.9%-3.3%)	0.9% (-0.4%-2.3%)	3.2% (1.9%-4.4%)	2.5% (1.5%-4.0%)	12.5% (11.2%-14.3%)	27.9% (26.1%-30.3%)	57.1% (53.1%-60.0%)
101	Cardiomyopathy and myocarditis	2.9% (1.9%-3.6%)	2.7% (1.7%-3.5%)	3.2% (2.3%-4.0%)	5.2% (4.5%-5.8%)	21.0% (20.0%-22.1%)	44.5% (43.4%-45.8%)	29.3% (27.3%-31.0%)
102	Ovarian cancer	1.5% (0.4%-2.5%)	1.6% (0.4%-2.7%)	1.2% (0.0%-2.3%)	0.7% (0.6%-0.9%)	16.5% (14.8%-18.4%)	45.0% (43.4%-46.7%)	37.9% (36.0%-39.6%)
103	Fire, heat and hot substances	0.2% (-1.0%-1.4%)	-0.1% (-1.3%-1.1%)	1.5% (0.2%-2.9%)	22.0% (20.4%-23.6%)	33.4% (32.0%-34.7%)	24.9% (23.8%-26.1%)	19.8% (18.4%-21.2%)
104	Vascular intestinal disorders	2.4% (1.4%-3.5%)	2.7% (1.7%-3.7%)	2.3% (1.1%-3.5%)	0.9% (0.7%-1.1%)	6.5% (5.8%-7.1%)	29.2% (26.3%-30.5%)	63.5% (61.6%-66.1%)

Table 9.2: Personal health care spending annualized rate of change and spending by age continued

		Annualized rate of change 1996-2013:			Percent of 2013 spending that is:			
Rank	Condition	All ages	Ages less than 65	Age greater than or equal to 65	Age less than 20	Age greater than or equal to 20 and less than 45	Age greater than or equal to 45 and less than 65	Age greater than or equal to 65
105	Collective violence and legal intervention	2.2% (1.5%-2.8%)	2.1% (1.4%-2.7%)	3.0% (2.1%-3.6%)	13.9% (12.2%-15.4%)	27.9% (25.2%-31.2%)	42.2% (39.1%-45.1%)	16.1% (14.1%-18.2%)
106	Malignant skin melanoma	2.5% (1.3%-3.7%)	2.1% (0.8%-3.5%)	3.4% (2.3%-4.5%)	1.0% (0.7%-1.3%)	26.6% (23.4%-29.9%)	42.8% (40.3%-45.5%)	29.6% (26.6%-33.0%)
107	Mouth cancer	1.2% (0.1%-2.1%)	0.8% (-0.3%-1.9%)	1.7% (0.6%-2.7%)	0.7% (0.5%-1.0%)	14.3% (13.1%-15.7%)	44.6% (43.2%-46.2%)	40.4% (38.6%-42.2%)
108	Gallbladder and biliary tract cancer	1.6% (0.6%-2.6%)	2.6% (1.6%-3.6%)	1.0% (-0.1%-2.0%)	0.5% (0.3%-0.8%)	6.2% (5.4%-7.1%)	33.6% (32.2%-34.9%)	59.7% (58.0%-61.3%)
109	Other pharynx cancer	3.8% (2.8%-4.8%)	4.1% (2.9%-5.4%)	2.6% (1.4%-3.8%)	5.0% (3.1%-7.7%)	35.3% (30.2%-40.7%)	39.1% (35.2%-42.8%)	20.6% (17.0%-24.2%)
110	Foreign body	2.1% (1.1%-3.3%)	1.9% (0.7%-3.2%)	3.1% (1.9%-4.5%)	26.7% (22.5%-30.7%)	35.0% (32.1%-38.3%)	21.5% (18.9%-24.8%)	16.8% (14.4%-19.7%)
111	Maternal hemorrhage	4.2% (3.2%-5.1%)	4.2% (3.2%-5.1%)	.% (.%-.%)	6.8% (5.0%-10.6%)	92.2% (88.9%-94.4%)	0.9% (0.4%-1.7%)	0.0% (0.0%-0.0%)

Table 9.2: Personal health care spending annualized rate of change and spending by age continued

Rank	Condition	Annualized rate of change 1996-2013: All ages	Ages less than 65	Age greater than or equal to 65	Percent of 2013 spending that is: Age less than 20	Age greater than or equal to 20 and less than 45	Age greater than or equal to 45 and less than 65	Age greater than or equal to 65
112	Varicella	2.9% (1.5%-4.5%)	0.2% (-0.8%-1.2%)	6.0% (3.9%-7.9%)	6.4% (2.3%-12.2%)	9.6% (6.1%-14.4%)	25.3% (22.2%-28.6%)	58.7% (48.4%-67.4%)
113	Meningitis	0.8% (-0.4%-2.0%)	0.4% (-0.8%-1.6%)	2.9% (1.8%-4.1%)	24.9% (23.8%-25.8%)	30.3% (29.6%-31.1%)	24.8% (24.1%-25.4%)	20.0% (19.1%-21.0%)
114	Multiple myeloma	2.9% (1.7%-4.0%)	3.5% (2.2%-4.8%)	2.2% (0.9%-3.3%)	0.0% (0.0%-0.0%)	6.2% (5.6%-6.9%)	48.5% (47.1%-49.9%)	45.3% (43.3%-46.9%)
115	Other nutritional deficiencies	2.0% (0.4%-3.7%)	1.3% (0.0%-3.8%)	2.7% (0.3%-5.0%)	10.5% (3.4%-16.4%)	15.0% (9.3%-19.7%)	20.9% (18.0%-24.1%)	53.7% (42.2%-65.0%)
116	Poisonings	2.7% (1.3%-4.0%)	1.4% (-0.1%-2.8%)	6.5% (5.0%-7.8%)	12.2% (10.4%-13.9%)	27.6% (25.1%-29.1%)	25.7% (23.6%-27.2%)	34.5% (31.9%-40.1%)
117	Eating disorders	0.4% (-0.8%-1.6%)	0.4% (-0.8%-1.6%)	.% (.%-.%)	35.2% (32.7%-37.8%)	62.0% (59.8%-64.1%)	2.8% (1.8%-4.7%)	0.0% (0.0%-0.0%)
118	Mesothelioma	2.9% (1.9%-3.7%)	2.1% (1.1%-3.0%)	3.6% (2.6%-4.5%)	0.6% (0.4%-0.7%)	7.8% (7.0%-8.6%)	37.6% (36.3%-38.9%)	54.1% (52.4%-55.8%)

Table 9.2: Personal health care spending annualized rate of change and spending by age continued

Rank	Condition	Annualized rate of change 1996-2013: All ages	Ages less than 65	Age greater than or equal to 65	Percent of 2013 spending that is: Age less than 20	Age greater than or equal to 20 and less than 45	Age greater than or equal to 45 and less than 65	Age greater than or equal to 65
119	Conduct disorder	0.9% (-0.4%-2.3%)	0.9% (-0.4%-2.3%)	.% (.%-.%)	95.7% (94.0%-97.2%)	4.3% (2.8%-6.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)
120	Nasopharynx cancer	3.9% (2.8%-5.0%)	4.2% (3.0%-5.5%)	2.9% (1.5%-4.2%)	10.0% (7.8%-12.7%)	36.9% (33.9%-40.2%)	30.4% (27.8%-32.9%)	22.6% (20.1%-25.8%)
121	Other transport injuries	1.8% (0.1%-3.4%)	1.5% (-0.2%-3.1%)	5.4% (2.7%-8.6%)	22.3% (17.5%-28.2%)	35.5% (31.4%-39.4%)	31.6% (26.0%-37.6%)	10.7% (8.2%-15.1%)
122	Larynx cancer	1.5% (0.4%-2.4%)	0.7% (-0.4%-1.6%)	2.3% (1.1%-3.3%)	0.5% (0.3%-0.8%)	8.2% (7.3%-9.2%)	39.2% (37.6%-41.0%)	52.1% (50.2%-54.1%)
123	Gout	4.3% (3.0%-5.6%)	4.7% (3.2%-6.1%)	3.8% (2.3%-5.5%)	0.9% (0.3%-1.8%)	14.6% (11.4%-17.7%)	40.9% (38.0%-43.7%)	43.6% (39.8%-47.3%)
124	Donor	9.6% (8.0%-11.2%)	9.6% (8.0%-11.2%)	9.8% (6.8%-11.9%)	2.9% (2.4%-3.5%)	62.4% (58.4%-64.7%)	33.2% (30.8%-36.5%)	1.5% (1.2%-2.1%)
125	Idiopathic intellectual disability	-1.2% (-3.4%-0.1%)	-1.4% (-3.5%--0.2%)	-1.0% (-3.2%-0.5%)	8.0% (1.5%-16.1%)	13.0% (5.5%-20.2%)	26.8% (18.3%-35.8%)	52.2% (40.3%-65.0%)

Table 9.2: Personal health care spending annualized rate of change and spending by age continued

Rank	Condition	Annualized rate of change 1996-2013: All ages	Ages less than 65	Age greater than or equal to 65	Percent of 2013 spending that is: Age less than 20	Age greater than or equal to 20 and less than 45	Age greater than or equal to 45 and less than 65	Age greater than or equal to 65
126	Esophageal cancer	1.3% (0.1%-2.3%)	1.7% (0.4%-2.6%)	1.0% (-0.3%-2.0%)	0.9% (0.6%-1.3%)	7.8% (7.1%-8.7%)	40.0% (38.8%-41.4%)	51.3% (49.6%-52.8%)
127	Endocarditis	-0.4% (-1.3%-0.3%)	-0.2% (-1.2%-0.5%)	-0.7% (-1.6%-0.1%)	2.8% (2.2%-3.9%)	24.7% (22.8%-26.8%)	31.6% (30.5%-32.8%)	40.9% (38.9%-42.9%)
128	Thyroid cancer	3.1% (2.0%-4.1%)	2.9% (1.7%-4.0%)	3.6% (2.3%-4.7%)	1.2% (1.1%-1.4%)	25.1% (23.8%-26.5%)	37.6% (36.3%-39.0%)	36.1% (34.4%-37.8%)
129	Hypertensive heart disease	-5.8% (-6.6%--5.2%)	-3.7% (-4.5%--3.1%)	-6.7% (-7.4%--6.0%)	0.1% (0.1%-0.2%)	7.6% (7.1%-8.3%)	27.0% (25.8%-28.2%)	65.3% (63.7%-66.8%)
130	Other neonatal disorders	6.5% (6.0%-7.1%)	6.5% (6.0%-7.1%)	.% (.%-.%)	100.0% (100.0%-100.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)
131	Protein-energy malnutrition	0.2% (-0.7%-0.9%)	1.3% (0.0%-2.9%)	-0.6% (-1.4%-0.1%)	13.3% (9.3%-17.3%)	12.6% (8.7%-16.9%)	20.7% (19.1%-22.0%)	53.4% (44.5%-62.1%)
132	Neonatal encephalopathy (birth asphyxia and birth trauma)	3.1% (2.4%-3.7%)	3.1% (2.4%-3.7%)	.% (.%-.%)	100.0% (100.0%-100.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)

Table 9.2: Personal health care spending annualized rate of change and spending by age continued

		Annualized rate of change 1996-2013:			Percent of 2013 spending that is:			
Rank	Condition	All ages	Ages less than 65	Age greater than or equal to 65	Age less than 20	Age greater than or equal to 20 and less than 45	Age greater than or equal to 45 and less than 65	Age greater than or equal to 65
133	Hemolytic disease in fetus and newborn and other neonatal jaundice	2.6% (2.2%-3.0%)	2.6% (2.2%-3.0%)	.% (.%-.%)	100.0% (100.0%-100.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)
134	Encephalitis	6.3% (4.8%-8.2%)	6.0% (4.4%-8.0%)	7.2% (5.9%-8.9%)	14.7% (13.4%-16.0%)	27.1% (25.5%-28.8%)	32.1% (30.8%-33.6%)	26.1% (23.6%-28.1%)
135	Tuberculosis	-0.5% (-1.5%-0.5%)	-0.5% (-1.6%-0.4%)	-0.5% (-1.5%-0.6%)	10.1% (4.6%-25.3%)	31.9% (28.9%-34.7%)	30.4% (23.2%-33.6%)	27.6% (20.5%-30.6%)
136	Whooping cough	2.7% (1.2%-4.1%)	2.7% (1.2%-4.1%)	.% (.%-.%)	31.1% (29.5%-33.0%)	43.3% (42.3%-44.2%)	25.5% (24.0%-27.0%)	0.0% (0.0%-0.0%)
137	Hepatitis	3.2% (1.8%-4.7%)	2.5% (1.0%-4.0%)	9.3% (7.4%-11.3%)	1.3% (0.9%-1.7%)	26.1% (23.1%-29.6%)	56.0% (52.4%-60.6%)	16.7% (14.2%-19.3%)
138	Sepsis and other infectious disorders of the newborn baby	4.2% (3.6%-4.6%)	4.2% (3.6%-4.6%)	.% (.%-.%)	100.0% (100.0%-100.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)
139	Hodgkin lymphoma	1.1% (-0.2%-2.3%)	1.3% (-0.1%-2.5%)	0.2% (-1.6%-1.8%)	12.9% (11.2%-14.6%)	52.6% (50.4%-54.8%)	20.1% (18.7%-21.5%)	14.4% (12.7%-16.4%)

Table 9.2: Personal health care spending annualized rate of change and spending by age continued

		Annualized rate of change 1996-2013:			Percent of 2013 spending that is:			
Rank	Condition	All ages	Ages less than 65	Age greater than or equal to 65	Age less than 20	Age greater than or equal to 20 and less than 45	Age greater than or equal to 45 and less than 65	Age greater than or equal to 65
140	Pneumoconiosis	3.2% (1.2%-5.9%)	3.4% (0.9%-5.8%)	3.2% (1.2%-5.9%)	0.1% (0.0%-0.1%)	2.7% (1.7%-4.2%)	25.0% (21.1%-29.5%)	72.3% (67.1%-76.4%)
141	Exposure to forces of nature	5.3% (4.1%-6.4%)	5.4% (4.4%-6.6%)	5.2% (3.4%-6.9%)	4.8% (3.8%-6.2%)	23.8% (21.7%-26.0%)	32.0% (30.5%-33.9%)	39.4% (36.9%-41.8%)
142	Drowning	-0.3% (-1.6%-1.2%)	-2.5% (-4.2%--0.9%)	5.0% (2.8%-6.8%)	28.9% (24.3%-32.5%)	11.7% (9.6%-13.5%)	14.1% (12.0%-16.6%)	45.3% (41.5%-50.6%)
143	Iodine deficiency	-0.8% (-2.9%-1.2%)	-1.0% (-3.1%-1.1%)	-0.5% (-2.8%-1.9%)	14.6% (7.8%-20.8%)	18.4% (10.0%-26.1%)	15.2% (8.1%-21.3%)	51.8% (32.0%-73.9%)
144	Tobacco	5.3% (2.4%-9.0%)	4.5% (1.6%-8.3%)	11.9% (9.9%-14.1%)	3.7% (2.1%-5.6%)	45.7% (40.7%-51.1%)	32.0% (28.7%-35.2%)	18.5% (15.2%-22.9%)
145	Maternal sepsis and other pregnancy related infection	4.4% (3.1%-5.7%)	4.4% (3.1%-5.7%)	.% (.%-.%)	14.0% (12.5%-15.6%)	85.9% (84.3%-87.4%)	0.1% (0.1%-0.2%)	0.0% (0.0%-0.0%)
146	Tension-type headache	5.4% (3.3%-7.6%)	4.8% (2.6%-7.2%)	9.6% (7.6%-11.3%)	3.6% (2.6%-5.2%)	44.1% (37.3%-50.6%)	34.5% (29.4%-39.4%)	17.8% (14.5%-21.2%)

Table 9.2: Personal health care spending annualized rate of change and spending by age continued

Rank	Condition	Annualized rate of change 1996-2013: All ages	Ages less than 65	Age greater than or equal to 65	Percent of 2013 spending that is: Age less than 20	Age greater than or equal to 20 and less than 45	Age greater than or equal to 45 and less than 65	Age greater than or equal to 65
147	Testicular cancer	2.8% (1.6%-4.4%)	2.9% (1.6%-4.5%)	1.1% (-2.2%-4.4%)	9.0% (7.5%-10.6%)	75.0% (72.4%-77.5%)	12.7% (10.8%-14.7%)	3.3% (2.3%-4.6%)
148	Intestinal infectious diseases	0.8% (-0.7%-2.3%)	0.0% (-1.6%-1.7%)	3.6% (1.8%-5.7%)	25.8% (21.8%-30.3%)	26.9% (24.7%-29.0%)	21.1% (19.2%-23.3%)	26.1% (22.0%-30.7%)
149	Vitamin A deficiency	14.7% (6.7%-24.4%)	14.7% (6.7%-24.4%)	-1.1% (-2.2%--0.3%)	100.0% (99.9%-100.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.1%)
150	Social services	-0.2% (-2.0%-1.7%)	0.2% (-2.1%-4.2%)	-0.5% (-2.2%-1.2%)	11.8% (3.8%-22.5%)	35.8% (3.9%-58.7%)	21.7% (6.5%-28.4%)	30.7% (12.0%-80.4%)
151	Diphtheria	-0.1% (-3.4%-3.2%)	-0.1% (-3.4%-3.2%)	.% (.%-.%)	57.9% (37.3%-78.7%)	27.9% (12.2%-46.2%)	14.2% (4.5%-26.8%)	0.0% (0.0%-0.0%)
152	Acute glomerulonephritis	1.8% (0.7%-3.6%)	1.6% (0.3%-3.4%)	2.3% (0.5%-4.1%)	30.5% (26.5%-35.2%)	14.0% (12.2%-16.0%)	19.6% (17.4%-21.2%)	36.0% (31.3%-39.7%)
153	Measles	-1.6% (-5.3%-1.6%)	-1.6% (-5.3%-1.6%)	.% (.%-.%)	5.2% (3.3%-7.6%)	26.4% (23.2%-29.6%)	68.4% (63.5%-72.9%)	0.0% (0.0%-0.0%)

Table 9.2: Personal health care spending annualized rate of change and spending by age continued

Rank	Condition	Annualized rate of change 1996-2013: All ages	Ages less than 65	Age greater than or equal to 65	Percent of 2013 spending that is: Age less than 20	Age greater than or equal to 20 and less than 45	Age greater than or equal to 45 and less than 65	Age greater than or equal to 65
154	Leprosy	1.0% (-1.5%-3.8%)	-4.9% (-7.8%--1.1%)	2.1% (-0.6%-5.0%)	1.4% (0.5%-2.8%)	1.5% (0.5%-3.4%)	5.8% (4.1%-7.7%)	91.3% (87.5%-94.6%)
155	Tetanus	-1.3% (-4.4%-2.6%)	2.6% (-0.3%-6.4%)	-7.6% (-14.0%--0.8%)	36.4% (17.4%-61.0%)	26.1% (17.3%-39.6%)	17.2% (7.6%-28.5%)	20.3% (5.8%-38.1%)

Table 9.3: Public health care spending results

Rank	Condition	2013 spending (billions of US dollars)	Annualized rate of change (1996-2013)
	All conditions	$76.63 ($76.40-$76.85)	2.69% (2.67%-2.71%)
1	HIV/AIDS	$3.52 ($3.29-$4.27)	4.97% (4.11%-6.20%)
2	Lower respiratory infections	$1.78 ($1.16-$2.09)	15.68% (8.31%-20.30%)
3	Diarrheal diseases	$0.93 ($0.67-$1.05)	14.11% (11.32%-16.58%)
4	Other infectious diseases - Viral & chlamydial infection, streptococcal	$0.67 ($0.48-$0.81)	1.25% (-1.20%-3.59%)
5	Hepatitis	$0.60 ($0.36-$0.69)	6.77% (3.82%-9.10%)
6	Preterm birth complications - Respiratory distress, extreme immaturity	$0.39 ($0.26-$0.49)	-0.67% (-2.93%-1.30%)
7	Varicella	$0.35 ($0.21-$0.40)	14.98% (11.79%-17.51%)
8	Tobacco - Tobacco use disorder, cessation	$0.34 ($0.18-$0.61)	9.58% (-1.34%-18.22%)
9	Family planning	$0.29 ($0.17-$0.42)	9.38% (1.16%-40.37%)
10	Tetanus	$0.19 ($0.11-$0.22)	1.66% (-1.17%-3.96%)
11	Pertussis	$0.19 ($0.11-$0.22)	1.66% (-1.17%-3.96%)
12	Diphtheria	$0.19 ($0.11-$0.22)	1.66% (-1.17%-3.96%)
13	Sexually transmitted diseases excluding HIV	$0.18 ($0.13-$0.29)	3.80% (1.46%-6.96%)
14	Breast cancer	$0.18 ($0.07-$0.27)	30.01% (17.91%-40.42%)
15	Meningitis	$0.17 ($0.10-$0.20)	6.00% (3.06%-8.20%)
16	Low back and neck pain	$0.14 ($0.12-$0.18)	8.96% (-0.88%-35.35%)
17	Tuberculosis	$0.14 ($0.14-$0.15)	0.92% (0.63%-1.23%)
18	Self-harm	$0.14 ($0.07-$0.25)	14.51% (4.94%-25.63%)
19	Other neonatal disorders - Feeding problems, temperature regulation	$0.13 ($0.09-$0.17)	1.00% (-1.27%-2.97%)
20	Trachea, bronchus, and lung cancers	$0.13 ($0.11-$0.15)	7.39% (1.11%-17.33%)
21	Depressive disorders	$0.11 ($0.06-$0.18)	10.83% (2.16%-22.34%)
22	Obesity - Treatment of morbid obesity including bariatric surgery	$0.09 ($0.06-$0.12)	12.36% (9.18%-15.46%)
23	Anxiety disorders	$0.08 ($0.03-$0.18)	13.41% (1.47%-25.03%)
24	Interpersonal violence - Rape, assault	$0.08 ($0.04-$0.16)	0.86% (-6.22%-10.06%)
25	Autistic spectrum disorders	$0.08 ($0.07-$0.08)	4.47% (-0.98%-7.36%)
26	Neonatal encephalopathy (birth asphyxia and birth trauma)	$0.07 ($0.05-$0.09)	-1.96% (-4.20%--0.01%)
27	Sense organ diseases - Cataracts, vision correction, adult hearing loss, macular degeneration	$0.07 ($0.06-$0.08)	12.03% (3.81%-27.47%)
28	Donor - Organ donation	$0.06 ($0.05-$0.07)	8.98% (7.08%-10.78%)
29	Road injuries - Auto, cylce, motorcylce, and pedestrian	$0.05 ($0.04-$0.07)	1.58% (-4.50%-11.23%)
30	Chronic obstructive pulmonary disease - Chronic, bronchitis, emphysema	$0.05 ($0.04-$0.06)	7.92% (0.13%-20.94%)
31	Ischemic heart disease	$0.05 ($0.04-$0.06)	3.05% (-1.83%-12.57%)

Table 9.3: Public health care spending results continued

Rank	Condition	2013 spending (billions of US dollars)	Annualized rate of change (1996-2013)
32	Cirrhosis of the liver	$0.04 ($0.02-$0.06)	3.36% (-7.22%-15.73%)
33	Hypertension - Treatment of hypertension	$0.04 ($0.02-$0.05)	6.97% (4.56%-9.63%)
34	Asthma	$0.04 ($0.02-$0.05)	4.96% (-4.85%-26.47%)
35	Alcohol use disorders - Alcohol dependence and harmful use	$0.03 ($0.01-$0.09)	-1.65% (-12.92%-12.99%)
36	Congenital anomalies	$0.03 ($0.03-$0.04)	-1.85% (-14.93%-7.15%)
37	Cervical cancer	$0.03 ($0.01-$0.36)	9.63% (0.92%-25.16%)
38	Measles	$0.03 ($0.02-$0.04)	-1.97% (-4.70%-0.25%)
39	Sepsis and other infectious disorders of the newborn baby	$0.03 ($0.02-$0.04)	-1.17% (-3.23%-0.61%)
40	Drug use disorders - Cocaine, opioid, amphetamines and cannabis dependence	$0.03 ($0.01-$0.10)	-0.53% (-14.64%-20.06%)
41	Poisonings	$0.03 ($0.02-$0.03)	17.59% (11.65%-25.04%)
42	Falls	$0.02 ($0.02-$0.03)	2.90% (-2.32%-10.39%)
43	Cerebrovascular disease	$0.02 ($0.02-$0.03)	3.28% (-1.62%-10.48%)
44	Diabetes mellitus	$0.02 ($0.01-$0.03)	16.43% (10.39%-20.95%)
45	Hyperlipidemia - Treatment of hyperlipidemia	$0.02 ($0.01-$0.03)	6.24% (3.86%-8.92%)
46	Endocrine, metabolic, blood, and immune disorders - Other diseases of thyroid, von Willebrand's disease	$0.02 ($0.01-$0.02)	-0.83% (-6.90%-9.07%)
47	Intestinal infectious diseases - E. coli, giardiasis, typhoid fever	$0.02 ($0.01-$0.02)	-2.80% (-5.01%--0.43%)
48	Colon and rectum cancers	$0.01 ($0.01-$0.05)	9.64% (0.73%-19.80%)
49	Iron-deficiency anemia - Anaemia	$0.01 ($0.01-$0.02)	-8.44% (-12.01%--4.23%)
50	Oral disorders - Oral surgery and caries, including fillings, crowns, extraction, & dentures	$0.01 ($0.01-$0.02)	29.89% (13.99%-47.63%)
51	Schizophrenia	$0.01 ($0.01-$0.03)	9.95% (-0.86%-21.43%)
52	Prostate cancer	$0.01 ($0.00-$0.02)	25.38% (16.88%-32.34%)
53	Exposure to mechanical forces - Falling object, striking other object, cuts, being crushed	$0.01 ($0.01-$0.01)	1.10% (-3.89%-8.62%)
54	Mesothelioma	$0.01 ($0.01-$0.01)	10.71% (0.76%-37.44%)
55	Hemoglobinopathies and hemolytic anemias	$0.01 ($0.01-$0.01)	4.88% (-0.17%-11.12%)
56	Hemolytic disease in fetus and newborn and other neonatal jaundice - Jaundice, hemolytic disease	$0.01 ($0.01-$0.01)	-1.32% (-3.56%-0.64%)
57	Epilepsy	$0.01 ($0.00-$0.03)	9.58% (-6.63%-27.93%)
58	Bipolar disorder	$0.01 ($0.00-$0.02)	9.92% (-0.89%-21.39%)
59	Liver cancer	$0.01 ($0.01-$0.01)	6.73% (-5.23%-22.24%)

Table 9.3: Public health care spending results continued

Rank	Condition	2013 spending (billions of US dollars)	Annualized rate of change (1996-2013)
60	Other unintentional injuries - Overexertion, other accidents	$0.01 ($0.01-$0.01)	5.54% (-0.78%-20.00%)
61	Other mental and behavioral disorders - Insomnia	$0.01 ($0.00-$0.01)	10.21% (-0.63%-21.71%)
62	Other neurological disorders - Pain syndromes, muscular dystrophy	$0.01 ($0.01-$0.01)	13.50% (-5.17%-57.18%)
63	Chronic kidney diseases	$0.01 ($0.01-$0.01)	6.24% (1.09%-16.40%)
64	Upper respiratory infections	$0.01 ($0.00-$0.01)	-0.79% (-3.24%-1.93%)
65	Other maternal disorders - 2nd and 3rd degree tears	$0.01 ($0.00-$0.01)	3.24% (0.99%-5.24%)
66	Cardiomyopathy and myocarditis	$0.01 ($0.00-$0.01)	4.42% (-0.46%-13.42%)
67	Other cardiovascular and circulatory diseases - Paroxysmal tachycardia, unspecified dysrhythmias	$0.01 ($0.00-$0.01)	6.37% (1.63%-14.36%)
68	Ovarian cancer	$0.01 ($0.00-$0.01)	26.06% (12.02%-52.80%)

Table 9.4: Aggregated personal health care spending by function

Rank	Condition	2013 spending (billions of dollars)	Percent of 2013 spending that is:					
			Ambulatory care	Inpatient care	Pharmaceuticals	Emergency care	Nursing facility care	Dental care
1	Cardiovascular diseases	$231.1 ($218.5-$240.7)	18.4% (16.9%-19.8%)	57.3% (55.0%-59.2%)	6.2% (5.7%-6.8%)	2.7% (2.4%-3.1%)	15.3% (13.8%-16.4%)	0.0% (0.0%-0.0%)
2	Diabetes, urogenital, blood, and endocrine diseases	$224.5 ($216.4-$233.5)	31.5% (29.8%-33.1%)	23.0% (21.1%-25.6%)	31.0% (29.3%-32.9%)	4.2% (3.6%-4.7%)	10.3% (9.1%-11.3%)	0.0% (0.0%-0.0%)
3	Other non-communicable diseases	$191.7 ($185.4-$201.4)	43.0% (41.2%-45.9%)	11.3% (9.8%-13.2%)	6.5% (5.9%-6.9%)	2.8% (2.5%-3.1%)	3.2% (2.8%-3.6%)	33.2% (31.5%-34.5%)
4	Mental and behavioral disorders	$187.8 ($179.2-$208.8)	52.1% (47.1%-54.6%)	19.0% (17.1%-20.2%)	20.9% (18.6%-22.6%)	1.6% (0.8%-2.3%)	6.5% (4.1%-15.3%)	0.0% (0.0%-0.0%)
5	Musculoskeletal disorders	$183.5 ($166.3-$192.7)	47.7% (42.1%-50.3%)	37.0% (34.1%-41.0%)	6.2% (5.5%-6.9%)	3.3% (2.8%-3.7%)	5.9% (5.3%-6.7%)	0.0% (0.0%-0.0%)
6	Injuries	$168.0 ($158.9-$177.0)	34.5% (31.7%-37.4%)	33.7% (31.7%-36.1%)	0.7% (0.6%-0.7%)	25.1% (23.7%-26.7%)	6.1% (5.1%-7.3%)	0.0% (0.0%-0.0%)
7	Communicable, maternal, neonatal, and nutritional disorders	$164.9 ($155.2-$174.5)	21.7% (20.4%-23.3%)	58.1% (55.3%-60.7%)	2.1% (2.0%-2.4%)	6.2% (5.5%-6.8%)	11.8% (9.8%-13.9%)	0.0% (0.0%-0.0%)

Table 9.4: Aggregated personal health care spending by function continued

Rank	Condition	2013 spending (billions of dollars)	Percent of 2013 spending that is: Ambulatory care	Inpatient care	Pharmaceuticals	Emergency care	Nursing facility care	Dental care
8	Well-care	$155.5 ($150.7-$162.0)	28.7% (27.1%-30.9%)	36.5% (34.4%-38.9%)	3.0% (2.7%-3.3%)	0.5% (0.3%-0.6%)	0.1% (0.0%-0.2%)	31.4% (29.9%-32.9%)
9	Expenditure on risk factors	$140.8 ($136.0-$147.1)	35.6% (33.9%-38.2%)	3.5% (2.8%-4.4%)	53.6% (51.2%-55.6%)	1.1% (0.9%-1.3%)	6.2% (5.4%-7.1%)	0.0% (0.0%-0.0%)
10	Chronic respiratory diseases	$132.1 ($125.5-$140.0)	31.1% (29.1%-33.1%)	26.7% (23.4%-30.3%)	28.4% (26.3%-30.5%)	4.7% (4.0%-5.4%)	9.0% (7.9%-10.2%)	0.0% (0.0%-0.0%)
11	Neoplasms	$115.4 ($105.1-$123.5)	42.0% (39.2%-45.9%)	51.2% (47.0%-54.0%)	1.0% (0.9%-1.2%)	1.2% (1.0%-1.5%)	4.6% (3.9%-5.3%)	0.0% (0.0%-0.0%)
12	Neurological disorders	$101.3 ($93.7-$108.5)	26.3% (24.0%-28.5%)	15.0% (12.7%-18.0%)	12.3% (10.9%-13.8%)	3.5% (3.0%-4.0%)	43.0% (39.2%-45.8%)	0.0% (0.0%-0.0%)
13	Digestive diseases	$99.4 ($92.9-$105.0)	20.6% (18.7%-22.7%)	60.8% (58.2%-63.1%)	5.5% (4.7%-6.2%)	6.4% (5.3%-7.6%)	6.7% (5.9%-7.6%)	0.0% (0.0%-0.0%)
14	Cirrhosis	$4.2 ($3.5-$5.1)	7.8% (4.6%-10.8%)	88.5% (84.6%-92.3%)	0.0% (0.0%-0.0%)	0.0% (0.0%-0.0%)	3.6% (2.3%-6.0%)	0.0% (0.0%-0.0%)

Table 9.5: Aggregated personal health care spending annualized rate of change and spending by age

Rank	Condition	Annualized rate of change 1996-2013				Percent of 2013 spending that is:		
		All ages	Age less than 65	Age greater than or equal to 65	Age less than 20	Age greater than or equal to 20 and less than 45	Age greater than or equal to 45 and less than 65	Age greater than or equal to 65
1	Cardiovascular diseases	1.2% (0.7%-1.6%)	1.6% (1.1%-2.0%)	1.0% (0.4%-1.4%)	0.9% (0.8%-0.9%)	5.8% (5.6%-6.0%)	28.1% (27.6%-28.6%)	65.2% (64.6%-65.8%)
2	Diabetes, urogenital, blood, and endocrine diseases	5.1% (4.5%-5.6%)	4.5% (3.9%-5.1%)	5.9% (5.4%-6.5%)	3.5% (3.2%-3.9%)	17.9% (17.2%-18.7%)	36.0% (35.2%-36.9%)	42.6% (41.6%-43.6%)
3	Other non-communicable diseases	3.1% (2.5%-3.7%)	2.9% (2.3%-3.6%)	3.5% (2.7%-4.4%)	15.3% (14.6%-16.1%)	21.0% (20.4%-21.6%)	30.7% (30.2%-31.4%)	32.9% (31.7%-34.0%)
4	Mental and behavioral disorders	3.7% (3.3%-4.3%)	3.7% (3.3%-3.9%)	3.7% (2.6%-7.4%)	19.8% (17.7%-21.6%)	35.4% (31.9%-37.2%)	32.0% (29.8%-33.1%)	12.8% (10.9%-20.3%)
5	Musculoskeletal disorders	5.4% (4.7%-6.0%)	5.0% (4.3%-5.7%)	6.0% (5.4%-6.6%)	1.9% (1.8%-2.0%)	17.5% (16.5%-18.2%)	40.5% (39.7%-41.2%)	40.0% (39.0%-41.8%)
6	Injuries	3.3% (2.9%-3.8%)	3.4% (2.9%-4.0%)	3.0% (2.4%-3.7%)	14.1% (13.4%-14.8%)	30.8% (29.7%-31.7%)	27.6% (26.5%-28.6%)	27.5% (26.1%-28.9%)
7	Communicable, maternal, neonatal, and nutritional disorders	3.7% (3.3%-4.2%)	2.6% (2.2%-3.0%)	6.4% (5.4%-7.1%)	23.8% (22.4%-25.3%)	23.1% (21.9%-24.5%)	16.6% (15.7%-17.3%)	36.6% (34.6%-38.4%)
8	Well-care	2.9% (2.3%-3.6%)	2.9% (2.3%-3.5%)	4.4% (3.1%-5.6%)	37.7% (36.0%-39.7%)	46.7% (45.3%-48.3%)	10.4% (9.9%-11.0%)	5.1% (4.7%-5.5%)

Table 9.5: Aggregated personal health care spending annualized rate of change and spending by age continued

Rank	Condition	Annualized rate of change 1996-2013				Percent of 2013 spending that is:		
		All ages	Age less than 65	Age greater than or equal to 65	Age less than 20	Age greater than or equal to 20 and less than 45	Age greater than or equal to 45 and less than 65	Age greater than or equal to 65
9	Expenditure on risk factors	6.6% (5.9%-7.3%)	6.5% (5.7%-7.2%)	6.8% (6.1%-7.5%)	0.6% (0.4%-0.9%)	8.1% (7.7%-8.5%)	41.3% (40.4%-42.3%)	50.0% (48.8%-51.1%)
10	Chronic respiratory diseases	3.7% (3.1%-4.3%)	3.4% (2.8%-4.0%)	4.1% (3.5%-4.9%)	14.5% (13.6%-15.3%)	16.8% (16.1%-17.5%)	29.7% (29.1%-30.4%)	39.0% (37.5%-40.4%)
11	Neoplasms	2.5% (1.8%-3.1%)	2.3% (1.7%-2.9%)	2.7% (2.0%-3.4%)	3.0% (2.8%-3.2%)	13.6% (13.0%-14.4%)	37.1% (36.4%-37.9%)	46.3% (45.3%-47.3%)
12	Neurological disorders	4.0% (3.5%-4.6%)	5.5% (4.8%-6.3%)	3.2% (2.4%-4.0%)	2.4% (2.2%-2.7%)	15.1% (14.1%-16.2%)	23.7% (22.4%-25.1%)	58.8% (56.4%-60.9%)
13	Digestive diseases	2.9% (2.2%-3.5%)	3.1% (2.4%-3.7%)	2.6% (1.9%-3.3%)	6.0% (5.5%-6.5%)	22.2% (21.6%-22.8%)	32.5% (31.7%-33.2%)	39.3% (38.4%-40.2%)
14	Cirrhosis	5.1% (4.4%-6.0%)	5.2% (4.4%-6.1%)	4.8% (4.0%-5.7%)	1.3% (1.0%-1.8%)	17.5% (16.4%-18.6%)	61.7% (60.1%-63.0%)	19.6% (18.6%-20.6%)

Section 10: Hierarchy of Conditions

Table 10.1: Hierarchy of Condition Categories

Condition Level 1	Condition Level 2	Condition Level 3
Communicable, maternal, neonatal, and nutritional diseases	HIV/AIDS and tuberculosis	Tuberculosis
Communicable, maternal, neonatal, and nutritional diseases	HIV/AIDS and tuberculosis	HIV/AIDS
Communicable, maternal, neonatal, and nutritional diseases	Diarrhea, lower respiratory, and other common infectious diseases	Diarrheal diseases
Communicable, maternal, neonatal, and nutritional diseases	Diarrhea, lower respiratory, and other common infectious diseases	Tetanus
Communicable, maternal, neonatal, and nutritional diseases	Diarrhea, lower respiratory, and other common infectious diseases	Measles
Communicable, maternal, neonatal, and nutritional diseases	Diarrhea, lower respiratory, and other common infectious diseases	Varicella and herpes zoster
Communicable, maternal, neonatal, and nutritional diseases	Diarrhea, lower respiratory, and other common infectious diseases	Intestinal infectious diseases
Communicable, maternal, neonatal, and nutritional diseases	Diarrhea, lower respiratory, and other common infectious diseases	Lower respiratory infections
Communicable, maternal, neonatal, and nutritional diseases	Diarrhea, lower respiratory, and other common infectious diseases	Upper respiratory infections
Communicable, maternal, neonatal, and nutritional diseases	Diarrhea, lower respiratory, and other common infectious diseases	Otitis media
Communicable, maternal, neonatal, and nutritional diseases	Diarrhea, lower respiratory, and other common infectious diseases	Meningitis
Communicable, maternal, neonatal, and nutritional diseases	Diarrhea, lower respiratory, and other common infectious diseases	Encephalitis
Communicable, maternal, neonatal, and nutritional diseases	Diarrhea, lower respiratory, and other common infectious diseases	Diphtheria
Communicable, maternal, neonatal, and nutritional diseases	Diarrhea, lower respiratory, and other common infectious diseases	Whooping cough

Communicable, maternal, neonatal, and nutritional diseases	Neglected tropical diseases and malaria	Neglected tropical diseases and malaria
Communicable, maternal, neonatal, and nutritional diseases	Maternal disorders	Maternal hemorrhage
Communicable, maternal, neonatal, and nutritional diseases	Maternal disorders	Maternal sepsis and other maternal infections
Communicable, maternal, neonatal, and nutritional diseases	Maternal disorders	Maternal hypertensive disorders
Communicable, maternal, neonatal, and nutritional diseases	Maternal disorders	Maternal obstructed labor and uterine rupture
Communicable, maternal, neonatal, and nutritional diseases	Maternal disorders	Maternal abortion, miscarriage, and ectopic pregnancy
Communicable, maternal, neonatal, and nutritional diseases	Maternal disorders	Indirect maternal deaths
Communicable, maternal, neonatal, and nutritional diseases	Maternal disorders	Other maternal disorders
Communicable, maternal, neonatal, and nutritional diseases	Neonatal disorders	Neonatal preterm birth complications
Communicable, maternal, neonatal, and nutritional diseases	Neonatal disorders	Neonatal encephalopathy due to birth asphyxia and trauma
Communicable, maternal, neonatal, and nutritional diseases	Neonatal disorders	Neonatal sepsis and other neonatal infections
Communicable, maternal, neonatal, and nutritional diseases	Neonatal disorders	Hemolytic disease and other neonatal jaundice
Communicable, maternal, neonatal, and nutritional diseases	Neonatal disorders	Other neonatal disorders
Communicable, maternal, neonatal, and nutritional diseases	Nutritional deficiencies	Protein-energy malnutrition
Communicable, maternal, neonatal, and nutritional diseases	Nutritional deficiencies	Iodine deficiency
Communicable, maternal, neonatal, and nutritional diseases	Nutritional deficiencies	Vitamin A deficiency
Communicable, maternal, neonatal, and nutritional diseases	Nutritional deficiencies	Iron-deficiency anemia

Communicable, maternal, neonatal, and nutritional diseases	Nutritional deficiencies	Other nutritional deficiencies
Communicable, maternal, neonatal, and nutritional diseases	Other communicable, maternal, neonatal, and nutritional diseases	Sexually transmitted diseases excluding HIV
Communicable, maternal, neonatal, and nutritional diseases	Other communicable, maternal, neonatal, and nutritional diseases	Hepatitis
Communicable, maternal, neonatal, and nutritional diseases	Other communicable, maternal, neonatal, and nutritional diseases	Leprosy
Communicable, maternal, neonatal, and nutritional diseases	Other communicable, maternal, neonatal, and nutritional diseases	Other infectious diseases
Communicable, maternal, neonatal, and nutritional diseases	Other communicable, maternal, neonatal, and nutritional diseases	Septicemia
Non-communicable diseases	Neoplasms	Esophageal cancer
Non-communicable diseases	Neoplasms	Colon and rectum cancer
Non-communicable diseases	Neoplasms	Lip and oral cavity cancer
Non-communicable diseases	Neoplasms	Nasopharynx cancer
Non-communicable diseases	Neoplasms	Other pharynx cancer
Non-communicable diseases	Neoplasms	Gallbladder and biliary tract cancer
Non-communicable diseases	Neoplasms	Pancreatic cancer
Non-communicable diseases	Neoplasms	Malignant skin melanoma
Non-communicable diseases	Neoplasms	Non-melanoma skin cancer
Non-communicable diseases	Neoplasms	Ovarian cancer
Non-communicable diseases	Neoplasms	Testicular cancer
Non-communicable diseases	Neoplasms	Stomach cancer
Non-communicable diseases	Neoplasms	Kidney cancer
Non-communicable diseases	Neoplasms	Bladder cancer
Non-communicable diseases	Neoplasms	Brain and nervous system cancer
Non-communicable diseases	Neoplasms	Thyroid cancer
Non-communicable diseases	Neoplasms	Mesothelioma
Non-communicable diseases	Neoplasms	Hodgkin lymphoma
Non-communicable diseases	Neoplasms	Non-Hodgkin lymphoma

Non-communicable diseases	Neoplasms	Multiple myeloma
Non-communicable diseases	Neoplasms	Leukemia
Non-communicable diseases	Neoplasms	Other neoplasms
Non-communicable diseases	Neoplasms	Liver cancer
Non-communicable diseases	Neoplasms	Larynx cancer
Non-communicable diseases	Neoplasms	Tracheal, bronchus, and lung cancer
Non-communicable diseases	Neoplasms	Breast cancer
Non-communicable diseases	Neoplasms	Cervical cancer
Non-communicable diseases	Neoplasms	Uterine cancer
Non-communicable diseases	Neoplasms	Prostate cancer
Non-communicable diseases	Other non-communicable diseases	Congenital anomalies
Non-communicable diseases	Other non-communicable diseases	Skin and subcutaneous diseases
Non-communicable diseases	Other non-communicable diseases	Sense organ diseases
Non-communicable diseases	Other non-communicable diseases	Oral disorders
Non-communicable diseases	Cardiovascular diseases	Rheumatic heart disease
Non-communicable diseases	Cardiovascular diseases	Other cardiovascular and circulatory diseases
Non-communicable diseases	Cardiovascular diseases	Heart Failure
Non-communicable diseases	Cardiovascular diseases	Ischemic heart disease
Non-communicable diseases	Cardiovascular diseases	Cerebrovascular disease
Non-communicable diseases	Cardiovascular diseases	Hypertensive heart disease
Non-communicable diseases	Cardiovascular diseases	Cardiomyopathy and myocarditis
Non-communicable diseases	Cardiovascular diseases	Atrial fibrillation and flutter
Non-communicable diseases	Cardiovascular diseases	Aortic aneurysm
Non-communicable diseases	Cardiovascular diseases	Peripheral vascular disease
Non-communicable diseases	Cardiovascular diseases	Endocarditis
Non-communicable diseases	Chronic respiratory diseases	Chronic obstructive pulmonary disease
Non-communicable diseases	Chronic respiratory diseases	Pneumoconiosis
Non-communicable diseases	Chronic respiratory diseases	Asthma
Non-communicable diseases	Chronic respiratory diseases	Interstitial lung disease and pulmonary sarcoidosis
Non-communicable diseases	Chronic respiratory diseases	Other chronic respiratory diseases

Non-communicable diseases	Cirrhosis and other chronic liver diseases	Cirrhosis and other chronic liver diseases
Non-communicable diseases	Digestive diseases	Peptic ulcer disease
Non-communicable diseases	Digestive diseases	Other digestive diseases
Non-communicable diseases	Digestive diseases	Gastritis and duodenitis
Non-communicable diseases	Digestive diseases	Appendicitis
Non-communicable diseases	Digestive diseases	Paralytic ileus and intestinal obstruction
Non-communicable diseases	Digestive diseases	Inguinal, femoral, and abdominal hernia
Non-communicable diseases	Digestive diseases	Inflammatory bowel disease
Non-communicable diseases	Digestive diseases	Vascular intestinal disorders
Non-communicable diseases	Digestive diseases	Gallbladder and biliary diseases
Non-communicable diseases	Digestive diseases	Pancreatitis
Non-communicable diseases	Neurological disorders	Alzheimer disease and other dementias
Non-communicable diseases	Neurological disorders	Parkinson disease
Non-communicable diseases	Neurological disorders	Epilepsy
Non-communicable diseases	Neurological disorders	Multiple sclerosis
Non-communicable diseases	Neurological disorders	Migraine
Non-communicable diseases	Neurological disorders	Tension-type headache
Non-communicable diseases	Neurological disorders	Other neurological disorders
Non-communicable diseases	Mental and substance use disorders	Schizophrenia
Non-communicable diseases	Mental and substance use disorders	Conduct disorder
Non-communicable diseases	Mental and substance use disorders	Idiopathic intellectual disability
Non-communicable diseases	Mental and substance use disorders	Other mental and substance use disorders
Non-communicable diseases	Mental and substance use disorders	Alcohol use disorders
Non-communicable diseases	Mental and substance use disorders	Drug use disorders
Non-communicable diseases	Mental and substance use disorders	Depressive disorders
Non-communicable diseases	Mental and substance use disorders	Bipolar disorder
Non-communicable diseases	Mental and substance use disorders	Anxiety disorders
Non-communicable diseases	Mental and substance use disorders	Eating disorders
Non-communicable diseases	Mental and substance use disorders	Autistic spectrum disorders
Non-communicable diseases	Mental and substance use disorders	Attention-deficit/hyperactivity disorder

Non-communicable diseases	Diabetes, urogenital, blood, and endocrine diseases	Diabetes mellitus
Non-communicable diseases	Diabetes, urogenital, blood, and endocrine diseases	Acute glomerulonephritis
Non-communicable diseases	Diabetes, urogenital, blood, and endocrine diseases	Chronic kidney disease
Non-communicable diseases	Diabetes, urogenital, blood, and endocrine diseases	Urinary diseases and male infertility
Non-communicable diseases	Diabetes, urogenital, blood, and endocrine diseases	Gynecological diseases
Non-communicable diseases	Diabetes, urogenital, blood, and endocrine diseases	Hemoglobinopathies and hemolytic anemias
Non-communicable diseases	Diabetes, urogenital, blood, and endocrine diseases	Endocrine, metabolic, blood, and immune disorders
Non-communicable diseases	Diabetes, urogenital, blood, and endocrine diseases	Renal Failure
Non-communicable diseases	Musculoskeletal disorders	Rheumatoid arthritis
Non-communicable diseases	Musculoskeletal disorders	Osteoarthritis
Non-communicable diseases	Musculoskeletal disorders	Low back and neck pain
Non-communicable diseases	Musculoskeletal disorders	Gout
Non-communicable diseases	Musculoskeletal disorders	Other musculoskeletal disorders
Injuries	Transport injuries	Road injuries
Injuries	Transport injuries	Other transport injuries
Injuries	Unintentional injuries	Falls
Injuries	Unintentional injuries	Drowning
Injuries	Unintentional injuries	Fire, heat, and hot substances
Injuries	Unintentional injuries	Poisonings
Injuries	Unintentional injuries	Exposure to mechanical forces
Injuries	Unintentional injuries	Animal contact
Injuries	Unintentional injuries	Foreign body
Injuries	Unintentional injuries	Other unintentional injuries
Injuries	Self-harm and interpersonal violence	Self-harm

Injuries	Self-harm and interpersonal violence	Interpersonal violence
Injuries	Forces of nature, war, and legal intervention	Exposure to forces of nature
Injuries	Forces of nature, war, and legal intervention	Collective violence and legal intervention
Well care spending	Well newborn, person, and dental spending	Well person spending
Well care spending	Well newborn, person, and dental spending	Well newborn spending
Well care spending	Well pregnancy and family planning care	Well pregnancy care
Well care spending	Well newborn, person, and dental spending	Well dental spending
Well care spending	Well pregnancy and family planning care	Family planning services
Well care spending	Well services	Donor services
Well care spending	Well services	Counseling services
Well care spending	Well services	Social services
Treatment of risk factors	Tobacco Intervention	Tobacco Intervention
Treatment of risk factors	Treatment of obesity	Treatment of obesity
Treatment of risk factors	Treatment of hypertension	Treatment of hypertension
Treatment of risk factors	Treatment of hyperlipidemia	Treatment of hyperlipidemia

Bibliography

1. Center for Medicare and Medicaid Services. *National Health Expenditure Accounts: Methodology Paper, 2013*. Washington, DC; 2014. http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/Downloads/DSM-13.pdf. Accessed May 12, 2015.

2. Tompkins CP, Altman SH, Eilat E. The Precarious Pricing System For Hospital Services. *Health Aff*. 2006;25(1):45-56. doi:10.1377/hlthaff.25.1.45.

3. Reinhardt UE. The Pricing Of U.S. Hospital Services: Chaos Behind A Veil Of Secrecy. *Health Aff*. 2006;25(1):57-69. doi:10.1377/hlthaff.25.1.57.

4. Hamavid H, Birger M, Dieleman J, et al. Assessing the complex and evolving relationship between charges and payments in US hospitals: 1996-2012. *Accepted by PLOS ONE*. August 2015.

5. International Monetary Fund. *World Economic Outlook*. Washington, DC; 2015. http://www.imf.org/external/pubs/ft/weo/2015/01/weodata/index.aspx. Accessed April 12, 2015.

6. Global, regional, and national age–sex specific all-cause and cause-specific mortality for 240 causes of death, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. *The Lancet*. 2015;385(9963):117-171. doi:10.1016/S0140-6736(14)61682-2.

7. Organisation for Economic Co-operation and Development. *OECD.StatExtracts*. http://stats.oecd.org/. Accessed October 7, 2014.

8. Agency for Healthcare Research and Quality. *United States Medical Expenditure Panel Survey.* Rockville, United States: Agency for Health Care Research and Quality

9. Substance Abuse and Mental Health Services Administration. *National Expenditures for Mental Health Services & Substance Abuse Treatment: 1986 - 2009*. Rockville, MD: Substance Abuse and Mental Health Services Administration; 2013.

10. Lefit K, Kassed C, Coffey R, et al. *Projections of National Expenditures for Mental Health Services and Substance Abuse Treatment, 2004-– 2014-*. Rockville, MD: Substance Abuse and Mental Health Services Administration; 2008.

11. ICD-9-CM Official Guidelines for Coding and Reporting. October 2011. http://www.cdc.gov/nchs/data/icd/icd9cm_guidelines_2011.pdf. Accessed May 15, 2015.

12. Naghavi M, Makela S, Foreman K, O'Brien J, Pourmalek F, Lozano R. Algorithms for enhancing public health utility of national causes-of-death data. *Population Health Metrics*. 2010;8(1):9. doi:10.1186/1478-7954-8-9.

13. Gelman A, Carlin JB, Stern HS, Dunson DB, Vehtari A, Rubin DB. *Bayesian Data Analysis*. 3rd Edition. Boca Raton, FL: Chapman and Hall/CRC Press; 2014.

14. Patil A, Fonnesbeck C, Huard D, Salvatier J. *PyMC2*. (Version 2.3.6); 2005. https://github.com/pymc-devs/pymc. Accessed March 8, 2016

15. Lang S, Brezger A. Bayesian P-Splines. *Journal of Computational and Graphical Statistics*. 13(1):183-212. doi:10.1198/1061860043010.

16. Foster JT. *Bspline*. (Version 1.0); 2015. https://github.com/johntfoster/bspline. Accessed May 13, 2016

17. Baral R, Johnson E, Dieleman J, et al. Adjusting health spending for the presence of comorbidities: an application to United States national inpatient data. *PLOS ONE*.

18. Haagsma JA, Graetz N, Bolliger I, et al. The global burden of injury: incidence, mortality, disability-adjusted life years and time trends from the Global Burden of Disease study 2013. *Inj Prev*. December 2015:injuryprev-2015-041616. doi:10.1136/injuryprev-2015-041616.

19. MEPS HC - 135D: 2010 Hospital Inpatient Stays. July 2012. http://meps.ahrq.gov/mepsweb/data_stats/download_data/pufs/h135d/h135ddoc.shtml. Accessed March 3, 2015

20. Schneider A, Hommel G, Blettner M. Linear Regression Analysis. *Dtsch Arztebl Int*. 2010;107(44):776-782. doi:10.3238/arztebl.2010.0776.

21. Green SB. How Many Subjects Does It Take To Do A Regression Analysis. *Multivariate Behavioral Research*. 1991;26(3):499-510. doi:10.1207/s15327906mbr2603_7.

22. HCUP NIS Description of Data Elements. September 2008. http://www.hcup-us.ahrq.gov/db/vars/totchg/nisnote.jsp.

23. Tina Highfill, David Johnson. Measuring Nursing Home Price Growth between 2000–2009. http://www.bea.gov/papers/pdf/Highfill%20Johnson_Nursing%20Homes%20MCE%20index.pdf. Accessed May 12, 2016.

24. Thomas Day. About Nursing Homes. https://www.longtermcarelink.net/eldercare/nursing_home.htm. Accessed May 12, 2016.

25. *National Nursing Home Survey: 2004 Overview.* Washington, DC: Center for Disease Control and Prevention; 2009. http://www.cdc.gov/nchs/data/series/sr_13/sr13_167.pdf. Accessed May 12, 2016.

26. Skilled nursing facility (SNF) care | Medicare.gov. Medicare.gov The Official U.S. Government site for Medicare. https://www.medicare.gov/coverage/skilled-nursing-facility-care.html. Accessed May 12, 2016.

27. Centers for Medicare and Medicaid Services, 7500 Security Boulevard, Baltimore, MD 21244. National Health Accounts Historical. https://www.cms.gov/research-statistics-data-and-systems/statistics-trends-and-reports/nationalhealthexpenddata/nationalhealthaccountshistorical.html. Published December 3, 2015. Accessed December 16, 2015.

28. Lassman D, Hartman M, Washington B, Andrews K, Catlin A. US Health Spending Trends By Age And Gender: Selected Years 2002–10. *Health Aff*. 2014;33(5):815-822. doi:10.1377/hlthaff.2013.1224.

29. Cylus J, Hartman M, Washington B, Andrews K, Catlin A. Pronounced Gender And Age Differences Are Evident In Personal Health Care Spending Per Person. *Health Aff*. December 2010:10.1377/hlthaff.2010.0216. doi:10.1377/hlthaff.2010.0216.

30. Smithson M, Verkuilen J. A better lemon squeezer? Maximum-likelihood regression with beta-distributed dependent variables. *Psychological Methods*. 2006;11(1):54-71. doi:10.1037/1082-989X.11.1.54.

31. GBD 2013 DALYs and HALE Collaborators, Murray CJL, Barber RM, et al. Global, regional, and national disability-adjusted life years (DALYs) for 306 diseases and injuries and healthy life expectancy (HALE) for 188 countries, 1990-2013: quantifying the epidemiological transition. *Lancet*. 2015;386(10009):2145-2191. doi:10.1016/S0140-6736(15)61340-X.

32. Kolenikov S. State Journal | Article. Stata Journal | Article. http://www.stata-journal.com/article.html?article=st0187 Accessed July 21, 2016.