



Centers for Medicare & Medicaid Services
Office of Minority Health (CMS OMH)

The Mapping Medicare Disparities Tool

Technical Documentation

Prepared by

NORC at the University of Chicago
55 East Monroe Street, 30th Floor
Chicago, IL 60603

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1. Purpose of the Analysis

The [Mapping Medicare Disparities \(MMD\) Tool](#) is designed to identify areas of disparities between sub-populations (e.g., racial and ethnic groups) in health outcomes, utilization, and spending. This information provides a starting point for understanding health-related data geographically and may be used to target populations for potential interventions. The MMD Tool presents various health-related measures by state, county, age, sex, and dual eligibility status (beneficiaries eligible for both Medicare and Medicaid programs). The MMD Tool also offers built-in “analyses” to investigate disparities (1) within counties and across racial and ethnic groups, and (2) within racial and ethnic groups and across counties.

2. Data and Analysis Population

The data used in this analysis come from the Centers for Medicare & Medicaid Services (CMS) administrative claims for Medicare beneficiaries enrolled in the fee-for-service (FFS) program, which are available from CMS through the Chronic Conditions Data Warehouse (CCW; www.ccwdata.org/web/guest/home). These claims files are known as CMS Research Identifiable Files (RIF), which consist of the Master Beneficiary Summary File (MBSF) – with beneficiary eligibility, enrollment, beneficiary characteristic data – and final action items for services/claims covered by Medicare Part A (hospital insurance) and Part B (medical insurance). Specifically, CMS RIF used in this analysis include:

- 100% Inpatient RIF
- 100% Skilled Nursing Facility (SNF) RIF
- 100% Hospice RIF
- 100% Home Health Agency RIF
- 100% Outpatient RIF
- 100% Carrier (physician/supplier) RIF
- 100% Durable Medical Equipment (DME) RIF

All but one of the measures included require only inpatient hospitalization and/or outpatient claims (in addition to the MBSF with enrollment information). The methodologies used to calculate hospitalization rates, preventable hospitalizations, readmission rates, and mortality rates require only inpatient claims data. However, the methodology used to calculate emergency department (ED) visit rates requires both inpatient and outpatient data. The prevalence of chronic conditions and total cost estimates requires all claim types, including Carrier and DME claims.

Included in this analysis are Medicare beneficiaries age 65 years or older, persons under age 65 with certain disabilities, and persons of any age with end stage renal disease (ESRD). We exclude Medicare beneficiaries with any Medicare Advantage enrollment during the year, since claims data are not available for these beneficiaries. Beneficiaries who died during the year are included up to their date of death, if they meet other inclusion criteria. See Appendix A for more details on the population used for each measure.

Table 1. Data and Definitions Used in the Mapping Medicare Disparities Tool

Measure	Prevalence Rates and Costs	Hospitalization Rates	AHRQ Prevention Quality Indicators (PQIs)	Readmission Rates	Mortality Rates	Emergency Department Visit Rates
Method	Chronic Conditions Data Warehouse (CCW) methodology	Centers for Disease Control and Prevention (CDC) Interactive Atlas methodology or CCW methodology ^[1]	Agency for Healthcare Research and Quality (AHRQ) methodology	Centers for Medicare & Medicaid Services (CMS) 30-day risk-standardized methodology	CMS 30-day risk-standardized methodology	Research Data Assistance Center (ResDAC) methodology
Condition	Acute Myocardial Infarction Arthritis Asthma Atrial Fibrillation Alzheimer’s Disease, Related Disorders, or Senile Dementia Cancer (breast, colorectal, lung, and/or prostate) ^[2] Chronic Kidney Disease Chronic Obstructive Pulmonary Disease (COPD) Depression Diabetes Heart Failure Hyperlipidemia (high cholesterol) Hypertension Ischemic Heart Disease Obesity Osteoporosis Schizophrenia/Other Psychotic Disorders Stroke / Transient Ischemic Attack 0, 1, 2, or 3+ Conditions End Stage Renal Disease (ESRD) Disability	Acute Myocardial Infarction (CDC) Arthritis (CCW) Asthma (CCW) Alzheimer’s Disease, Related Disorders, or Senile Dementia (CCW) Cancer (breast, colorectal, lung, and prostate) (CCW) Cardiac Dysrhythmia (CDC) Chronic Kidney Disease (CCW) COPD (CCW) Depression (CCW) Diabetes (CCW) Heart Failure (CDC) Hyperlipidemia (high cholesterol) (CCW) Hypertension (CDC) Ischemic Heart Disease (CDC) Obesity (CCW) Osteoporosis (CCW) Schizophrenia/Other Psychotic Disorders (CCW) Stroke (CDC) 0, 1, 2, or 3+ Conditions, or “Overall”, regardless of the condition specified ^[3] ESRD Disability	Diabetes Short-term Complications (PQI 01) Perforated Appendix (PQI 02) Diabetes Long-term Complications (PQI 03) COPD or Asthma in Older Adults (PQI 05) Hypertension (PQI 07) Heart Failure (PQI 08) Dehydration (PQI 10) Bacterial Pneumonia (PQI 11) Urinary Tract Infection (PQI 12) Angina Without Procedure (PQI 13) Uncontrolled Diabetes (PQI 14) Lower-Extremity Amputation among Patients with Diabetes (PQI 16) Prevention Quality Overall Composite (PQI 90) Prevention Quality Acute Composite (PQI 91) Prevention Quality Chronic Composite (PQI 92)	Acute Myocardial Infarction Heart Failure	Acute Myocardial Infarction Heart Failure	0, 1, 2, or 3+ Conditions, or “Overall” regardless of the condition specified

Measure	Prevalence Rates and Costs	Hospitalization Rates	AHRQ Prevention Quality Indicators (PQIs)	Readmission Rates	Mortality Rates	Emergency Department Visit Rates
Data	100% Claims (claim types depending on the condition), except for ESRD and disability which depend on the reason for entitlement from the 100% Master Beneficiary Summary File	100% Inpatient Claims	100% Inpatient Claims	100% Inpatient Claims	100% Inpatient Claims	100% Inpatient and Outpatient Claims

[1] Listed in the parentheses following each condition under the hospitalization measure is the agency (Centers for Disease Control and Prevention [CDC] or Chronic Condition Data Warehouse [CCW]) whose methodology was used for determining which of the International Classification of Diseases, 9th edition (ICD-9) diagnosis codes should be used to calculate hospitalization rates for each condition.

[2] Cancer includes: breast cancer, colorectal cancer, prostate cancer, and lung cancer. An individual having two or more cancers from this list only is identified once as having cancer in our methodology.

[3] Identifies the hospitalization rate (i.e., not condition specific) for beneficiaries having 0, 1, 2, or 3 + conditions from the list above. Overall hospitalization rate provides the rate by demographic variables only, regardless of the number of chronic conditions.

3. Methodology

3.1 Prevalence Rates and Total Costs

Prevalence rates are calculated by searching for certain diagnosis codes in Medicare beneficiaries' claims. A beneficiary is considered to have a condition (ischemic heart disease, acute myocardial infarction, atrial fibrillation, heart failure, hypertension, stroke or transient ischemic attack, chronic kidney disease, diabetes, Alzheimer's disease or related disorder, arthritis, asthma, cancer, chronic obstructive pulmonary disease [COPD], depression, hyperlipidemia, obesity, osteoporosis, schizophrenia) if the CMS administrative data has a claim indicating that the beneficiary is diagnosed for a specific condition over the reference time period (one, two, or three years, depending on the condition chosen) or, in the case of ESRD and disability, if the reason for entitlement (original or current) is listed as disabled or ESRD in the MBSF. The prevalence rate of a condition for a specific sub-population (e.g., all beneficiaries in a county) is the proportion of beneficiaries who are found to have the condition. The total costs (i.e., Medicare spending) are annual averages of all costs across all types of claims for beneficiaries with a particular condition (regardless of having or not having other conditions). The principal costs for beneficiaries with a condition are annual averages of all costs across all types of claims with a primary diagnosis associated with that particular condition (regardless of having or not having other conditions). The MMD Tool provides the prevalence rates, total costs, and principal costs for each of the 18 chronic diseases, as well as for beneficiaries with a disability or ESRD (Table 1) by *beneficiary characteristics* (i.e., every combination of state and county of residence, sex, age group, race and ethnicity, and dual eligibility). See Appendix A for more details, including the CCW methodology.

3.2 Hospitalizations

The hospitalization rate is the share of the sub-population that is hospitalized for a specific disease in a given year, presented per 1,000 beneficiaries. The MMD Tool provides the hospitalization rates for 18 chronic diseases as well as for beneficiaries that have a disability or ESRD (Table 1) by *beneficiary characteristics* (i.e., every combination of state and county of residence, sex, age group, race and ethnicity, and dual eligibility). The hospitalization rates for the remaining chronic conditions are based on the diagnosis codes from CCW.

3.3 Preventable Hospitalizations - Agency for Healthcare Research and Quality (AHRQ) Prevention Quality Indicators (PQIs)

Measures of preventable hospitalizations were developed by AHRQ to measure quality of care for “ambulatory care-sensitive conditions,” which are defined as conditions for which outpatient care or early intervention can possibly prevent hospitalization, or more severe diseases^{1,2} These measures are population based and adjusted for age and sex, but are adopted in the analysis for the Medicare FFS population. The MMD Tool includes 15 preventable hospitalizations related to the Medicare FFS population (Table 1) by *beneficiary characteristics* (i.e., every combination of state and county of residence, sex, age group, race and ethnicity, and dual eligibility).³ See Appendix A for more details, including the AHRQ PQI methodology.

3.4 Readmission Rates

To calculate readmission rates, CMS’s risk-standardized 30-day all-cause readmission rate calculation methodology was used (available from QualityNet).⁴ This methodology calls for a risk-standardized readmission rate (RSRR), which is derived from the ratio of the number of “predicted” readmissions to the number of “expected” readmissions at a given hospital, multiplied by the national observed readmission rate. The number of predicted readmissions (the numerator) is estimated using a hierarchical logistic regression model. Using this model, it is possible to estimate how much of the variation in hospital readmission rates can be attributed to individual patients’ risk factors (i.e., sex, race and ethnicity, and age group) and how much of the variation in hospital readmission rates can be attributed to the hospital where the condition was diagnosed. The MMD Tool provides the readmission rates for two cardiovascular diseases—acute myocardial infarction and heart failure (Table 1) by state and county of the hospital, and *beneficiary characteristics* (i.e., every combination of sex, age group, and race and ethnicity).⁵ See Appendix A for more details, including the CMS readmission rate methodology.

¹ Agency for Healthcare Research and Quality (AHRQ). Prevention Quality Indicators Overview. Rockville, MD: AHRQ. Accessed January 2015. http://www.qualityindicators.ahrq.gov/modules/pqi_resources.aspx

² AHRQ. Prevention Quality Indicators. Rockville, MD: AHRQ. July 2010. http://www.qualityindicators.ahrq.gov/Downloads/Modules/PQI/V42/PQI_Brochure_10_update.pdf

³ AHRQ. Prevention Quality Indicators Technical Specifications. Version 4.5 Rockville, MD: AHRQ. May 2013. http://www.qualityindicators.ahrq.gov/Modules/PQI_TechSpec.aspx

⁴ QualityNet. “Measure Methodology Reports. Baltimore, MD: Centers for Medicare & Medicaid Services. Accessed January 2015. <https://www.qualitynet.org/dcs/ContentServer?c=Page&pagename=QnetPublic%2FPage%2FQnetTier3&cid=1219069855273>

⁵ Because the methodology originally calculates hospital-level measures, these estimates are summarized by the county and state of the hospital’s location.

3.5 Mortality Rates

To calculate mortality rates, CMS’s risk-standardized 30-day all-cause mortality rate calculation methodology was used (available from QualityNet).⁶ This methodology calls for a risk-standardized mortality rate (RSMR) which is derived from the ratio of the number of “predicted” deaths to the number of “expected” deaths at a given hospital, multiplied by the national observed mortality rate. The number of predicted deaths (the numerator) is estimated using a hierarchical logistic regression model. Using this model, it is possible to estimate how much of the variation in hospital mortality rates can be attributed to individual patients’ risk factors (i.e., sex, race and ethnicity, age group, and dual eligibility) and how much of the variation in hospital mortality rates can be attributed to the hospital where the condition was diagnosed. The MMD Tool provides the mortality rates for two cardiovascular diseases—acute myocardial infarction and heart failure (Table 1) by state and county of the hospital, and *beneficiary characteristics* (i.e., every combination of sex, age group, and race and ethnicity).⁷ See Appendix A for more details, including the CMS mortality rate methodology.

3.6 Emergency Department Visit Rates

The ED visit rate is the share of the sub-population that is admitted to an emergency department in a given year, presented per 1,000 beneficiaries. This measure is not disease- or condition-specific, and it includes ED visits from both inpatient and outpatient data regardless of whether the beneficiary is admitted to the hospital. The calculations are based on the inpatient and outpatient files. The MMD Tool provides the ED visit rates by *beneficiary characteristics* (i.e., every combination of state and county of residence, sex, age group, race and ethnicity, and dual eligibility). See Appendix A for more details on the methodology based on guidance from the Research Data Assistance Center (ResDAC).⁸

⁶ QualityNet. Measure Methodology Reports. Baltimore, MD: Centers for Medicare & Medicaid Services. Accessed January 2015. <https://www.qualitynet.org/dcs/ContentServer?cid=1163010421830&pagename=QnetPublic%2FPage%2FQnetTier4&c=Page>

⁷ Because the methodology originally calculates hospital-level measures, these estimates are summarized by the county and state of the hospital’s location.

⁸ Research Data Assistance Center (ResDAC). Identifying Dual Eligible Medicare Beneficiaries in the Medicare Beneficiary Enrollment Files. Minneapolis, MN: ResDAC. May 17, 2012. <http://www.resdac.org/resconnect/articles/149>

4. Analysis of Measures by the Number of Chronic Conditions

Based on the chronic conditions investigated in the MMD Tool (a total of 18 conditions), a categorical variable is computed depicting the total number of conditions for each beneficiary: no condition, one condition, two conditions, and three or more conditions. Having a disability or ESRD is excluded from this calculation and analysis. The MMD Tool provides the number of conditions by *beneficiary characteristics* (i.e., every combination of state and county of residence, sex, age group, race and ethnicity, and dual eligibility). Prevalence, hospitalization, and ED rates, as well as total costs can be investigated by these categories. See Appendix A for more details on the methodology used to determine multiple chronic conditions.

5. Age Standardization of Measures

In addition to providing actual rates for each measure, the MMD Tool also allows for the selection of age-adjusted rates. Through selecting this option, the MMD Tool will age-standardize each measure by applying a weight to each age group's rate, based on the national age distribution of the selected measure's Medicare population. This approach allows for the comparison of rates between regions (e.g., state or county) with different age distributions. See Appendix A for more details on the methodology used to age standardize the measures.

6. Spatial Smoothing of Measures

Although smoothed measures are not currently available, the MMD Tool will provide spatially smoothed versions of all of the measures in the near future. Spatial smoothing can help both with reducing the random noise in the data and the amount of suppression by increasing cell sizes. Referred to as *shrinking estimation*, the basic notion is that smoothed estimates for each geographic area “borrow strength” (or precision) from data in other areas, by an amount dependent on the precision of the raw estimate of each area. For example, a prevalence rate in area X is adjusted by combining the prevalence rate in area X and the prevalence rates in the surrounding area. For additional details, please refer to Marshall (1991).⁹

⁹ Marshall, RJ. Mapping disease and mortality rates using empirical Bayes estimators. *Journal of the Royal Statistical Society. Series C (Applied Statistics)*, 1991; 40(2):283-294.

7. Analysis Population

The MMD Tool displays the analysis population used for each measure within *beneficiary characteristics* (i.e., every combination of state and county of residence, sex, age group, race and ethnicity, and, where applicable, dual eligibility) in the following categories:

- 11-499; 500-999; 1,000-4,999; 5,000-9,999; and 10,000+

If the population size for a sub-population, given by a particular combination of beneficiary characteristics, is less than 11, the measure for this sub-population is not presented in the MMD Tool. See next section for more details on suppression.

Because the readmission and mortality rates are based on index admissions instead of the number of beneficiaries, the MMD Tool does not provide the analysis population categories for readmission and mortality rates.

8. Suppression

To maintain beneficiary confidentiality and privacy, the underlying data is not individually identifiable health information in the sense of the Health Insurance Portability and Accountability Act (HIPAA) Privacy Rule. With the exception of mortality and readmission measures, suppression is applied as follows:

- A cell (as denoted by a combination of the demographic variables) must have at least eleven (11) individuals, which is the value of the denominator, otherwise this cell is omitted completely from the MMD Tool.
- Instead of the actual values of the denominator, the following five (5) categories are shown for the denominator: (11 – 499; 500 – 999; 1,000 – 4,999; 5,000 – 9,999; $\geq 10,000$).
- When percentages are reported - any percentage where fewer than three but greater than zero individuals comprise the underlying numerator, the percentage is set to 0 percent. Any corresponding dollar variables are made missing.

9. Utilizing the MMD Tool

The MMD Tool allows users to build queries step-by-step. First, a user must select either a state- or county-level option and second, the measure of interest, followed one of the 18 chronic conditions. Then, following Step 4 below, the user can begin to filter results by beneficiary characteristics or leave one or more of the tabs untouched, which defaults to “All.” Note that when viewing results, the legend will vary depending on the selection of filters chosen. The intrinsically dynamic legend displays relative rankings rather than fixing legend boundaries, and the rankings are re-computed for each set of filters by aggregating the results for a specific query and dividing the data into 10 equal groups (deciles). This is done to account for the variation of data displayed in the map. Here are the basic steps in building a query:

Step 1. Select the year for your query.

- Choose between 2012, 2013, or 2014 in the **Year** tab.

Step 2 Select the focus of your query.

- Choose between the state-level or county-level option in the **Geography** tab.

Step 3. Select the measure.

- Choose between nine measures (prevalence rates, risk-adjusted total costs, total costs, principle costs, PQIs, hospitalizations, readmission rates, mortality rates, ED visit rates) in the **Measure** tab.

Step 4. Select the adjustment method.

- Choose between the adjustment options (actual, age standardized, smoothed, smoothed & standardized) in the **Adjustment** tab.

Step 5. Select the condition.

- Choose one of 18 chronic conditions (ischemic heart disease, acute myocardial infarction, atrial fibrillation, heart failure, hypertension, stroke / transient ischemic attack, chronic kidney disease, diabetes, Alzheimer’s disease or related disorder, arthritis, asthma, cancer, COPD, depression, hyperlipidemia, obesity, osteoporosis, schizophrenia), the reason for entitlement (disabled, ESRD), or multiple chronic conditions (0, 1, 2, 3+) in the **Condition** tab. A user may not select more than one condition for review at a time.

Step 6. Select patient characteristics.

The MMD Tool allows a user to filter by beneficiary characteristic:

- Choose between male and female in the **Sex** tab.
- Choose between four age groups (under 65, 65-74, 75-84, 85 and older) in the **Age** tab.
- Choose between Medicare only and dual eligible in the **Dual Eligibility** tab.
- Choose between seven racial and ethnic groups (All, White, Black, Asian/Pacific Islander, Other, Hispanic, American Indian/Alaska Native) in the **Race and Ethnicity** tab.

Step 7. Select the analysis.

- Choose between four analyses (base measure, within county race and ethnicity differences, difference from state average, difference from national average) in the **Analysis** tab.

Step 8. Select a comparison race and ethnicity.

- If an option other than base measure is chosen in the **Analysis** tab (within county race differences, difference from state average, difference from national average), choose between seven racial and ethnic groups (All, White, Black, Asian/Pacific Islander, Other, Hispanic, Native American/Alaska Native) in the **Comparison Race and Ethnicity** tab. Note that the **Comparison Race and Ethnicity** will not be available for selection if the **Base Measure** of the **Analysis** tab is queried.

This option allows users to examine:

- Disparities (or differences) between racial and ethnic groups within a county
- Disparities (or differences) between racial and ethnic groups in a given county and the national average of a comparison racial and ethnic group
- Disparities (or differences) between racial and ethnic groups in a given county and the state average of a comparison racial and ethnic group

To better understand the significance of the disparities, the MMD Tool provides information on the total population from which the statistics are computed, as well as the statistics themselves. The MMD Tool takes into account user selections, determines the size of the population of interest, and computes the specified rates or values.

Appendix A: Expanded Data and Methodology

A.1 Data

The MMD Tool is based on the 2011 through 2014 CMS administrative claims data for Medicare beneficiaries enrolled in the FFS program, which are available from CMS through the CCW.¹⁰ These claims files are known as CMS RIFs, which consist of:

- 100% Inpatient RIF with claims from inpatient hospital providers
- 100% SNF RIF with claims from SNF providers
- 100% Hospice RIF with claims from hospice providers
- 100% Home Health Agency (HHA) RIF with claims from HHA providers
- 100% Outpatient RIF with claims from institutional providers
- 100% Carrier RIF (also known as the Physician/Supplier Part B File) with claims from non-institutional providers
- 100% DME RIF with claims from DME suppliers

The following beneficiary characteristics from the Master Beneficiary Summary File¹¹ are available to generate stratified analyses:

- State: State of residence of the beneficiary
- County: County of residence of the beneficiary
- Age: Age of the beneficiary at the end of the prior year
- Sex: Sex of the beneficiary
- Dual eligibility: Beneficiaries eligible for both Medicare and Medicaid regardless of the level of assistance from the state¹²
- Race and ethnicity: Race or ethnicity of the beneficiary¹³

¹⁰ See www.cwwdata.org. Data dictionaries for CMS RIFs can be found at www.resdac.org.

¹¹ The data dictionary is available at:

<https://www.cwwdata.org/web/guest/data-dictionaries>

¹² Research Data Assistance Center (ResDAC). Identifying Dual Eligible Medicare Beneficiaries in the Medicare Beneficiary Enrollment Files. Minneapolis, MN: ResDAC. May 17, 2012.. <http://www.resdac.org/resconnect/articles/149>

¹³ Specifically, this is the RTI_RACE_CD variable in the MBSF. A Medicare beneficiary's race and ethnicity is based on the variable imputed race definition created by the Research Triangle Institute (RTI). RTI's race definition improves on the Social Security Administration classification of a beneficiary's race and ethnicity which is designated at birth. The RTI race variable imputes race for Hispanic and Asian/Pacific Islander classifications based on Census surname lists for Hispanic and Asian/Pacific Islander origin, as well as geography. The race and ethnicity classifications are: Non-Hispanic White, Black or African American, Asian/Pacific Islander, Hispanic, and American Indian/Alaska Native.

A.2 Expanded Methodology

A.2.1 Prevalence Rates and Total Costs

The chronic conditions are identified using the Internal Classification of Diseases, 9th edition, (ICD-9) diagnosis codes that are present in the Medicare administrative claims.¹⁴ A beneficiary is considered to have a chronic condition if there exists a claim indicating that he/she is receiving a service or treatment related to the specific condition.

The analysis population for calculating the prevalence rates and total costs for chronic conditions is 100 percent of Medicare beneficiaries continuously enrolled in Medicare FFS Parts A and B for the selected year (i.e., 2012, 2013, 2014), as is the analysis population for calculating the total costs for beneficiaries who have a disability or ESRD. Additionally, beneficiaries who died during the year but otherwise were continuously enrolled up until the date of death, as well as beneficiaries who became eligible for enrollment following the first of the year but were continuously enrolled from that date to the end of the year, are included in the analysis population. Excluded from the analysis are beneficiaries who were enrolled at any point during the year in a Medicare Advantage (MA) plan. Table A.1 presents how the population used to calculate the measures in this measure are derived at the national level for the years 2012, 2013, and 2014.

Table A.1. Deriving Analysis Population for Prevalence Rates of Chronic Conditions and Total Costs of Chronic Conditions and End Stage Renal Disease and Disability

Steps to Create the Analysis Population	Formula	Number of Beneficiaries		
		2012	2013	2014
Total Medicare Enrollees ¹⁵		53,597,183	55,277,442	56,861,574
Exclude Beneficiaries without Continuous Enrollment in Part A & B throughout Year	(-)	5,008,773	5,168,747	5,294,038
Exclude Beneficiaries with Enrollment in Medicare Advantage	(-)	14,521,816	15,865,941	17,519,876
Total Medicare Beneficiaries Included in Analysis	=	34,066,594	34,242,754	34,047,660

However, the MMD Tool will display the number of Medicare beneficiaries by *beneficiary characteristics* (i.e., every combination of state and county of residence, sex, age group, and race and ethnicity) using 100 percent of Medicare beneficiaries continuously enrolled in Medicare FFS Parts A and B for the selected year.

¹⁴ ICD-9 diagnosis codes are a set of codes used by physicians, hospitals, and allied health workers to indicate diagnosis for all patient encounters in order to improve statistical tracking of diseases.

¹⁵ This count excludes beneficiaries with duplicate records in a year, as well as those with null or zero identifiers.

Unlike the methodology used to calculate prevalence rates for chronic conditions, the prevalence rates of beneficiaries who have a disability or ESRD are identified using the reason for entitlement (original or current) found in the MBSF. A beneficiary is considered to have a disability or ESRD if either the original or current reason for entitlement includes disability or ESRD.

The analysis population for calculating the prevalence rates of ESRD and disability is the 100 percent of Medicare beneficiaries continuously enrolled in Medicare FFS for the selected year (i.e., 2012, 2013, 2014). Additionally, beneficiaries who died during the year but otherwise were continuously enrolled up until the date of death, as well as beneficiaries who became eligible for enrollment following the first of the year but were continuously enrolled from that date to the end of the year, are included in this analysis population. Excluded from the analysis are beneficiaries who were enrolled at any point during the year in an MA plan. Table A.2 presents how the population used to calculate prevalence rates for ESRD and disability are derived at the national level for the years 2012, 2013, and 2014.

Table A.2. Deriving Analysis Population for Prevalence Rates of End Stage Renal Disease and Disability

Steps to Create the Analysis Population	Formula	Number of Beneficiaries		
		2012	2013	2014
Total Medicare Enrollees ¹⁶		53,597,183	55,277,442	56,861,574
Exclude Beneficiaries without Continuous Enrollment throughout Year	(-)	50,259	58,035	59,949
Exclude Beneficiaries with Enrollment in Medicare Advantage	(-)	14,742,588	16,113,498	17,777,683
Total Medicare Beneficiaries Included in Analysis	=	38,804,336	39,105,909	39,023,942

¹⁶ This count excludes beneficiaries with duplicate records in 2012, as well as those with null or zero identifiers.

A.2.2 Hospitalization Rates

The hospitalization rate is calculated using the principal diagnosis codes that are present in the Medicare administrative claims, or, in the case of beneficiaries who have a disability or ESRD, using the overall number of hospitalizations for Medicare beneficiaries with a reason for entitlement (original or current) listed as disabled or ESRD in the MBSF. The analysis population includes 100 percent of Medicare beneficiaries continuously enrolled in Medicare FFS Parts A for the selected year (i.e., 2012, 2013, 2014). These beneficiaries are at least 18 years old and are enrolled in Medicare Part A. Additionally, beneficiaries who died during the year but otherwise were continuously enrolled up until the date of death, as well as beneficiaries who became eligible for enrollment following the first of the year but were continuously enrolled from that date to the end of the year, are included in the analysis population. Excluded from the analysis are beneficiaries who were enrolled at any point during the year in an MA plan. Table A.3 presents how the population used to calculate the measures in this measure are derived at the national level for the years 2012, 2013, and 2014.

Table A.3. Deriving Analysis Population for Hospitalizations Measure

Steps to Create the Analysis Population	Formula	Number of Beneficiaries		
		2012	2013	2014
Total Medicare Enrollees ¹⁷		53,597,183	55,277,442	56,861,574
Exclude Beneficiaries without Continuous Enrollment in Part A throughout Year	(-)	448,203	457,644	462,616
Exclude Beneficiaries with Enrollment in Medicare Advantage	(-)	14,711,773	16,079,660	17,742,150
Total Medicare Beneficiaries Included in Analysis	=	38,437,207	38,740,138	38,656,808

¹⁷ This count excludes beneficiaries with duplicate records in a year, as well as those with null or zero identifiers.

Table A.4. Centers for Disease Control and Prevention and Chronic Conditions Data Warehouse Specifications

Hospitalization Measures ^[1]		Prevalence Rates and Total Cost Measures ^[2]			
Disease Category	ICD-9 Diagnosis Code	Disease Category	ICD-9 Diagnosis Code	Reference Time Period	Claim Types Used
Ischemic Heart Disease	410-414, 429.2 [Principal Diagnosis]	Ischemic Heart Disease	410-414 [Any Diagnosis]	2	IP, SNF, HHA, HOP, Carrier
Acute Myocardial Infarction	410 [Principal Diagnosis]	Acute Myocardial Infarction	410 [Principal and Second Diagnosis]	1	IP
Cardiac Dysrhythmia	427 [Principal Diagnosis]	Atrial Fibrillation	427.31 [Principal and Second Diagnosis]	1	IP, HOP, Carrier
Heart Failure	428 [Principal Diagnosis]	Heart Failure	398.91, 402.01, 402.11, 402.91, 404.01, 404.11, 404.91, 404.03, 404.13, 404.93, 428 [Any Diagnosis]	2	IP, HOP, Carrier
Hypertension	401-405 [Principal Diagnosis]	Hypertension	326.11, 401-405, 437.2 [Any Diagnosis]	1	IP, SNF, HHA, HOP, Carrier
Stroke	430-434, 436-438 [Principal Diagnosis]	Stroke / Transient Ischemic Attack	430, 431, 433-436, 997.02 [Any Diagnosis]	1	IP, HOP, Carrier

HHA: Home Health Agency; HOP: Hospice; IP: Inpatient; SNF: Skilled Nursing Facility

[1] Centers for Disease Control and Prevention (CDC). Condition Categories. Division for Heart Disease and Stroke Prevention: Interactive Atlas. Washington, DC: CDC; 2015.

<http://nccd.cdc.gov/dhdspatlas/help.aspx#icdCodes>

[2] Chronic Conditions Data Warehouse.. Condition Categories. Baltimore, MD: Centers for Medicare & Medicaid Services; 2015.

<https://www.ccwdata.org/web/guest/condition-categories>

The hospitalization rates for cardiovascular diseases are calculated using the Center for Disease Control and Prevention (CDC) methodology to provide trend analysis using CDC's Interactive Atlas of Heart Disease and Stroke.¹⁸ Table A.4 provides a side-by-side comparison of the CDC and CCW methodologies for cardiovascular diseases. The hospitalization rates for the remaining chronic conditions are based on the diagnosis codes from the CCW.

A.2.3 Preventable Hospitalizations - AHRQ PQIs

The preventable hospitalization rate is calculated using the PQIs from the AHRQ.¹⁹ PQIs are population based and adjusted for age and sex. They are adopted for Medicare FFS beneficiaries by using the Medicare population instead of the entire population. The 15 preventable hospitalizations included in the MMD Tool are: Diabetes Short-term Complications Admission Rate (PQI 01), Perforated Appendix Admission Rate (PQI 02), Diabetes Long-term Complications Admission Rate (PQI 03), Chronic Obstructive Pulmonary Disease (COPD) or Asthma in Older Adults Admission Rate (PQI 05), Hypertension Admission Rate (PQI 07), Heart Failure Admission Rate (PQI 08), Dehydration Admission Rate (PQI 10), Bacterial Pneumonia Admission Rate (PQI 11), Urinary Tract Infection Admission Rate (PQI 12), Angina without Procedure (PQI 13), Uncontrolled Diabetes Admission Rate (PQI 14), Lower-Extremity Amputation among Patients with Diabetes Rate (PQI 16), Prevention Quality Overall Composite (PQI 90), Prevention Quality Acute Composite (PQI 91), Prevention Quality Chronic Composite (PQI 92). Technical details for each of the 15 preventable hospitalizations included in the MMD Tool can be found on the AHRQ's website.²⁰ AHRQ's QI SAS 9.3 software was used for the computations.²¹

The analysis population includes 100 percent of Medicare beneficiaries continuously enrolled in Medicare FFS Parts A for the selected year (i.e., 2012, 2013, 2014). These beneficiaries are 18 years old or older and are enrolled in Medicare Part A. Additionally, beneficiaries who died during the year, but otherwise were continuously enrolled up until the date of death, as well as beneficiaries who became eligible for enrollment following the first of the year, but were continuously enrolled from that date to the end of the year, are included in the analysis population. Excluded from the analysis are beneficiaries who were enrolled at any point during the year in an MA plan. Table A.5 presents how the population used to calculate the measures in this measure are derived at the national level for the years 2012, 2013, and 2014.

¹⁸ Hospitalization rates for past years can be viewed at: <http://nccd.cdc.gov/DHDSPAtlas/viewer.aspx>

¹⁹ Agency for Healthcare Research and Quality (AHRQ). Prevention Quality Indicators Overview. Rockville, MD: AHRQ. Accessed January 2015. http://www.qualityindicators.ahrq.gov/modules/pqi_resources.aspx

²⁰ AHRQ. Prevention Quality Indicators Technical Specifications Version 4.5. Rockville, MD: AHRQ. May 2013. http://www.qualityindicators.ahrq.gov/Modules/PQI_TechSpec.aspx

²¹ AHRQ. AHRQ Quality Indicators Software. Rockville, MD: AHRQ. May 2013. <http://www.qualityindicators.ahrq.gov/Software/Default.aspx>

Table A.5. Deriving Analysis Population for Prevention Quality Indicator Measure

Steps to Create the Analysis Population	Formula	Number of Beneficiaries		
		2012	2013	2014
Total Medicare Enrollees ²²		53,597,183	55,277,442	56,861,574
Exclude Beneficiaries without Continuous Enrollment in Part A throughout Year	(-)	448,203	457,644	462,616
Exclude Beneficiaries with Enrollment in Medicare Advantage	(-)	14,711,773	16,079,660	17,742,150
Total Medicare Beneficiaries Included in Analysis	=	38,437,207	38,740,138	38,656,808

A.2.4 Readmission Rates

The readmission rate among beneficiaries with an inpatient claim and a principle diagnosis code of acute myocardial infarction (AMI), or heart failure (HF) is calculated using CMS’s risk-standardized readmission measures methodology.²³

The analysis population includes 100 percent of Medicare beneficiaries continuously enrolled in Medicare FFS Parts A for the selected year (i.e., 2012, 2013, 2014). These beneficiaries are 18 years old or older and are enrolled in Medicare Part A. Additionally, beneficiaries who died during the year but otherwise were continuously enrolled up until the date of death, as well as beneficiaries who became eligible for enrollment following the first of the year but were continuously enrolled from that date to the end of the year, are included in the analysis population. Excluded from the analysis are beneficiaries who were enrolled at any point during the year in an MA plan.

The CMS’s risk-standardized readmission rate methodology calls for an RSRR, which is derived from the ratio of the number of “predicted” readmissions to the number of “expected” readmissions at a given hospital, multiplied by the national observed readmission rate. Specifically, for each hospital, the numerator of the ratio is the number of readmissions within 30 days predicted on the basis of the hospital’s performance with its observed case mix (AMI, HF), and the denominator is the number of readmissions expected on the basis of the nation’s performance with that hospital’s case mix. The number of predicted readmissions (the numerator) is estimated using a hierarchical logistic regression model. The predicted number of readmissions is calculated by regressing risk factors (for AMI and HF, respectively) and the hospital-specific intercept on the risk of readmission. The estimated regression coefficients are then multiplied by the patient’s *beneficiary characteristics* in the hospital. The results are then transformed and summed over all patients attributed to the hospital to get a value. The expected

²² This count excludes beneficiaries with duplicate records in a year, as well as those with null or zero identifiers.

²³ QualityNet. Measure Methodology Reports: Readmission Measures. Baltimore, MD: Centers for Medicare & Medicaid Services. Accessed January 2015. <https://www.qualitynet.org/dcs/ContentServer?cid=1219069855841&pagename=QnetPublic%2FPage%2FQnetTier4&c=Page>

number of readmissions (the denominator) is obtained by regressing the risk factors and a common intercept on the readmission outcome using all hospitals in our sample. The estimated regression coefficients are then multiplied by the patient characteristics in the hospital. The results are then transformed and summed over all patients in the hospital. To assess hospital performance for the analysis period, we then re-estimated the model coefficients using the years of data in that period. This ratio is multiplied by the national rate to calculate the RSRR.²⁴ These hospital-level rates are then aggregated for each set of beneficiary characteristics for the MMD Tool.

A.2.5 Mortality Rates

The mortality rate among beneficiaries with an inpatient claim and a principle diagnosis code of AMI or HF is calculated using CMS's risk-standardized mortality measures methodology.²⁵

The analysis population includes 100 percent of Medicare beneficiaries continuously enrolled in Medicare FFS Parts A for the selected year (i.e., 2012, 2013, 2014). These beneficiaries are 18 years old or older, and are enrolled in Medicare Part A. Additionally, beneficiaries who died during the year but otherwise were continuously enrolled up until the date of death, as well as beneficiaries who became eligible for enrollment following the first of the year but were continuously enrolled from that date to the end of the year, are included in the analysis population. Excluded from the analysis are beneficiaries who were enrolled at any point during the year in an MA plan.

The CMS's risk-standardized mortality rate methodology calls for an RSMR, which is derived from the ratio of the number of "predicted" deaths to the number of "expected" deaths at a given hospital, multiplied by the national observed mortality rate. Specifically, for each hospital, the numerator of the ratio is the number of deaths within 30 days predicted on the basis of the hospital's performance with its observed case mix (AMI, HF), and the denominator is the number of deaths expected on the basis of the nation's performance with that hospital's case mix. The number of predicted deaths (the numerator) is estimated using a hierarchical logistic regression model. The predicted number of deaths is calculated by regressing risk factors (for AMI and HF, respectively) and the hospital-specific intercept on the risk of mortality. The estimated regression coefficients are then multiplied by the patient's *beneficiary characteristics* in the hospital. The results are then transformed and summed over all patients attributed to the hospital to get a value. The expected number of deaths (the denominator) is obtained by regressing the risk factors and a common intercept on the mortality outcome using all hospitals

²⁴ 2015 Condition-Specific Measures Updates and Specifications Report: Hospital-Level 30-Day Risk-Standardized Readmissions Measures (Version 8.0).

²⁵ QualityNet. Methodology and Updates Reports: Mortality Measures. Baltimore, MD: Centers for Medicare & Medicaid Services. Accessed January 2015. <https://www.qualitynet.org/dcs/ContentServer?cid=1163010421830&pagename=QnetPublic%2FPPage%2FQnetTier4&c=Page>

in our sample. The estimated regression coefficients are then multiplied by the patient characteristics in the hospital. The results are then transformed and summed over all patients in the hospital. To assess hospital performance for the analysis period, we then re-estimated the model coefficients using the years of data in that period. This ratio is multiplied by the national rate to calculate the RSMR.²⁶ These hospital-level rates are then aggregated for each set of beneficiary characteristics for the MMD Tool.

A.2.6 Emergency Department Visit Rate

The ED visit rate is calculated using the revenue center codes that are present in the Medicare inpatient and outpatient files. This measure is not disease or condition specific. The total number of ED visits a beneficiary had in a year included visits where the beneficiary was released from the outpatient setting and where the beneficiary was admitted to an inpatient setting. The analysis population includes 100 percent of Medicare beneficiaries continuously enrolled in Medicare FFS Parts A and B for the selected year (i.e., 2012, 2013, 2014). Additionally, beneficiaries who died during the year but otherwise were continuously enrolled up until the date of death, as well as beneficiaries who became eligible for enrollment following the first of the year but were continuously enrolled from that date to the end of the year, are included in the analysis population. Excluded from the analysis are beneficiaries who were enrolled at any point during the year in an MA plan. Table A.6 presents how the population used to calculate the measures in this measure are derived at the national level for the years 2012, 2013, and 2014.

Table A.6. Deriving Analysis Population for Emergency Department Visit Measure

Steps to Create the Analysis Population	Formula	Number of Beneficiaries		
		2012	2013	2014
Total Medicare Enrollees ²⁷		53,597,183	55,277,442	56,861,574
Exclude Beneficiaries without Continuous Enrollment in Part A & B throughout Year	(-)	5,008,773	5,168,747	5,294,038
Exclude Beneficiaries with Enrollment in Medicare Advantage	(-)	14,521,816	15,865,941	17,519,876
Total Medicare Beneficiaries Included in Analysis	=	34,066,594	34,242,754	34,047,660

ED rates are calculated using guidance provided by the ResDAC.²⁸ Table A.7 provides the list of revenue center codes needed to determine a visit to the ED.

²⁶ 2013 Measures Updates and Specifications: Acute Myocardial Infarction, Heart Failure, and Pneumonia 30-Day Risk-Standardized Mortality Measure (Version 7.0).

²⁷ This count excludes beneficiaries with duplicate records in 2012, as well as those with null or zero identifiers.

²⁸ Research Data Assistance Center (ResDAC). How to Identify Hospital Claims for Emergency Room Visits in the Medicare Claims Data. Minneapolis, MN: ResDAC. July 22, 2015. <http://www.resdac.org/resconnect/articles/144>

Table A.7. Emergency Department Visit Specifications

Measure	Revenue Center Code	Reference Time Period	Claim Types Used
Emergency Department Visit	0450-0459, 0981 [Any Diagnosis]	1	Inpatient, Outpatient

A.2.7. Analysis of Measures by the Number of Chronic Conditions

The chronic condition indicators are identified using the ICD-9 diagnosis codes that are present in the Medicare administrative claims. Based on only the chronic conditions investigated in the MMD Tool (a total of 18 conditions), a categorical variable is computed depicting the total number of conditions for each beneficiary: No condition, one condition, two conditions, and three or more conditions. Having a disability or ESRD is excluded from this calculation and analysis. Additionally, for the purposes of this analysis, a beneficiary having multiple forms of cancer (breast, colorectal, prostate, and lung) would only appear as having one chronic condition in the MMD Tool.

A.2.8 Age Standardization of Measures

In addition to providing un-adjusted rates for each measure, the MMD Tool also allows for the selection of age-adjusted rates. If the age standardized option is selected, the MMD Tool will apply a weight to each age group’s rate based on the national age group distribution of the selected measure’s Medicare population.

For example, to age standardize rates in the prevalence measure, the weights listed in Table A.8 are applied to each age group’s rate. These weights are calculated based on the national age group distribution of the analysis population used in the prevalence measure: 100 percent of Medicare beneficiaries continuously enrolled in Medicare FFS Parts A and B for the selected year. There are slight differences in weighting depending on the years and measures selected.

Table A.8. 2012 Age Weights for Prevalence Measure

Age Group	Number of Beneficiaries	Weight
< 65	6,174,269	0.1822
65 - 74	14,215,633	0.4194
75 - 84	8,871,580	0.2617
85 +	4,633,722	0.1367
Overall	33,895,204	1.0000

However, in instances where a region (e.g., state or county) has zero beneficiaries in one or more of the age groups (i.e., under 65, 65-74, 75-84, 85 and older), the weights for each of the region's remaining age groups are recalculated by equally distributing the missing age group's shares to the remaining age groups.

Applying weights based on the national age group distribution of the selected measures' Medicare population allows for the comparison of rates between regions (e.g., state or county) with different age distributions.

Glossary

Admission from another hospital indicates the patient was admitted to this hospital from another short-term, acute-care hospital. This usually signifies that the patient required the transfer in order to obtain more specialized services than the originating hospital could provide. Not available for 2007 and after.

Age group in years, calculated on the basis of the age of the beneficiary at the end of the prior year.

Associated principal diagnoses refers to principal diagnoses that appear with the procedure you have chosen; for example, “For what conditions do patients receive total hip replacement?”

Diagnosis indicates a specific condition or disease affecting hospitalized patients.

Died generally indicates in-hospital mortality.

Disabled refers to patients with this reason for Medicare entitlement (original or current) listed as either disabled or ESRD/disabled in the RIF MBSF.

Dual eligible includes patients who are covered by both Medicare and Medicaid.

Emergency department visit rates are the share of the sub-population that is admitted to the ED, presented per 1,000 beneficiaries.

End stage renal disease refers to patients with this reason for Medicare entitlement (original or current) listed as either ESRD or ESRD/disabled in the RIF MBSF.

ICD-9-CM stands for the “International Classification of Diseases, 9th revision, Clinical Modification.” All diagnoses (or conditions) and all procedures that patients receive in the hospital are assigned an ICD-9-CM code. Codes for diagnoses can be up to five digits long, and codes for procedures can be up to four digits long. There are about 12,000 diagnosis codes and about 3,500 procedure codes. Each hospital stay can have multiple diagnoses and multiple procedures.

Geographical lines were derived using the five-digit Federal Information Processing Standard (FIPS) code, which uniquely identifies counties and county equivalents in the United States, certain U.S. possessions, and certain freely associated states.

Hospitalization rates are the share of the sub-population that is hospitalized for a specific disease in a given year, presented per 1,000 beneficiaries.

Medicare includes FFS and managed care Medicare patients.

Medicaid includes FFS and managed care Medicaid patients.

Prevalence rates are the share of the sub-population that is found to have a specific disease in a given year.

Principal costs are the costs associated with the principal diagnosis.

Principal diagnosis is the condition established after analysis to be chiefly responsible for occasioning the admission of the patient to the hospital for care. The principal diagnosis is always the reason for admission (definition according to the Uniform Bill (UB-92)).

Prevention Quality Indicators are measures that can be used with hospital inpatient discharge data to identify “ambulatory care sensitive conditions.” These are conditions for which good outpatient care can potentially prevent the need for hospitalization or for which early intervention can prevent complications or more severe disease.

Total cost is the sum of all costs associated with all diagnosis codes.

Urban/rural indicators – The ability to distinguish between urban and rural counties has been incorporated into the MMD Tool, classifying each county using data from the National Bureau of Economic Research.²⁹ According to this classification, the U.S. Office of Management and Budget designates counties as *metropolitan* (a core urban area of 50,000 or more population), *micropolitan* (an urban core of at least 10,000 but less than 50,000 population), or neither.³⁰ The MMD Tool presents the *metropolitan* and *micropolitan* areas, known as core based statistical areas (CBSAs) as “urban,” and all other areas (i.e., counties that are not part of a CBSA) as “rural.”

²⁹ National Bureau of Economic Research (NBER). SSA to FIPS CBSA and MSA County Crosswalk. Cambridge, MA: NBER. Accessed January 2015.

<http://www.nber.org/data/cbsa-msa-fips-ssa-county-crosswalk.html>

³⁰ U.S. Census Bureau. Geographic Terms and Concepts. Washington, DC: Census Bureau. Accessed January 2015.

https://www.census.gov/geo/reference/gtc/gtc_cbsa.html