

Measure Information Form

Project Title:

Standardized Mortality Ratio (SMR)

Project Overview:

The Centers for Medicare & Medicaid Services (CMS) has contracted with the University of Michigan Kidney Epidemiology and Cost Center (UM-KECC) develop measures of mortality in ESRD patients. The contract name is ESRD Quality Measure Development, Maintenance, and Support. The contract number is HHSM-500-2013-13017I.

Date:

Information included is current on January 29, 2015

Measure Name

Descriptive Information

Measure Name (Measure Title De.2.)

Dialysis Facility Standardized Mortality Ratio (SMR)

Measure Type De.1.

Outcome

Brief Description of Measure De.3.

Standardized mortality ratio for dialysis facility patients. This measure is calculated as a ratio but can also be expressed as a rate.

If Paired or Grouped De.4.

N/A

Subject/Topic Areas De.5.

Renal: Renal, Renal: End State Renal Disease

Crosscutting Areas De 6.

N/A

Measure Specifications

Measure-specific Web Page S.1.

N/A

If This Is an eMeasure S.2a.

N/A

Data Dictionary, Code Table, or Value Sets S.2b.

Available in Appendix A.

For Endorsement Maintenance S.3.

This form is being used for endorsement maintenance. Updates include:

- The model now adjusts for each incident comorbidity separately rather than using a comorbidity index.
- We have also modified the indicators for diabetes by consolidating the individual indicators.
- We have included adjustments for 210 prevalent comorbidities (identified through Medicare claims)
- The measure is now limited to Medicare patients

Numerator Statement S.4.

Number of deaths among eligible patients at the facility during the time period.

Time Period for Data S.5.

At least one year.

Numerator Details S.6.

Information on death is obtained from several sources which include the CMS ESRD Program Medical Management Information System, the Death Notification Form (CMS Form 2746), and the Social Security Death Master File. The number of deaths that occurred among eligible dialysis patients during the time period is calculated. This count includes only Medicare patients, as detailed below. It does not include deaths from street drugs or accidents unrelated to treatment: Deaths from these causes varied by facility, with certain facilities (in particular, urban facilities that treated large numbers of male and young patients) reporting large numbers of deaths from these causes and others reporting extremely low numbers (Turenne, 1996). Since these deaths are unlikely to have been due to treatment facility characteristics, they are excluded from the calculations.

Denominator Statement S.7.

Number of deaths that would be expected among eligible dialysis patients at the facility during the time period, given the national average mortality rate and the patient mix at the facility.

Target Population Category S.8.

Populations at Risk : Populations at Risk

Denominator Details S.9.

UM-KECC's treatment history file provides a complete history of the status, location, and dialysis treatment modality of an ESRD patient from the date of the first ESRD service until the patient dies or the data collection cutoff date is reached. For each patient, a new record is created each time he/she changes facility or treatment modality. Each record represents a time period associated with a specific modality and dialysis facility. SIMS/CROWNWeb is the primary basis for placing patients at dialysis facilities and dialysis claims are used as an additional source. Information regarding first ESRD service date, death and transplant is obtained from additional sources including the CMS Medical Evidence Form (Form CMS-2728), transplant data from the Organ Procurement and Transplant Network (OPTN), the Death Notification Form (Form CMS-2746) and the Social Security Death Master File.

The denominator for SMR for a facility is the total number of expected deaths identified using all patient-records at the facility meeting inclusion criteria. The number of days at risk in each of these patient-records is used to calculate the expected number of deaths for that patient-record.

The denominator is based on expected mortality calculated from a Cox model (Cox, 1972; SAS Institute Inc., 2004; Kalbfleisch and Prentice, 2002; Collett, 1994). The model used is fit in two stages. The stage 1 model is a Cox model stratified by facility and adjusted for patient age, race, ethnicity, sex, diabetes, duration of ESRD, nursing home status, patient comorbidities, calendar year, and body mass index (BMI) at incidence. This model allows the baseline survival probabilities to vary between strata (facilities), and assumes that the regression coefficients are the same across

all strata. Stratification by facility at this stage avoids biases in estimating regression coefficients that can occur if the covariate distributions vary substantially across centers. The results of this analysis are estimates of the regression coefficients in the Cox model and these provide an estimate of the relative risk for each patient. This is based on a linear predictor that arises from the Cox model, and is then used as an offset in the stage 2 model, which is unstratified and includes an adjustment for the race-specific age-adjusted state population death rates.

Assignment of Patients to Facilities

We detail patient inclusion criteria, facility assignment and how to count days at risk, all of which are required for the risk adjustment model. As patients can receive dialysis treatment at more than one facility in a given year, we assign each patient day to a facility (or no facility, in some cases) based on a set of conventions below.

General Inclusion Criteria for Dialysis Patients

Since a patient's follow-up in the database can be incomplete during the first 90 days of ESRD therapy, we only include a patient's follow-up into the tabulations after that patient has received chronic renal replacement therapy for at least 90 days. Thus, hospitalizations, mortality and survival during the first 90 days of ESRD do not enter into the calculations. This minimum 90-day period also assures that most patients are eligible for Medicare, either as their primary or secondary insurer. It also excludes from analysis patients who die or recover renal function during the first 90 days of ESRD.

In order to exclude patients who only received temporary dialysis therapy, we assign patients to a facility only after they have been on dialysis there for the past 60 days. This 60 day period is used both for patients who started ESRD for the first time and for those who returned to dialysis after a transplant. That is, deaths and survival during the first 60 days of dialysis at a facility do not affect the SMR of that facility.

Identifying Facility Treatment Histories for Each Patient

For each patient, we identify the dialysis provider at each point in time. Starting with day 91 after onset of ESRD, we attribute patients to facilities according to the following rules. A patient is attributed to a facility once the patient has been treated there for the past 60 days. When a patient transfers from one facility to another, the patient continues to be attributed to the original facility for 60 days and then is attributed to the destination facility from day 61. In particular, a patient is attributed to their current facility on day 91 of ESRD if that facility had treated him or her for the past 60 days. If on day 91, the facility had not treated a patient for the past 60 days, we wait until the patient reaches day 60 of continuous treatment at that facility before attributing the patient to that facility. When a patient is not treated in a single facility for a span of 60 days (for instance, if there were two switches within 60 days of each other), we do not attribute that patient to any facility. Patients were removed from a facility's analysis upon receiving a transplant. Patients who withdrew from dialysis or recovered renal function remain assigned to their treatment facility for 60 days after withdrawal or recovery.

If a period of one year passes with neither paid dialysis claims nor SIMS information to indicate that a patient was receiving dialysis treatment, we consider the patient lost to follow-up and do not include that patient in the analysis. If dialysis claims or other evidence of dialysis reappears, the patient is entered into analysis after 60 days of continuous therapy at a single facility.

Days at Risk for Each Patient-Record

After patient treatment histories are defined as described above, periods of follow-up time (or patient-records) are created for each patient. A patient-record begins each time the patient is determined to be at a different facility or at the start of each calendar year. The number of days at risk starts over at zero for each patient record so that the number of days at risk for any patient-record is always a number between 0 and 365 (or 366 for leap years). Therefore, a patient who is in one facility for all four years gives rise to four patient-records and is analyzed the same way as would be four separate patients in that facility for one year each. When patients are treated at the same facility for two or more separate time periods during a year, the days at risk at the facility is the sum of all time spent at the facility for the year so that a given patient can generate only one patient-record per year at a given facility. For example, consider a patient who spends two periods of 100 days assigned to a facility, but is assigned to a different facility for the 165 days between these two 100-day periods. This patient will give rise to one patient-record of 200 days at risk at the first facility, and a separate patient-record of 165 days at risk at the second facility.

Then we use the number of days at risk in each of these patient-records to calculate the expected number of deaths for that patient-record, and sum the total number of expected deaths during all patient-records at the facility as the expected number of death for that facility. Detailed methodology is described in Statistical Risk Model and Variables S.14.

Denominator Exclusions (NQF Includes “Exceptions” in the “Exclusion” Field) S.10.

N/A

Denominator Exclusion Details (NQF Includes “Exceptions” in the “Exclusion” Field) S.11.

N/A

Stratification Details/Variables S.12.

N/A

Risk Adjustment Type S.13.

Statistical risk model

Statistical Risk Model and Variables S.14.

The SMR is based on expected mortality calculated from a Cox model (Cox, 1972; SAS Institute Inc., 2004; Kalbfleisch and Prentice, 2002; Collett, 1994). The model used is fit in two stages. The stage 1 model is a Cox model stratified by facility and adjusted for patient age, race, ethnicity, sex, diabetes as cause of ESRD, duration of ESRD, nursing home status from previous year, patient comorbidities at incidence, prevalent comorbidities, calendar year and body mass index (BMI) at incidence. This model allows the baseline survival probabilities to vary between strata (facilities), and assumes that the regression coefficients are the same across all strata. Stratification by facility at this stage avoids biases in estimating regression coefficients that can occur if the covariate distributions vary substantially across centers.

The patient characteristics included in the stage 1 model as covariates are:

- Age: We determine each patient’s age for the birth date provided in the SIMS and REMIS databases. Age is included as a piecewise continuous variable with different coefficients based on whether the patient is 0-13 years old, 14-60 years old, or 61+ years old.

- Sex: We determine each patient's sex from his/her Medical Evidence Form (CMS-2728).
- Race (White, Black, Asian/PI, Native American or other): We determine race from REBUS/PMMIS, the EDB (Enrollment Data Base), and SIMS.
- Ethnicity (Hispanic, non-Hispanic or unknown): We determine ethnicity from his/her CMS-2728.
- Diabetes as cause of ESRD: We determine each patient's primary cause of ESRD from his/her CMS-2728.
- Duration of ESRD: We determine each patient's length of time on dialysis using the first service date from his/her CMS-2728, claims history (all claim types), the SIMS database and the SRTR database and categorize as less than one year, 1-2 years, 2-3 years, or 3+ years as of the period start date.
- Nursing home status in previous year: Using the Nursing Home Minimum Dataset, we determine if a patient was in a nursing home the previous year.
- BMI at incidence: We calculate each patient's BMI as the height and weight provided on his/her CMS 2728. BMI is included as a log-linear term. The logarithm of BMI is included as a piecewise continuous log-linear term with different coefficients based on whether the log of BMI is greater or less than 3.5.
- Comorbidities at incidence: We determine each patient's comorbidities at incidence from his/her CMS-2728 namely, alcohol dependence, atherosclerotic heart disease, cerebrovascular disease, chronic obstructive pulmonary disease, congestive heart failure, diabetes (includes currently on insulin, on oral medications, without medications, and diabetic retinopathy), drug dependence, inability to ambulate, inability to transfer, malignant neoplasm, cancer, other cardiac disease, peripheral vascular disease, and tobacco use (current smoker). Each comorbidity is included as a separate indicator in the model, having a value of 1 if the patient has that comorbidity, and a value of 0 otherwise. Another categorical indicator variable is included as a covariate in the stage 1 model to flag records where patients have at least one comorbidities. This variable has a value of 1 if the patient has at least one comorbidity and a value of 0 otherwise.
- Prevalent comorbidities: We identify a patient's prevalent comorbidities based on claims from the previous calendar year. The comorbidities adjusted for include those included in Appendix A.
- Calendar year: 2010-2013
- Missing indicator variables: Categorical indicator variables are included as covariates in the stage I model to account for records with missing values for cause of ESRD, comorbidity at incidence(missing CMS-2728 form), and BMI. These variables have a value of 1 if the patient is missing the corresponding variable and a value of 0 otherwise. BMI is imputed when either missing, or outside the range of [10,70) for adults or [5,70) for children. To impute BMI, we used the average values of the group of patients with similar characteristics (age, race, sex, diabetes) when data for all four of these characteristics were available. If either race or diabetes was also missing, the imputation was based on age and sex only. If either age or sex is missing, the patient is excluded from computations.

Beside main effects, two-way interaction terms between age, race, ethnicity, sex duration of ESRD and diabetes as cause of ESRD are also included:

- Age*Race: Black
- Ethnicity*Race: Non-White
- Diabetes as cause of ESRD*Race
- Diabetes as cause of ESRD*Vintage
- Duration of ESRD: less than or equal to 1 year *Race
- Duration of ESRD: less than or equal to 1 year* Sex
- Diabetes as cause of ESRD*Sex
- Sex*Race: Black

Detailed Risk Model Specifications S.15.

Using the estimates of the regression coefficients from stage 1, we estimate the relative risk for each patient-record. The predicted value for the patient-record from stage 1 is then used as an offset in the stage 2 model, which is unstratified and includes an adjustment for the race-specific age-adjusted state population death rates.

Age-adjusted population death rates (per 100,000) by state and race are obtained from the U.S. Centers for Disease Control National Center for Health Statistics. The 2014 DFR used age-adjusted death rates for 2008-10 from Table 19 of the publication Health, United States, 2013, available at <http://www.cdc.gov/nchs/data/hus/hus13.pdf>.

Each patient typically gives rise to several patient-records. Specifically, a new patient record is defined for each calendar year and each time a patient changes facilities. The i^{th} patient record is associated with a risk period t_i , which specifies the number of days that the patient is at risk during that record. Note that each patient record corresponds to a single facility and to a single calendar year.

The Cox model is applied in two stages. Stage 1 yields estimates of the coefficients (β_j) for the 56 covariates that are measured on individual patients (or patient-records). The coefficients measure the within-facility effects for individual risk factors or comorbidities. Using these coefficients, a relative risk or predicted risk is calculated for each patient-record. Stage 2 adjusts for the differences in mortality rate at the state level. The model of this stage uses only one covariate, the log of the population death rate for that patient's race within the state where the patient is being treated. The predicted value for the patient-record from stage 1 is used as an offset in the stage 2 model and the stage 2 analysis is not stratified. The combined predicted values from stages 1 and 2, and the baseline survival curve from stage 2 of the Cox model are then used to calculate the expected number of deaths for a specific patient-record.

Let p denotes the number of patient characteristics in the model and x_{ij} be the specific value of the j^{th} characteristic for the i^{th} patient-record. In stage 1, for patient-record i , we denote the measured characteristics or covariates in a vector form as

$$X_i = (x_{i1}, x_{i2}, \dots, x_{ip})$$

and use this to define the regression portion of a Cox model in which facilities define the strata. Note that for a categorical characteristic, the x_{ij} value is 1 if the patient falls into the category and 0 otherwise. The output of this model is a set of regression coefficients, $\beta_1, \beta_2, \dots, \beta_p$ and the corresponding predicted value for the i^{th} patient-record is given by

$$X_i\beta = \beta_1 x_{i1} + \beta_2 x_{i2} + \dots + \beta_p x_{ip}. \quad (1)$$

In stage 2, the only covariate is x_{i0} , which specifies the logarithm of the state age-adjusted population death rate corresponding to the race of the patient giving rise to patient-record i . The stage 2 model is not stratified, so there is a single baseline survival function assumed. The stage 1 $X_i\beta$ from equation (1) is used as an offset in the analysis. The Stage 2 Cox model gives rise to an estimate of the regression coefficient β_0 and of the baseline survival function, $S_0(t)$. After stage 2, the linear prediction is

$$A_i = \beta_0 x_{i0} + X_i\beta = \beta_0 x_{i0} + \beta_1 x_{i1} + \beta_2 x_{i2} + \dots + \beta_p x_{ip}$$

Suppose that t_i is the end of follow-up time for patient-record i , so that $S_0(t_i)$ is the baseline survival probability at time t_i . The survival probability for this patient-record i at time t_i is:

$$S_i(t_i) = [S_0(t_i)]^{\exp(A_i)}.$$

The expected number of deaths for this patient-record during follow-up time t_i arises from considerations in the Cox model and can be written as

$$-\ln(S_i(t_i)) = -\exp(A_i) \ln [S_0(t_i)].$$

The expected number of deaths at a given facility can now be computed simply by summing these expected values over the totality of patient-records in that facility. Specifically, the expected value is the sum over the N patient-records at the facility giving

$$Exp = \sum_{i=1}^N -\ln[S_i(t_i)] = -\sum_{i=1}^N \exp(A_i) \ln[S_0(t_i)].$$

Note that, patient-records with 100 days of follow-up, who are otherwise the same, give rise to the same expected mortality even if the 100 day period started at different dates during the year. This approximation is made to simplify the calculations.

Let Obs be the total number of deaths observed at the facility during the total four year follow up period. As stated above, the SMR is the ratio of the total number of deaths observed to the expected number so that

$$SMR = \text{Obs}/\text{Exp}.$$

Type of Score S.16.

Ratio

Interpretation of Score S.17.

Better quality = lower score

Calculation Algorithm/Measure Logic S.18.

See flowchart.

Calculation Algorithm/Measure Logic Diagram URL or Attachment S.19.

Available in Appendix B.

Sampling S.20.

N/A

Survey/Patient-Reported Data S.21.

N/A

Missing Data S.22.

N/A

Data Source S.23.

Administrative claims

Electronic Clinical Data : Electronic Clinical Data

Data Source or Collection Instrument S.24.

Data for the SMR are derived from an extensive national ESRD patient database, which is largely derived from the CMS Consolidated Renal Operations in a Web-enabled Network (CROWN), which includes Renal Management Information System (REMIS), and the Standard Information Management System (SIMS) database, Medicare claims, the CMS Medical Evidence Form (Form CMS-2728), transplant data from the Organ Procurement and Transplant Network (OPTN), the Death Notification Form (Form CMS-2746), the Nursing Home Minimum Dataset, the Dialysis Facility Compare (DFC) and the Social Security Death Master File.

Data Source or Collection Instrument (Reference) S.25.

No data collection instrument provided

Level of Analysis S.26.

Facility

Care Setting S.27.

Dialysis Facility

Composite Performance Measure S.28.

N/A

Appendix A

Statistical Risk Model and Variables S.14.

Model Coefficients, Data Years 2010–2013

Covariate	Coefficient	p-value
Comorbidities at start of ESRD		
At least of the comorbidities listed below	0.15783	<.0001
Atherosclerotic heart disease	0.04559	<.0001
Other cardiac disease	0.06736	<.0001
Diabetes (all types including diabetic retinopathy)	0.01596	0.0389
Congestive heart failure	0.12221	<.0001
Inability to ambulate	0.14953	<.0001
Chronic obstructive pulmonary disease	0.07399	<.0001
Inability to transfer	0.11727	<.0001
Malignant neoplasm, cancer	0.10791	<.0001
Peripheral vascular disease	0.05252	<.0001
Cerebrovascular disease, CVA, TIA	0.01484	0.0311
Tobacco use (current smoker)	0.10783	<.0001
Alcohol dependence	0.03135	0.0989
Drug dependence	0.07436	0.0008
No Medical Evidence (CMS-2728) Form	0.0115	0.7696
Cause of ESRD		
Diabetes	0.14834	<.0001
Missing	-0.02574	0.2855
Sex: Female	-0.07704	<.0001
Age		
Age (continuous)	-0.05786	0.0003
Age spline at 14	0.08753	<.0001
Age spline at 60	0.00651	<.0001
Race: black X age interaction		
Age (continuous)	-0.0371	0.1983
Age spline at 14	0.03412	0.2384
Age spline at 60	0.0009396	0.4437
Patient in nursing home	0.31026	<.0001
Incident BMI		
Log of BMI (continuous)	-0.48904	<.0001
Log of BMI spline at 35	0.57016	<.0001
BMI Missing	0.14771	<.0001
Race		
White	Reference	-
Black	0.31856	0.4275
Asian/PI	-0.33283	<.0001
Native American	-0.12939	0.0015
Other	-0.25062	<.0001
Time on ESRD		
< 1 year	-0.18009	<.0001
1 to 2 years	-0.21764	<.0001
2 to 3 years	-0.17079	<.0001
3+ years	Reference	-
Calendar year		
2010	0.1289	<.0001
2011	0.10334	<.0001
2012	0.00509	0.3735
2013	Reference	-
Ethnicity		

Covariate	Coefficient	p-value
Hispanic	-0.31125	<.0001
Non-Hispanic ethnicity	Reference	
Unknown ethnicity	0.09259	0.0082
Ethnicity X race: nonwhite interaction		
Hispanic ethnicity	0.30208	<.0001
Unknown ethnicity	0.12773	0.0004
Race X diabetes as cause of ESRD interaction		
Asian/PI	0.04491	0.0405
Black	-0.08505	<.0001
Native American	-0.00639	0.8865
Other	0.10269	0.0266
Time with ESRD X diabetes as cause of ESRD interaction		
< 1 year	-0.20115	<.0001
1 to 2 years	-0.11321	<.0001
2 to 3 years	-0.04516	0.0004
3+ years	Reference	-
Time on ESRD: < 1 year X race interaction		
Asian/PI	-0.13672	<.0001
Black	0.03974	0.0003
Native American	-0.10883	0.0344
Other	0.26902	<.0001
Time on ESRD: < 1 year X sex: female interaction	0.00915	0.3193
Sex: female X cause of ESRD: diabetes interaction	-0.00839	0.3009
Race: black X sex: female interaction	0.06686	<.0001

*The diabetes indicator includes all diabetes comorbidities on CMS-2728 and diabetes as cause of ESRD

Prevalent Comorbidity Coefficients, Data Years 2010–2013

Note: ICD-9 to ICD-10 crosswalk is pending clinician review.

ICD-9 Description	ICD-9 Code	Coefficient	P-value
Protein-cal malnutr NOS	2639	0.19068	<.0001
Aut neuropthy in oth dis	3371	0.02175	0.1983
Epilep NOS w/o intr epil	34590	0.10419	<.0001
Cerebral edema	3485	0.21974	<.0001
Subendo infarct, initial	41071	0.28073	<.0001
AMI NEC, unspecified	41080	-0.00835	0.8738
AMI NOS, unspecified	41090	0.04091	0.0037
Intermed coronary synd	4111	0.05768	<.0001
Ac ischemic hrt dis NEC	41189	0.07088	0.0013
Angina pectoris NEC/NOS	4139	0.00621	0.5314
Cardiomyopath in oth dis	4258	0.04292	0.0329
Atriovent block complete	4260	0.15129	<.0001
Parox ventric tachycard	4271	0.18283	<.0001
Parox tachycardia NOS	4272	0.07202	0.0747
Atrial fibrillation	42731	0.24876	<.0001
Atrial flutter	42732	0.06245	<.0001
Sinoatrial node dysfunct	42781	-0.04157	<.0001
Subdural hemorrhage	4321	0.13039	<.0001
Stricture of artery	4471	-0.02833	0.0635
Paralytic ileus	5601	-0.01047	0.5007
Convulsions NEC	78039	0.09323	<.0001
Gangrene	7854	0.17237	<.0001
Cachexia	7994	0.33328	<.0001
Candidal esophagitis	11284	0.21728	<.0001
Sarcoidosis	135	0.0498	0.1881
Malignant neopl rectum	1541	0.30273	<.0001
Mal neo liver, primary	1550	0.36764	<.0001
Mal neo upper lobe lung	1623	0.27901	<.0001
Mal neo bronch/lung NOS	1629	0.41213	<.0001
Malign neopl prostate	185	-0.06496	<.0001
Malig neo bladder NOS	1889	0.19631	<.0001
Malig neopl kidney	1890	-0.04592	0.0198
Malign neopl thyroid	193	-0.24613	<.0001
Secondary malig neo lung	1970	0.5234	<.0001
Second malig neo liver	1977	0.90921	<.0001
Secondary malig neo bone	1985	0.71735	<.0001
Malignant neoplasm NOS	1991	0.35314	<.0001
Oth lymph unsp xtrndl org	20280	0.20078	<.0001
Mult mye w/o achv rmson	20300	0.41084	<.0001

ICD-9 Description	ICD-9 Code	Coefficient	P-value
Ch lym leuk wo achv rmsn	20410	0.37957	<.0001
Essntial thrombocythemia	23871	0.12789	0.0003
Low grde myelody syn les	23872	0.15381	0.0017
Myelodysplastic synd NOS	23875	0.20555	<.0001
DMII wo cmp nt st uncntr	25000	0.0721	<.0001
DMII wo cmp uncntrld	25002	-0.01161	0.0705
DMII keto nt st uncntrld	25010	0.0982	0.0001
DMII ketoacd uncontrold	25012	0.14458	<.0001
DMI ketoacd uncontrold	25013	0.28449	<.0001
DMII hprosmir uncontrold	25022	0.04571	0.2251
DMII renl nt st uncntrld	25040	0.03375	<.0001
DMI renl nt st uncntrld	25041	0.07679	<.0001
DMII ophth nt st uncntrl	25050	0.00575	0.482
DMI ophth uncntrld	25053	0.0629	0.0443
DMII neuro nt st uncntrl	25060	-0.00885	0.2742
DMI neuro nt st uncntrld	25061	0.03226	0.0203
DMII neuro uncntrld	25062	-0.004	0.7193
DMI neuro uncntrld	25063	0.05321	0.037
DMII circ nt st uncntrld	25070	-0.01444	0.0857
DMI circ nt st uncntrld	25071	-0.02272	0.1652
DMII circ uncntrld	25072	0.00435	0.7765
DMII oth nt st uncntrld	25080	0.12132	<.0001
DMI oth nt st uncntrld	25081	0.09973	<.0001
DMII oth uncntrld	25082	0.05006	0.0001
DMI oth uncntrld	25083	0.14618	<.0001
Glucocorticoid deficient	25541	0.31984	<.0001
Oth severe malnutrition	262	0.17484	<.0001
Dis urea cycle metabol	2706	-0.01549	0.7273
Amyloidosis NEC	27739	0.32816	<.0001
Metabolism disorder NEC	27789	0.13233	0.0078
Morbid obesity	27801	0.00932	0.3779
Obesity hypovent synd	27803	-0.02953	0.3107
Sickle cell disease NOS	28260	0.61472	<.0001
Antin chemo indcd pancyt	28411	0.39212	<.0001
Other pancytopenia	28419	0.17159	<.0001
Neutropenia NOS	28800	0.19529	<.0001
Drug induced neutropenia	28803	0.29116	<.0001
Prim hypercoagulable st	28981	0.15977	<.0001
Senile dementia uncomp	2900	0.07334	<.0001
Senile delusion	29020	0.1114	0.0105
Vascular dementia,uncomp	29040	0.10829	<.0001
Drug withdrawal	2920	0.13901	0.0014

ICD-9 Description	ICD-9 Code	Coefficient	P-value
Dementia w/o behav dist	29410	0.10461	<.0001
Dementia w behavior dist	29411	0.12167	<.0001
Demen NOS w/o behv dstrb	29420	0.15134	<.0001
Mental disor NEC oth dis	2948	0.16473	<.0001
Schizophrenia NOS-unspec	29590	0.16904	<.0001
Depress psychosis-unspec	29620	0.08783	<.0001
Recurr depr psychos-unsp	29630	0.04595	0.0459
Recur depr psych-severe	29633	0.04953	0.0214
Bipolar disorder NOS	29680	0.03951	0.0718
Bipolar disorder NEC	29689	0.0765	0.1406
Episodic mood disord NOS	29690	-0.0061	0.8254
Alcoh dep NEC/NOS-unspec	30390	0.02262	0.4481
Alcoh dep NEC/NOS-remiss	30393	-0.0592	0.1194
Opioid dependence-unspec	30400	0.23963	<.0001
Opioid dependence-contin	30401	0.10216	0.0083
Drug depend NOS-unspec	30490	0.09283	0.0412
Cereb degeneration NOS	3319	0.10725	<.0001
Grand mal status	3453	-0.00454	0.8984
Psymotr epil w/o int epi	34540	-0.05696	0.1739
Anoxic brain damage	3481	0.2873	<.0001
Idio periph neurpthy NOS	3569	0.03128	0.0003
Neuropathy in diabetes	3572	0.0258	0.0042
Critical illness myopathy	35981	-0.10948	0.0009
Prolif diab retinopathy	36202	-0.056	<.0001
Mod nonprolf db retinoph	36205	-0.10539	0.0017
Diabetic macular edema	36207	-0.16216	<.0001
Hyp ht dis NOS w ht fail	40291	-0.01224	0.5579
Pulm embol/infarct NEC	41519	0.02084	0.2221
Prim pulm hypertension	4160	0.05884	0.0002
Chr pulmon heart dis NEC	4168	0.1898	<.0001
Prim cardiomyopathy NEC	4254	0.23084	<.0001
Crbl emblsm w infrct	43411	0.18777	<.0001
Crbl art ocl NOS w infrc	43491	0.12749	<.0001
Aortic atherosclerosis	4400	0.03595	0.0233
Athscl extrm ntv art NOS	44020	0.02718	0.0013
Ath ext ntv at w claudct	44021	0.02956	0.0173
Ath ext ntv at w rst pn	44022	0.0837	<.0001
Ath ext ntv art ulcrcton	44023	0.05416	<.0001
Dsct of thoracic aorta	44101	0.11966	0.0452
Lower extremity aneurysm	4423	0.02375	0.4642
Periph vascular dis NEC	44389	0.02878	0.0596
Periph vascular dis NOS	4439	0.16444	<.0001

ICD-9 Description	ICD-9 Code	Coefficient	P-value
Deep phlebitis-leg NEC	45119	-0.04641	0.1151
Oth inf vena cava thromb	4532	0.30687	<.0001
Ac DVT/emb prox low ext	45341	0.08701	<.0001
Ch DVT/embl low ext NOS	45350	0.05663	0.1025
Ch DVT/embl prox low ext	45351	0.03822	0.3528
Ch emblsm subclav veins	45375	0.16767	<.0001
Ac DVT/embl up ext	45382	0.07744	0.0026
Ac emblsm axillary veins	45384	0.07944	0.049
Ac embl internl jug vein	45386	0.08068	0.0006
Ac embl thorac vein NEC	45387	0.07384	0.0288
Esoph varice oth dis NOS	45621	0.18859	<.0001
Obs chr bronc w(ac) exac	49121	0.13193	<.0001
Obs chr bronc w ac bronc	49122	-0.0088	0.5824
Emphysema NEC	4928	0.07809	<.0001
Chronic obst asthma NOS	49320	0.01834	0.1388
Ch obst asth w (ac) exac	49322	0.01286	0.4885
Bronchiectas w/o ac exac	4940	0.03515	0.3221
Chr airway obstruct NEC	496	0.16266	<.0001
Food/vomit pneumonitis	5070	0.1607	<.0001
Postinflam pulm fibrosis	515	0.15118	<.0001
Lung involv in oth dis	5178	0.15956	0.0088
Ac resp flr fol trma/srg	51851	0.02845	0.355
Ot pul insuf fol trm/srg	51852	-0.06297	0.3178
Other pulmonary insuff	51882	0.09857	<.0001
Chronic respiratory fail	51883	0.11434	<.0001
Acute & chronc resp fail	51884	0.12628	<.0001
Gastrostomy comp - mech	53642	0.15365	<.0001
Regional enteritis NOS	5559	0.12126	0.0002
Ulceratve colitis unspcf	5569	0.02044	0.5561
Chr vasc insuff intest	5571	0.13302	<.0001
Fecal impaction	56032	0.04821	0.1281
Intestinal obstruct NOS	5609	0.08494	<.0001
Alcohol cirrhosis liver	5712	0.15572	<.0001
Cirrhosis of liver NOS	5715	0.41697	<.0001
Hepatic encephalopathy	5722	0.31225	<.0001
Portal hypertension	5723	0.22903	<.0001
Oth sequela, chr liv dis	5728	0.2376	<.0001
Chronic pancreatitis	5771	0.17966	<.0001
Pressure ulcer, low back	70703	0.22465	<.0001
Pressure ulcer, hip	70704	0.24053	<.0001
Pressure ulcer, buttock	70705	0.09838	<.0001
Ulcer of lower limb NOS	70710	0.09412	<.0001

ICD-9 Description	ICD-9 Code	Coefficient	P-value
Ulcer other part of foot	70715	0.08756	<.0001
Ulcer oth part low limb	70719	0.16587	<.0001
Chronic skin ulcer NEC	7078	0.14188	<.0001
Syst lupus erythematosus	7100	0.19554	<.0001
Systemic sclerosis	7101	0.39484	<.0001
Pyogen arthritis-unspec	71100	-0.04327	0.3753
Pyogen arthritis-l/leg	71106	0.02859	0.4542
Rheumatoid arthritis	7140	0.0896	<.0001
Inflamm polyarthrop NOS	7149	-0.02268	0.6699
Sacroiliitis NEC	7202	0.04558	0.2878
Ac osteomyelitis-unspec	73000	-0.04987	0.131
Ac osteomyelitis-ankle	73007	-0.08917	<.0001
Ac osteomyelitis NEC	73008	-0.03235	0.307
Osteomyelitis NOS-hand	73024	0.24478	<.0001
Osteomyelitis NOS-ankle	73027	-0.12149	<.0001
Path fx vertebrae	73313	0.22531	<.0001
Aseptic necrosis femur	73342	0.10754	0.0188
Asept necrosis bone NEC	73349	0.15539	0.006
Coma	78001	0.21242	<.0001
Fracture of pubis-closed	8082	0.11422	0.0001
Pelvic fracture NOS-clos	8088	0.05103	0.1367
Fx femur intrcaps NEC-cl	82009	-0.00952	0.7647
Fx neck of femur NOS-cl	8208	0.04397	0.0051
Fx femur NOS-closed	82100	-0.02136	0.4055
Amput below knee, unilat	8970	-0.09002	<.0001
Amputat bk, unilat-compl	8971	-0.01234	0.7926
Amput above knee, unilat	8972	-0.11732	<.0001
Amputat leg, unilat NOS	8974	-0.08497	0.064
React-indwell urin cath	99664	0.05432	0.0555
Compl heart transplant	99683	0.09947	0.1582
Asymp hiv infectn status	V08	0.46221	<.0001
Heart transplant status	V421	0.19932	0.0002
Liver transplant status	V427	0.03733	0.2656
Trnspl status-pancreas	V4283	0.1358	0.0026
Gastrostomy status	V441	0.02576	0.2534
Ileostomy status	V442	-0.07135	0.0349
Colostomy status	V443	0.01882	0.4186
Urinostomy status NEC	V446	0.27221	<.0001
Respirator depend status	V4611	0.08244	<.0001
Status amput othr toe(s)	V4972	-0.02421	0.1067
Status amput below knee	V4975	0.14259	<.0001
Status amput above knee	V4976	0.09281	<.0001

ICD-9 Description	ICD-9 Code	Coefficient	P-value
Atten to gastrostomy	V551	-0.05311	0.0197
Long-term use of insulin	V5867	0.0585	<.0001
BMI 40.0-44.9, adult	V8541	-0.03968	0.0375
	miss_comorbid	0.53332	<.0001

Appendix B: Calculation Algorithm/Measure Logic Diagram URL or Attachment S.19.

Standardized Mortality Ratio: The ratio of observed to expected deaths

Numerator Statement: Number of deaths observed

Denominator Statement: Number of deaths expected based on the national rate for patients with similar characteristics

