MEASURE INFORMATION FORM

Project Title:

End-Stage Renal Disease Evaluation of Potential Prevalent Comorbidity Adjustments in the Standardized Mortality Ratio for Dialysis Facilities.

Project Overview:

The Centers for Medicare & Medicaid Services (CMS) has contracted with University of Michigan Kidney Epidemiology and Cost Center (UM-KECC) to evaluate the potential of including prevalent comorbidities in the SMR and SHR risk adjustment models. Motivation for this project comes from public comments expressing interest in considering the addition of more recent measures of patient health status to the risk-adjustment models, which now adjust for comorbidities at incidence. This work is part of a larger project to reevaluate the SMR and SHR measures.

Date:

Information included is current on April 15, 2016

Measure Name:

Standardized Mortality Ratio for Dialysis Facilities

Descriptive Information:

Measure Name (Measure Title De.2.)
Standardized Mortality Ratio for Dialysis Facilities

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: End Stage Renal Disease (ESRD)

Crosscutting Areas De 6.
None

Measure Specifications:

Measure-specific Web Page S.1.
N/A

If This Is an eMeasure S.2a.
This is not an eMeasure

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

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.
This measure was developed with 12 months of data. The time window can be specified from one to four years. Currently, the measure is publicly reported using four years of data.

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

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.

This measure is limited to Medicare dialysis patients. We require that patients reach a certain level of Medicare-paid dialysis bills to be included in the mortality statistics, or that patients have Medicare-paid

inpatient claims during the period. Specifically, months within a given dialysis patient-period are used for SMR calculation when they meet the criterion of being within two months after a month with either: (a) $900+ of Medicare-paid dialysis claims OR (b) at least one Medicare-paid inpatient claim. The intention of this criterion is to assure completeness of information on hospitalizations for all patients included in the analysis.

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.
See Data Dictionary/ Code Table

Type of Score S.16.
Ratio

Interpretation of Score S.17.
Better quality = Lower score

Calculation Algorithm/Measure Logic S.18.
See flowchart in Appendix.

Calculation Algorithm/Measure Logic Diagram URL or Attachment S.19.
See flowchart in Appendix.

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

Data Source or Collection Instrument S.24.
Data are derived from an extensive national ESRD patient database, which is primarily based on the CMS Consolidated Renal Operations in a Web-enabled Network (CROWN) system. The CROWN data include the Renal Management Information System (REMIS), CROWNWeb facility-reported clinical and administrative data (including CMS-2728 Medical Evidence Form, CMS-2746 Death Notification Form, and CMS-2744 Annual Facility Survey Form data), the historical Standard Information Management System (SIMS) database (formerly maintained by the 18 ESRD Networks until replaced by CROWNWeb in May 2012), the National Vascular Access Improvement Initiative's Fistula First Catheter Last project (in CROWNWeb since May 2012), Medicare dialysis and hospital payment records, transplant data from the Organ Procurement and Transplant Network (OPTN), the Nursing Home Minimum Dataset, the Quality

Improvement Evaluation System (QIES) Workbench, which includes data from the Certification and Survey Provider Enhanced Report System (CASPER), the Dialysis Facility Compare (DFC) and the Social Security Death Master File. The database is comprehensive for Medicare patients. Non-Medicare patients are included in all sources except for the Medicare payment records. CROWNWeb provides tracking by dialysis provider and treatment modality for non-Medicare patients. Information on hospitalizations is obtained from Part A Medicare Inpatient Claims Standard Analysis Files (SAFs), and past-year comorbidity is obtained from multiple Part A types (inpatient, home health, hospice, skilled nursing facility claims) and Part B outpatient types of Medicare Claims SAFs.

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

MEASURE JUSTIFICATION FORM

Project Title:

End-Stage Renal Disease Evaluation of Potential Prevalent Comorbidity Adjustments in the Standardized Mortality Ratio for Dialysis Facilities.

Project Overview:

The Centers for Medicare & Medicaid Services (CMS) has contracted with University of Michigan Kidney Epidemiology and Cost Center (UM-KECC) to evaluate the potential of including prevalent comorbidities in the SMR and SHR risk adjustment models. Motivation for this project comes from public comments expressing interest in considering the addition of more recent measures of patient health status to the risk-adjustment models, which now adjust for comorbidities at incidence. This work is part of a larger project to reevaluate the SMR and SHR measures.

Date:

Information included is current on May 10, 2016

Measure Name:

Standardized Mortality Ratio

Type of Measure:

Outcome

Importance:

1a—Opportunity for Improvement

The measure focus is evidence-based, demonstrated as follows:

- Health outcome: [3] a rationale supports the relationship of the health outcome to processes or structures of care. Applies to patient-reported outcomes (PRO), including health-related quality of life/functional status, symptom/symptom burden, experience with care, health-related behavior.
- Intermediate clinical outcome: a systematic assessment and grading of the quantity, quality, and consistency of the body of evidence [4] that the measured intermediate clinical outcome leads to a desired health outcome.
- Process: [5] a systematic assessment and grading of the quantity, quality, and consistency of the body of evidence [4] that the measured process leads to a desired health outcome.
- Structure: a systematic assessment and grading of the quantity, quality, and consistency of the body of evidence [4] that the measured structure leads to a desired health outcome.
- Efficiency: [6] evidence not required for the resource use component.

1a.1. This is a Measure of 1a.2. —

Health Outcome – Mortality

Linkage
1a.2.1 Rationale

2011 Submission
This was not a question on the 2011 Submission Form.

2016 Submission
ESRD patients on chronic dialysis experience all-cause mortality far in excess of age matched controls [1]. Patients in some dialysis facilities have consistently higher mortality than patients in other facilities, even after controlling for multiple patient characteristics [2]. Selection of dialysis modality, sometimes the result of dialysis facility practices, likely influences mortality [3]. Furthermore, mortality from certain conditions resulting from kidney failure and chronic dialysis care, including uremic toxin accumulation, volume overload/HTN and its treatment, bone/mineral disease, and infections related to dialysis access, have been described in detail [4-6].

Specific dialysis practices have been identified for several of these ESRD-related conditions that can improve patient survival and morbidity, including provision of adequate small solute clearance [7], control of total body volume while guarding against rapid ultrafiltration [8-11] and appropriate management of mineral and bone disorders [12-14]. In addition, improved infection prevention efforts by dialysis providers can result in reduced infection-related hospitalization and mortality [15-20].

[1]. United States Renal Data System. 2015 USRDS annual data report: Epidemiology of kidney disease in the United States. National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, MD, 2015.

[2]. Kalbfleisch J, Wolfe R, Bell S, Sun R, Messana J, Shearon T, Ashby V, Padilla R, Zhang M, Turenne M, Pearson J, Dahlerus C, Li Y. Risk Adjustment and the Assessment of Disparities in Dialysis Mortality Outcomes. J Am Soc Nephrol. 2015; Nov;26(11):2641-5.

Abstract: Standardized mortality ratios (SMRs) reported by Medicare compare mortality at individual dialysis facilities with the national average, and are currently adjusted for race. However, whether the adjustment for race obscures or clarifies disparities in quality of care for minority groups is unknown. Cox model-based SMRs were computed with and without adjustment for patient race for 5920 facilities in the United States during 2010. The study population included virtually all patients treated with dialysis during this period. Without race adjustment, facilities with higher proportions of black patients had better survival outcomes; facilities with the highest percentage of black patients (top 10%) had overall mortality rates approximately 7% lower than expected. After adjusting for within-facility racial differences, facilities with higher proportions of black patients had poorer survival outcomes among black and non-black patients; facilities with the highest percentage of black patients (top 10%) had mortality rates approximately 6% worse than expected. In conclusion, accounting for within-facility racial differences in the computation of SMR helps to clarify disparities in quality of health care among patients with ESRD. The adjustment that accommodates within-facility comparisons is key, because it

could also clarify relationships between patient characteristics and health care provider outcomes in other settings.

[3]. Weinhandl ED, Nieman KM, Gilbertson DT, Collins AJ. Hospitalization in daily home hemodialysis and matched thrice-weekly in-center hemodialysis patients. Am J Kidney Dis. 2015 Jan;65(1):98-108.

BACKGROUND: Cardiovascular disease is a common cause of hospitalization in dialysis patients. Daily hemodialysis improves some parameters of cardiovascular function, but whether it associates with lower hospitalization risk is unclear.

STUDY DESIGN: Observational cohort study using US Renal Data System data.

SETTING & PARTICIPANTS: Medicare-enrolled daily (5 or 6 sessions weekly) home hemodialysis (HHD) patients initiating NxStage System One use from January 1, 2006, through December 31, 2009, and contemporary thrice-weekly in-center hemodialysis patients, matched 5 to 1.

PREDICTOR: Daily HHD or thrice-weekly in-center hemodialysis.

OUTCOMES & MEASUREMENTS: All-cause and cause-specific hospital admissions, hospital readmissions, and hospital days assessed from Medicare Part A claims.

RESULTS: For 3,480 daily HHD and 17,400 thrice-weekly in-center hemodialysis patients in intention-to-treat analysis, the HR of all-cause admission for daily HHD versus in-center hemodialysis was 1.01 (95%CI, 0.98-1.03). Cause-specific admission HRs were 0.89 (95%CI, 0.86-0.93) for cardiovascular disease, 1.18 (95%CI, 1.13-1.23) for infection, 1.01 (95%CI, 0.93-1.09) for vascular access dysfunction, and 1.02 (95%CI, 0.99-1.06) for other morbidity. Regarding cardiovascular disease, first admission and readmission HRs for daily HHD versus in-center hemodialysis were 0.91 and 0.87, respectively. Regarding infection, first admission and readmission HRs were 1.35 and 1.03, respectively. Protective associations of daily HHD with heart failure and hypertensive disease were most pronounced, as were adverse associations of daily HHD with bacteremia/sepsis, cardiac infection, osteomyelitis, and vascular access infection.

LIMITATIONS: Results may be confounded by unmeasured factors, including vascular access type; information about dialysis frequency, duration, and dose was lacking; causes of admission may be misclassified; results may not apply to patients without Medicare coverage.

CONCLUSIONS: All-cause hospitalization risk was similar in daily HHD and thrice-weekly in-center hemodialysis patients. However, risk of cardiovascular-related admission was lower with daily HHD, and risk of infection-related admission was higher. More attention should be afforded to infection in HHD patients.

[4]. Himmelfarb J, Ikizler T. Hemodialysis N Engl J. 2010 Nov; 363:1833–1845.

Abstract: Fifty years ago, Belding Scribner and his colleagues at the University of Washington developed a blood-access device using Teflon-coated plastic tubes, which facilitated the use of repeated hemodialysis as a life-sustaining treatment for patients with uremia.1,2 The introduction of the Scribner shunt, as it became known, soon led to the development of a variety of surgical techniques for the creation of arteriovenous fistulas and grafts. Consequently, hemodialysis has made survival possible for more than a million people throughout the world who have end-stage renal disease (ESRD) with limited or no kidney function. The expansion of dialysis into a form of long-term renal-replacement therapy transformed the field of nephrology and also created a new area of medical science, which has been called the physiology of the artificial kidney. This review describes the medical, social, and economic evolution of hemodialysis therapy.

[5]. Kliger AS. Maintaining Safety in the Dialysis Facility. Clin J Am Soc Nephrol. 2015 Apr 7;10(4):688-95.

Abstract: Errors in dialysis care can cause harm and death. While dialysis machines are rarely a major cause of morbidity, human factors at the machine interface and suboptimal communication among caregivers are common sources of error. Major causes of potentially reversible adverse outcomes include medication errors, infections, hyperkalemia, access-related errors, and patient falls. Root cause analysis of adverse events and "near misses" can illuminate care processes and show system changes to improve safety. Human factors engineering and simulation exercises have strong potential to define common clinical team purpose, and improve processes of care. Patient observations and their participation in error reduction increase the effectiveness of patient safety efforts.

[6]. Hung AM, Hakim RM. Dialysate and Serum Potassium in Hemodialysis. Am J Kidney Dis. 2015 Jul;66(1):125-32.

Abstract: Most patients with end-stage renal disease depend on intermittent hemodialysis to maintain levels of serum potassium and other electrolytes within a normal range. However, one of the challenges has been the safety of using a low-potassium dialysate to achieve that goal, given the concern about the effects that rapid and/or large changes in serum potassium concentrations may have on cardiac electrophysiology and arrhythmia. Additionally, in this patient population, there is a high prevalence of structural cardiac changes and ischemic heart disease, making them even more susceptible to acute arrhythmogenic triggers. This concern is highlighted by the knowledge that about two-thirds of all cardiac deaths in dialysis are due to sudden cardiac death and that sudden cardiac death accounts for 25% of the overall death for end-stage renal disease. Developing new approaches and practice standards for potassium removal during dialysis, as well as understanding other modifiable triggers of sudden cardiac death, such as other electrolyte components of the dialysate (magnesium and calcium), rapid ultrafiltration rates, and safety of a number of medications (ie, drugs that prolong the QT interval or use of digoxin), are critical in order to decrease the unacceptably high cardiac mortality experienced by hemodialysis-dependent patients.

[7]. Port FK, Ashby VB, Dhingra RK, Roys EC, Wolfe RA: Dialysis dose and body mass index are strongly associated with survival in hemodialysis patients. J Am Soc Nephrol 13:1061-1066, 2002

Abstract: Low dose of hemodialysis (HD) and small body size are independent risk factors for mortality. Recent changes in clinical practice, toward higher HD doses and use of more high-flux dialyzers, suggest the need to redetermine the dose level above which no benefit from higher dose can be observed. Data were analyzed from 45,967 HD patients starting end-stage renal disease (ESRD) therapy during April 1, 1997, through December 31, 1998. Data from Health Care Financing Administration (HCFA) billing records during months 10 to 15 of ESRD were used to classify each patient into one of five categories of HD dose by urea reduction ratio (URR) ranging from <60% to >75%. Cox regression models were used to calculate relative risk (RR) of mortality after adjustment for demographics, body mass index (BMI), and 18 comorbid conditions. Of the three body-size groups, the lowest BMI group had a 42% higher mortality risk than the highest BMI tertile. In each of three body-size groups by BMI, the RR was 17%, 17%, and 19% lower per 5% higher URR category among groups with small, medium, and large BMI, respectively ($P < 0.0001$ for each group). Patients treated with URR >75% had a substantially lower RR than patients treated with URR 70 to 75% ($P < 0.005$ each, for medium and small BMI groups). It is concluded that a higher dialysis dose, substantially above the Dialysis Outcomes Quality Initiative guidelines (URR >65%), is a strong predictor of lower patient mortality for patients in all body-size groups. Further reductions in mortality might be possible with increased HD dose.

[8]. Saran R, Bragg-Gresham JL, Levin NW, Twardowski ZJ, Wizemann V, Saito A, Kimata N, Gillespie BW, Combe C, Bommer J, Akiba T, Mapes DL, Young EW, Port FK. Longer Treatment Time and Slower Ultrafiltration in Hemodialysis: Associations With Reduced Mortality in the DOPPS. Kidney Int. 2006 Apr;69(7):1222-8.

Abstract: Longer treatment time (TT) and slower ultrafiltration rate (UFR) are considered advantageous for hemodialysis (HD) patients. The study included 22,000 HD patients from seven countries in the Dialysis Outcomes and Practice Patterns Study (DOPPS). Logistic regression was used to study predictors of TT > 240 min and UFR > 10 ml/h/kg bodyweight. Cox regression was used for survival analyses. Statistical adjustments were made for patient demographics, comorbidities, dose of dialysis (Kt/V), and body size. Europe and Japan had significantly longer ($P < 0.0001$) average TT than the US (232 and 244 min vs 211 in DOPPS I; 235 and 240 min vs 221 in DOPPS II). Kt/V increased concomitantly with TT in all three regions with the largest absolute difference observed in Japan. TT > 240 min was independently associated with significantly lower relative risk (RR) of mortality (RR = 0.81; $P = 0.0005$). Every 30 min longer on HD was associated with a 7% lower RR of mortality (RR = 0.93; $P < 0.0001$). The RR reduction with longer TT was greatest in Japan. A synergistic interaction occurred between Kt/V and TT ($P = 0.007$) toward mortality reduction. UFR > 10 ml/h/kg was associated with higher odds of intradialytic hypotension (odds ratio = 1.30; $P = 0.045$) and a higher risk of mortality (RR = 1.09; $P = 0.02$). Longer TT and higher Kt/V were independently as well as synergistically associated with lower mortality. Rapid UFR during HD was also associated with higher mortality risk. These results warrant a randomized clinical trial of longer dialysis sessions in thrice-weekly HD.

[9]. FHN Trial Group, Chertow GM, Levin NW, Beck GJ, Depner TA, Eggers PW, Gassman JJ, Gorodetskaya I, Greene T, James S, Larive B, Lindsay RM, Mehta RL, Miller B, Ornt DB, Rajagopalan S, Rastogi A, Rocco

MV, Schiller B, Sergeyeva O, Schulman G, Ting GO, Unruh ML, Star RA, Kliger AS. In-center hemodialysis six times per week versus three times per week. N Engl J Med. 2010 Dec 9;363(24):2287-300.

BACKGROUND: In this randomized clinical trial, we aimed to determine whether increasing the frequency of in-center hemodialysis would result in beneficial changes in left ventricular mass, self-reported physical health, and other intermediate outcomes among patients undergoing maintenance hemodialysis.

METHODS: Patients were randomly assigned to undergo hemodialysis six times per week (frequent hemodialysis, 125 patients) or three times per week (conventional hemodialysis, 120 patients) for 12 months. The two coprimary composite outcomes were death or change (from baseline to 12 months) in left ventricular mass, as assessed by cardiac magnetic resonance imaging, and death or change in the physical-health composite score of the RAND 36-item health survey. Secondary outcomes included cognitive performance; self-reported depression; laboratory markers of nutrition, mineral metabolism, and anemia; blood pressure; and rates of hospitalization and of interventions related to vascular access.

RESULTS: Patients in the frequent-hemodialysis group averaged 5.2 sessions per week; the weekly standard Kt/V(urea) (the product of the urea clearance and the duration of the dialysis session normalized to the volume of distribution of urea) was significantly higher in the frequent-hemodialysis group than in the conventional-hemodialysis group (3.54±0.56 vs. 2.49±0.27). Frequent hemodialysis was associated with significant benefits with respect to both coprimary composite outcomes (hazard ratio for death or increase in left ventricular mass, 0.61; 95% confidence interval [CI], 0.46 to 0.82; hazard ratio for death or a decrease in the physical-health composite score, 0.70; 95% CI, 0.53 to 0.92). Patients randomly assigned to frequent hemodialysis were more likely to undergo interventions related to vascular access than were patients assigned to conventional hemodialysis (hazard ratio, 1.71; 95% CI, 1.08 to 2.73). Frequent hemodialysis was associated with improved control of hypertension and hyperphosphatemia. There were no significant effects of frequent hemodialysis on cognitive performance, self-reported depression, serum albumin concentration, or use of erythropoiesis-stimulating agents.

CONCLUSIONS: Frequent hemodialysis, as compared with conventional hemodialysis, was associated with favorable results with respect to the composite outcomes of death or change in left ventricular mass and death or change in a physical-health composite score but prompted more frequent interventions related to vascular access. (Funded by the National Institute of Diabetes and Digestive and Kidney Diseases and others; ClinicalTrials.gov number, NCT00264758.).

[10]. Flythe JE, Curhan GC, Brunelli SM. Disentangling the Ultrafiltration Rate–Mortality Association: The Respective Roles of Session Length and Weight Gain. Clin J Am Soc Nephrol. 2013 Jul;8(7):1151-61

BACKGROUND AND OBJECTIVES: Rapid ultrafiltration rate is associated with increased mortality among hemodialysis patients. Ultrafiltration rates are determined by interdialytic weight gain and session length. Although both interdialytic weight gain and session length have been linked to mortality, the

relationship of each to mortality, independent of the other, is not adequately defined. This study was designed to evaluate whether shorter session length independent of weight gain and larger weight gain independent of session length are associated with increased mortality.

DESIGN, SETTING, PARTICIPANTS, & MEASUREMENTS: Data were taken from a national cohort of 14,643 prevalent, thrice-weekly, in-center hemodialysis patients dialyzing from 2005 to 2009 (median survival time, 25 months) at a single dialysis organization. Patients with adequate urea clearance and delivered dialysis session ≥240 and <240 minutes were pair-matched on interdialytic weight gain (n=1794), and patients with weight gain ≤3 and >3 kg were pair-matched on session length (n=2114); mortality associations were estimated separately.

RESULTS: Compared with delivered session length ≥240, session length <240 minutes was associated with increased all-cause mortality (adjusted hazard ratio [95% confidence interval], 1.32 [1.03 to 1.69]). Compared with weight gain ≤3, weight gain >3 kg was associated with increased mortality (1.29 [1.01 to 1.65]). The associations were consistent across strata of age, sex, weight, and weight gain and session length. Secondary analyses demonstrated dose-response relationships between both and mortality.

CONCLUSIONS: Among patients with adequate urea clearance, shorter dialysis session length and greater interdialytic weight gain are associated with increased mortality; thus, both are viable targets for directed intervention.

[11]. Weiner DE, Brunelli SM, Hunt A, Schiller B, Glassrock R, Maddux FW, Johnson D, Parker T, Nissenson A. Improving clinical outcomes among hemodialysis patients: a proposal for a "volume first" approach from the chief medical officers of US dialysis providers. Am J Kidney Dis. 2014 Nov;64(5):685-95.

Abstract: Addressing fluid intake and volume control requires alignment and coordination of patients, providers, dialysis facilities, and payers, potentially necessitating a "Volume First" approach. This article reports the consensus opinions achieved at the March 2013 symposium of the Chief Medical Officers of 14 of the largest dialysis providers in the United States. These opinions are based on broad experience among participants, but often reinforced by only observational and frequently retrospective studies, highlighting the lack of high-quality clinical trials in nephrology. Given the high morbidity and mortality rates among dialysis patients and the absence of sufficient trial data to guide most aspects of hemodialysis therapy, participants believed that immediate attempts to improve care based on quality improvement initiatives, physiologic principles, and clinical experiences are warranted until such time as rigorous clinical trial data become available. The following overarching consensus opinions emerged. (1) Extracellular fluid status should be a component of sufficient dialysis, such that approaching normalization of extracellular fluid volume should be a primary goal of dialysis care. (2) Fluid removal should be gradual and dialysis treatment duration should not routinely be less than 4 hours without justification based on individual patient factors. (3) Intradialytic sodium loading should be avoided by incorporating dialysate sodium concentrations set routinely in the range of 134-138 mEq/L, avoidance of routine use of sodium modeling, and avoidance of hypertonic saline solution. (4) Dietary counseling should emphasize sodium avoidance.

[12]. Block GA, Kilpatrick RD, Lowe KA, Wang W, Danese MD. CKD-mineral and bone disorder and risk of death and cardiovascular hospitalization in patients on hemodialysis. Clin J Am Soc Nephrol. 2013 Dec;8(12):2132-40.

BACKGROUND AND OBJECTIVES: Parathyroid hormone, calcium, and phosphate have been independently associated with cardiovascular event risk. Because these parameters may be on the same causal pathway and have been proposed as quality measures, an integrated approach to estimating event risks is needed.

DESIGN, SETTING, PARTICIPANTS, & MEASUREMENTS: Prevalent dialysis patients were followed from August 31, 2005 to December 31, 2006. A two-stage modeling approach was used. First, the 16-month probabilities of death and composite end point of death or cardiovascular hospitalization were estimated and adjusted for potential confounders. Second, patients were categorized into 1 of 36 possible phenotypes using average parathyroid hormone, calcium, and phosphate values over a 4-month baseline period. Associations among phenotypes and outcomes were estimated and adjusted for the underlying event risk estimated from the first model stage.

RESULTS: Of 26,221 patients, 98.5% of patients were in 22 groups with at least 100 patients and 20% of patients were in the reference group defined using guideline-based reference ranges for parathyroid hormone, calcium, and phosphate. Within the 22 most common phenotypes, 20% of patients were in groups with significantly ($P<0.05$) higher risk of death and 54% of patients were in groups with significantly higher risk of the composite end point relative to the in-target reference group. Increased risks ranged from 15% to 47% for death and from 8% to 55% for the composite. More than 40% of all patients were in the three largest groups with elevated composite end point risk (high parathyroid hormone, target calcium, and high phosphate; target high parathyroid hormone, target calcium, and high phosphate; and target high parathyroid hormone, target calcium, and target phosphate).

CONCLUSION: After adjusting for baseline risk, phenotypes defined by categories of parathyroid hormone, calcium, and phosphate identify patients at higher risk of death and cardiovascular hospitalization. Identifying common high-risk phenotypes may inform clinical interventions and policies related to quality of care.

[13]. Pun PH, Horton JR, Middleton JP. Dialysate calcium concentration and the risk of sudden cardiac arrest in hemodialysis patients. Clin J Am Soc Nephrol. 2013 May;8(5):797-803.

BACKGROUND AND OBJECTIVES: The optimal dialysate calcium concentration to maintain normal mineralization and reduce risk of cardiovascular events in hemodialysis patients is debated. Guidelines suggest that dialysate Ca concentration should be lowered to avoid vascular calcification, but cardiac arrhythmias may be more likely to occur at lower dialysate Ca. Concurrent use of QT-prolonging medications may also exacerbate arrhythmic risk. This study examined the influence of serum Ca, dialysate Ca, and QT interval-prolonging medications on the risk of sudden cardiac arrest in a cohort of hemodialysis patients.

DESIGN, SETTING, PARTICIPANTS, & MEASUREMENTS: This case-control study among 43,200 hemodialysis patients occurred between 2002 and 2005; 510 patients who experienced a witnessed sudden cardiac arrest were compared with 1560 matched controls. This study examined covariate-adjusted sudden cardiac arrest risk associations with serum Ca, dialysate Ca, serum dialysate Ca gradient, and prescription of QT-prolonging medications using logistic regression techniques.

RESULTS: Patients assigned to low Ca dialysate<2.5 mEq/L were more likely to be exposed to larger serum dialysate Ca gradient and had a greater fall in BP during dialysis treatment. After accounting for covariates and baseline differences, low Ca dialysate<2.5 mEq/L (odds ratio=2.00, 95% confidence interval=1.40-2.90), higher corrected serum Ca (odds ratio=1.10, 95% confidence interval=1.00-1.30), and increasing serum dialysate Ca gradient (odds ratio=1.40, 95% confidence interval=1.10-1.80) were associated with increased risk of sudden cardiac arrest, whereas there were no significant risk associations with QT-prolonging medications.

CONCLUSIONS: Increased risk of sudden cardiac arrest associated with low Ca dialysate and large serum dialysate Ca gradients should be considered in determining the optimal dialysate Ca prescription.

[14]. Ishani A, Liu J, Wetmore JB, Lowe KA, Do T, Bradbury BD, Block GA, Collins AJ. Clinical outcomes after parathyroidectomy in a nationwide cohort of patients on hemodialysis. Clin J Am Soc Nephrol. 2015 Jan 7;10(1):90-7.

BACKGROUND AND OBJECTIVES: Patients receiving dialysis undergo parathyroidectomy to improve laboratory parameters in resistant hyperparathyroidism with the assumption that clinical outcomes will also improve. However, no randomized clinical trial data demonstrate the benefits of parathyroidectomy. This study aimed to evaluate clinical outcomes up to 1 year after parathyroidectomy in a nationwide sample of patients receiving hemodialysis.

DESIGN, SETTING, PARTICIPANTS, & MEASUREMENTS: Using data from the US Renal Data System, this study identified prevalent hemodialysis patients aged ≥18 years with Medicare as primary payers who underwent parathyroidectomy from 2007 to 2009. Baseline characteristics and comorbid conditions were assessed in the year preceding parathyroidectomy; clinical events were identified in the year preceding and the year after parathyroidectomy. After parathyroidectomy, patients were censored at death, loss of Medicare coverage, kidney transplant, change in dialysis modality, or 365 days. This study estimated cause-specific event rates for both periods and rate ratios comparing event rates in the postparathyroidectomy versus preparathyroidectomy periods.

RESULTS: Of 4435 patients who underwent parathyroidectomy, 2.0% died during the parathyroidectomy hospitalization and the 30 days after discharge. During the 30 days after discharge, 23.8% of patients were rehospitalized; 29.3% of these patients required intensive care. In the year after parathyroidectomy, hospitalizations were higher by 39%, hospital days by 58%, intensive care unit admissions by 69%, and emergency room/observation visits requiring hypocalcemia treatment by 20-fold compared with the preceding year. Cause-specific hospitalizations were higher for acute myocardial infarction (rate ratio, 1.98; 95% confidence interval, 1.60 to 2.46) and dysrhythmia (rate ratio 1.4; 95% confidence interval1.16 to 1.78); fracture rates did not differ (rate ratio 0.82; 95% confidence interval 0.6 to 1.1).

CONCLUSIONS: Parathyroidectomy is associated with significant morbidity in the 30 days after hospital discharge and in the year after the procedure. Awareness of clinical events will assist in developing evidence-based risk/benefit determinations for the indication for parathyroidectomy.

[15]. Gilbertson DT, Unruh M, McBean AM, Kausz AT, Snyder JJ, Collins AJ. Influenza vaccine delivery and effectiveness in end-stage renal disease. Kidney Int. 2003 Feb;63(2):738-43.

BACKGROUND: Influenza vaccination rates in the general population have been associated with improved outcomes, yet high-risk populations, such as end-stage renal disease (ESRD) patients, have received little attention in determining the potential benefits. This report assessed the frequency and effectiveness of influenza vaccination, while also assessing disparities in vaccination rates in the ESRD population.

METHODS: Using the United States Renal Data System research files containing claims for all Medicare ESRD patients, vaccination rates and outcomes among vaccinated and unvaccinated persons for the 1997 to 1998 and 1998 to 1999 influenza seasons were compared after adjustment for baseline demographic factors and health characteristics.

RESULTS: Vaccination rates in the ESRD population were less than 50% for each season. Influenza vaccination rates were lower in non-whites, women, younger patients, and peritoneal dialysis patients. Influenza vaccination was associated with a lower risk for hospitalization and death.

CONCLUSIONS: Despite universal coverage of free influenza vaccination, the ESRD population had a less than 50% vaccination rate for the years 1997 to 1998 and 1998 to 1999 as demonstrated by Medicare billing data. Substantial differences were found in vaccination rates among non-whites and peritoneal dialysis patients. This study confirms that the ESRD populations benefit from influenza vaccination, suggesting that dialysis providers should take advantage of all opportunities to immunize this high-risk group.

[16]. Rosenblum A, Wang W, Ball LK, Latham C, Maddux FW, Lacson E Jr. Hemodialysis catheter care strategies: a cluster-randomized quality improvement initiative. Am J Kidney Dis. 2014 Feb;63(2):259-67.

BACKGROUND: The prevalence of central venous catheters (CVCs) for hemodialysis remains high and, despite infection-control protocols, predisposes to bloodstream infections (BSIs).

STUDY DESIGN: Stratified, cluster-randomized, quality improvement initiative.

SETTING & PARTICIPANTS: All in-center patients with a CVC within 211 facility pairs matched by region, facility size, and rate of positive blood cultures (January to March 2011) at Fresenius Medical Care, North America.

QUALITY IMPROVEMENT PLAN: Incorporate the use of 2% chlorhexidine with 70% alcohol swab sticks for exit-site care and 70% alcohol pads to perform "scrub the hubs" in dialysis-related CVC care procedures compared to usual care.

OUTCOME: The primary outcome was positive blood cultures for estimating BSI rates.

MEASUREMENTS: Comparison of 3-month baseline period from April 1 to June 30 and follow-up period from August 1 to October 30, 2011.

RESULTS: Baseline BSI rates were similar (0.85 vs 0.86/1,000 CVC-days), but follow-up rates differed at 0.81/1,000 CVC-days in intervention facilities versus 1.04/1,000 CVC-days in controls (P = 0.02). Intravenous antibiotic starts during the follow-up period also were lower, at 2.53/1,000 CVC-days versus 3.15/1,000 CVC-days in controls (P < 0.001). Cluster-adjusted Poisson regression confirmed 21%-22% reductions in both (P < 0.001). Extended follow-up for 3 successive quarters demonstrated a sustained reduction of bacteremia rates for patients in intervention facilities, at 0.50/1,000 CVC-days (41% reduction; P < 0.001). Hospitalizations due to sepsis during 1-year extended follow-up were 0.19/1,000 CVC-days (0.069/CVC-year) versus 0.26/1,000 CVC-days (0.095/CVC-year) in controls (~27% difference; P < 0.05).

LIMITATIONS: Inability to capture results from blood cultures sent to external laboratories, underestimation of sepsis-specific hospitalizations, and potential crossover adoption of the intervention protocol in control facilities.

CONCLUSIONS: Adoption of the new catheter care procedure (consistent with Centers for Disease Control and Prevention recommendations) resulted in a 20% lower rate of BSIs and intravenous antibiotic starts, which were sustained over time and associated with a lower rate of hospitalizations due to sepsis.

[17]. Patel PR, Kallen AJ. Bloodstream infection prevention in ESRD: forging a pathway for success. Am J Kidney Dis. 2014 Feb;63(2):180-2.

Abstract: There should be little doubt regarding the importance of infections in the hemodialysis patient population. For years, the US Renal Data System has reported increasing hospitalization rates for all infectious diagnoses and for bacteremia/sepsis in patients treated with hemodialysis.1 In 2011, the Centers for Disease Control and Prevention (CDC) reported that although the burden of central line–

associated bloodstream infections (BSIs) in hospitalized patients had declined nationally, the estimated burden of central line–associated BSIs in people treated with outpatient hemodialysis was substantial, possibly reaching 37,000 in 2008.2 Soon after, the US Department of Health and Human Services released their National Action Plan to Prevent Healthcare-Associated Infections (HAIs) for End Stage Renal Disease (ESRD) Facilities.3 The Action Plan, which was developed by the Federal Steering Committee for the Prevention of HAIs in ESRD Facilities with dialysis community stakeholder input, highlighted BSIs as a top priority for national prevention efforts.

[18]. Dalrymple LS, Mu Y, Romano PS, Nguyen DV, Chertow GM, Delgado C, Grimes B, Kaysen GA, Johansen KL. Outcomes of infection-related hospitalization in Medicare beneficiaries receiving in-center hemodialysis. Am J Kidney Dis. 2015 May;65(5):754-62.

BACKGROUND: Infection is a common cause of hospitalization in adults receiving hemodialysis. Limited data are available about downstream events resulting from or following these hospitalizations.

STUDY DESIGN: Retrospective cohort study using the US Renal Data System.

SETTING & PARTICIPANTS: Medicare beneficiaries initiating in-center hemodialysis therapy in 2005 to 2008.

FACTORS: Demographics, dual Medicare/Medicaid eligibility, body mass index, comorbid conditions, initial vascular access type, nephrology care prior to dialysis therapy initiation, residence in a care facility, tobacco use, biochemical measures, and type of infection.

OUTCOMES: 30-day hospital readmission or death following first infection-related hospitalization.

RESULTS: 60,270 Medicare beneficiaries had at least one hospitalization for infection. Of those who survived the initial hospitalization, 15,113 (27%) were readmitted and survived the 30 days following hospital discharge, 1,624 (3%) were readmitted to the hospital and then died within 30 days of discharge, and 2,425 (4%) died without hospital readmission. Complications related to dialysis access, sepsis, and heart failure accounted for 12%, 9%, and 7% of hospital readmissions, respectively. Factors associated with higher odds of 30-day readmission or death without readmission included non-Hispanic ethnicity, lower serum albumin level, inability to ambulate or transfer, limited nephrology care prior to dialysis therapy, and specific types of infection. In comparison, older age, select comorbid conditions, and institutionalization had stronger associations with death without readmission than with readmission.

LIMITATIONS: Findings limited to Medicare beneficiaries receiving in-center hemodialysis.

CONCLUSIONS: Hospitalizations for infection among patients receiving in-center hemodialysis are associated with exceptionally high rates of 30-day hospital readmission and death without readmission.

[19]. Dalrymple LS, Mu Y, Nguyen DV, Romano PS, Chertow GM, Grimes B, Kaysen GA, Johansen KL. Risk Factors for Infection-Related Hospitalization in In-Center Hemodialysis. Clin J Am Soc Nephrol. 2015 Dec 7;10(12):2170-80.

BACKGROUND AND OBJECTIVES: Infection-related hospitalizations have increased dramatically over the last 10 years in patients receiving in-center hemodialysis. Patient and dialysis facility characteristics associated with the rate of infection-related hospitalization were examined, with consideration of the region of care, rural-urban residence, and socioeconomic status.

DESIGN, SETTING, PARTICIPANTS, & MEASUREMENTS: The US Renal Data System linked to the American Community Survey and Rural-Urban Commuting Area codes was used to examine factors associated with hospitalization for infection among Medicare beneficiaries starting in-center hemodialysis between 2005 and 2008. A Poisson mixed effects model was used to examine the associations among patient and dialysis facility characteristics and the rate of infection-related hospitalization.

RESULTS: Among 135,545 Medicare beneficiaries, 38,475 (28%) had at least one infection-related hospitalization. The overall rate of infection-related hospitalization was 40.2 per 100 person-years. Age ≥85 years old, cancer, chronic obstructive pulmonary disease, inability to ambulate or transfer, drug dependence, residence in a care facility, serum albumin <3.5 g/dl at dialysis initiation, and dialysis initiation with an access other than a fistula were associated with a ≥20% increase in the rate of infection-related hospitalization. Patients residing in isolated small rural compared with urban areas had lower rates of hospitalization for infection (rate ratio, 0.91; 95% confidence interval, 0.86 to 0.97), and rates of hospitalization for infection varied across the ESRD networks. Measures of socioeconomic status (at the zip code level), total facility staffing, and the composition of staff (percentage of nurses) were not associated with the rate of hospitalization for infection.

CONCLUSIONS: Patient and facility factors associated with higher rates of infection-related hospitalization were identified. The findings from this study can be used to identify patients at higher risk for infection and inform the design of infection prevention strategies.

[20]. Gilbertson DT, Wetmore JB. Infections Requiring Hospitalization in Patients on Hemodialysis. Clin J Am Soc Nephrol. 2015 Dec 7;10(12):2101-3.

Introduction: Although the past decade has witnessed significant improvements in survival or patients receiving hemodialysis (HD) (1), hospitalization rates, particularly for infection, have not improved commensurately. Notable lack of progress is evident regarding hospitalizations for bacteremia/septicemia and pulmonary infections, such as pneumonia and influenza (2). For bacteremia/septicemia, first–year (incident) admission rates showed a 39% relative increase between 2003 and 2010 from 12.9% to 18.0%. Similarly, admission rates for prevalent patients increased 36% from 8.6% to 11.6%. Pneumonia/influenza hospitalization rates also did not improve between 2003 and 2010; although first–year admission rates decreased slightly (from 10.2% to 9.0%), rates for prevalent patients increased from 8.3% to 9.0%.

1a.3. —Linkage

1a.3.1. Source of Systematic Review
Other systematic review and grading of the body of evidence

1a.4. —Clinical Practice Guideline Recommendation

1a.4.1. Guideline Citation
N/A

1a.4.2. Specific Guideline
N/A

1a.4.3. Grade
N/A

1a.4.4. Grades and Associated Definitions
N/A

1a.4.5. Methodology Citation
N/A

1a.4.6. Quantity, Quality, and Consistency
N/A

1a.5.—United States Preventative Services Task Force Recommendation

1a.5.1. Recommendation Citation
N/A

1a.5.2. Specific Recommendation
N/A

1a.5.3. Grade
N/A

1a.5.4. Grades and Associated Definitions
N/A

1a.5.5. Methodology Citation
N/A

1a.6. — Other Systematic Review of the Body of Evidence

1a.6.1. Review Citation
N/A

1a.6.2. Methodology Citation
N/A

1a.7. —Findings from Systematic Review of Body of the Evidence Supporting the Measure

1a.7.1. Specifics Addressed in Evidence Review
N/A

1a.7.2. Grade
N/A

1a.7.3. Grades and Associated Definitions
N/A

1a.7.4. Time Period
N/A

1a.7.5. Number and Type of Study Designs
N/A

1a.7.6. Overall Quality of Evidence
N/A

1a.7.7. Estimates of Benefit
N/A

1a.7.8. Benefits Over Harms
N/A

1a.7.9. Provide for Each New Study
N/A

1a.8. —Other Source of Evidence

1a.8.1. Process Used
N/A

1a.8.2. Citation
N/A

1b.—Evidence to Support Measure Focus

1b.1. Rationale
U.S Dialysis Patients are much more likely to die than age-matched individuals without ESRD. The excess mortality associated with ESRD patients on dialysis is influenced by dialysis facility practices, and is one of several important health outcomes used by providers, health consumers, and insurers to evaluate the quality of care provided in dialysis facilities.

1b.2. Performance Scores
The Standardized Mortality Ratio for Dialysis Facilities varies widely across facilities. For example, for the period 2010 – 2013, the 4 year SMR varied from 0.00 to 3.1. The mean value for 4-year SMR was 1.02 and the standard deviation was 0.28. The data used to calculate these rates is limited to those facilities with at least 3 expected deaths (reflecting how the measure is currently calculated on DFC).

Distribution of the SMR, 2010-2013:

2011: Facilities = 5004, Mean SMR = 1.02, Standard Error = .39, 10th = .057, 25th = .76, 50th = .98, 75th = 1.24, 90th = 1.52

2012: Facilities = 5155, Mean SMR = 1.02, Standard Error = .39, 10th = .058, 25th = .76, 50th = .99, 75th = 1.23, 90th = 1.52

2013: Facilities = 5279, Mean SMR = 1.02, Standard Error = .39, 10th = .057, 25th = .76, 50th = .98, 75th = 1.23, 90th = 1.51

2014: Facilities = 5409, Mean SMR = 1.02, Standard Error = .40, 10th = .056, 25th = .75, 50th = .98, 75th = 1.24, 90th = 1.53

1b.3. Summary of Data Indicating Opportunity
N/A

1b.4. and 1b.5. Disparities
There is evidence indicating that mortality for Hispanic ESRD patients is lower than mortality for non-Hispanic ESRD patients, and mortality for female ESRD patients is lower than mortality for male ESRD patients (see references below). This might suggest absence of a disparity with respect to ethnicity and female sex. However, Kalbfleisch et al (2015) demonstrate that when accounting for within facility differences in racial and ethnic composition, SMRs will vary depending on the percent of patients by race and ethnicity. Without an ethnicity adjustment, identical SMRs for one facility with predominantly Hispanic patients and one facility with predominantly non-Hispanic patients, for example, would give the false impression that quality of care at the two facilities was equivalent, when in fact ethnicity-adjusted mortality at the facility with more Hispanic patients would be lower if performance was identical. This same result holds for sex. As such the SMR is adjusted for these patient characteristics to avoid masking disparities in care across groups. It is also adjusted for race, since historically the issue described above also applied to black patients.

To examine other sociodemographic disparities we included quintiles of socioeconomic status (defined for each patient as the median zip code household income). This had little effect on the resulting expected deaths counts from the model.

See the section on risk adjustment for further details on adjustments for race, ethnicity, and sex based on the findings of Kalbfleisch et al (2015).

1c.—High Priority

1c.1. Demonstrated High-Priority Aspect of Health Care
Affects large numbers, Patient/societal consequences of poor quality, Severity of illness

1c.3. Epidemiologic or Resource Use Data

Epidemiological: At the end of 2013 there were 661,648 patients being dialyzed of which 117,162 were new (incident) End Stage Renal Disease (ESRD) patients (USRDS 2015). ESRD mortality in the US was 33% higher than in Europe (Goodkin, 2004), suggesting that this improvement of this outcome is - possible. The components of unexplained or unexpected mortality that are actionable and associated with treatment and overall management of ESRD and other conditions are important to identify. For example, through effective volume control and fluid weight management' management of mineral and bone disease.

There is substantial evidence on the association between dialysis facility care practices, intermediate outcomes and mortality. For example, these include practices related to adequate dialysis, volume control, and appropriate management of mineral and bone disorder. Port et al, reported that dose of dialysis and BMI were both associated with mortality among hemodialysis patients. [Port 2002.] Flythe and Brunelli (2013) report that high ultrafiltration rates have been shown in several studies to be independently associated with increased risk of mortality. Rivara et al, found that high concentrations of serum calcium and phosphorus were associated with increased mortality (Rivara 2015).

Financial: Inefficient and inappropriate management of all aspects of patient ESRD care carries a high costs for both providers and payers. In 2013, total Medicare costs for the ESRD program were $30.9 billion (a 1.6% increase from 2012) (USRDS 2015).

Policy: This measure has been in use in the Dialysis Facility Reports since 1995 and on the Dialysis Facility Compare (DFC) web site (www.medicare.gov) since 2001, when the Balanced Budget Act (1997) required a system to measure and report the quality of dialysis services under Medicare.

The Dialysis Facility Reports are used by the dialysis facilities and ESRD Networks for quality improvement, and by ESRD state surveyors for monitoring and surveillance. The Standardized Mortality Ratio for Dialysis Facilities (SMR) in particular is used by ESRD state surveyors in conjunction with other standard criteria for prioritizing and selecting facilities to survey. This patient survival classification measure is reported publicly on the DFC web site to assist patients in selecting dialysis facilities.

1c.4. Citations

United States Renal Data System, 2015 annual data report: An overview of the epidemiology of kidney disease in the United States. National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, MD, 2015.

Goodkin DA, Young EW, Kurokawa K, Prutz K-G, Levin NW: Mortality among hemodialysis patients in Europe, Japan, and the United States: Case-mix effects. Am J Kidney Dis 2004; 44[Suppl 2]: S16–S21.

Port FK, Ashby VB, Dhingra RK, Roys EC, Wolfe RA: Dialysis dose and body mass index are strongly associated with survival in hemodialysis patients. J Am Soc Nephrol 13:1061-1066, 2002

Rivara M, Ravel V, Kalantar-Zadeh K et al. Uncorrected and Albumin-Corrected Calcium, Phosphorus, and Mortality in Patients Undergoing Maintenance Dialysis. J Am Soc Nephrol 26: 2015

Flythe JE, Curhan GC, Brunelli SM. Disentangling the Ultrafiltration Rate–Mortality Association: The Respective Roles of Session Length and Weight Gain. Clin J Am Soc Nephrol. 2013 Jul;8(7):1151-61

1c.5. Patient-Reported Outcome Performance Measure (PRO-PM)
N/A

Scientific Acceptability:

1.—Data Sample Description What Type of Data was used for Testing?
Administrative Claims, Clinical database/registry, Administrative Claims, Clinical database/registry

1.1. Identify the Specific Dataset
Data are derived from an extensive national ESRD patient database, which is primarily based on the CMS Consolidated Renal Operations in a Web-enabled Network (CROWN) system. The CROWN data include the Renal Management Information System (REMIS), CROWNWeb facility-reported clinical and administrative data (including CMS-2728 Medical Evidence Form, CMS-2746 Death Notification Form, and CMS-2744 Annual Facility Survey Form data), the historical Standard Information Management System (SIMS) database (formerly maintained by the 18 ESRD Networks until replaced by CROWNWeb in May 2012), the National Vascular Access Improvement Initiative's Fistula First Catheter Last project (in CROWNWeb since May 2012), Medicare dialysis and hospital payment records, transplant data from the Organ Procurement and Transplant Network (OPTN), the Nursing Home Minimum Dataset, the Quality Improvement Evaluation System (QIES) Workbench, which includes data from the Certification and Survey Provider Enhanced Report System (CASPER), the Dialysis Facility Compare (DFC) and the Social Security Death Master File. The database is comprehensive for Medicare patients. Non-Medicare patients are included in all sources except for the Medicare payment records. CROWNWeb provides tracking by dialysis provider and treatment modality for non-Medicare patients. Information on hospitalizations is obtained from Part A Medicare Inpatient Claims Standard Analysis Files (SAFs), and past-year comorbidity is obtained from multiple Part A types (inpatient, home health, hospice, skilled nursing facility claims) and Part B outpatient types of Medicare Claims SAFs.

1.2. What are the Dates of the Data Used in Testing?
Data from calendar years 2010 through 2013 were used for testing.

1.3. What Levels of Analysis Were Tested?
Hospital/facility/agency, Hospital/facility/agency

1.4. How Many and Which Measured Entities Were Included in the Testing and Analysis?
For each year of the four years from 2010-2013, there were 5,004, 5,155, 5,279, and 5,409 facilities, respectively.

1.5. How Many and Which Patients Were Included in the Testing and Analysis?
For each year of the four years from 2010-2013, there were 373,002, 382,145, 390,893, and 397,804 patients, respectively.

1.6. Sample Differences, if Applicable
N/A

1.8 What were the patient-level sociodemographic (SDS) variables that were available and analyzed in the data or sample used?

Patient level:

- Employment status 6 months prior to ESRD
- Sex
- Race
- Ethnicity
- Medicare coverage*

**Assessed at the start of time at risk based on calendar year and facility assignment. Medicare coverage in the model was defined as:*

1. Medicare as primary and Medicaid

2. Medicare as primary and NO Medicaid

3. Medicare as secondary or Medicare HMO

Data on patient level SDS/SES factors obtained from Medicare claims and administrative data.

Proxy/Area level: ZIP code level – Area Deprivation Index (ADI) elements from Census data:

- Unemployment rate (%)
- Median family income (rescaled as (income-60,000)/10,000)
- Income disparity
- Families below the poverty level (%)
- Single-parent households w/ children <18 (%)
- Home ownership rate (%)
- Median home value (rescaled as (homevalue-200,000)/100,000)
- Median monthly mortgage (rescaled as (mortgage-1,500)/1,000)
- Median gross rent (rescaled as (rent-900)/1,000)
- Population (aged 25+) with <9 years of education (%)
- Population (aged 25+) without high school diploma (%)

2a.2—Reliability Testing

2a2.1. Level of Reliability Testing

Performance measure score

2a2.2. Method of Reliability Testing

2011 Submission

To assess reliability, we assessed the degree to which the SMR was consistent year to year. If one looks at two adjacent time intervals, one should expect that a reliable measure will exhibit correlation over these periods since large changes in patterns affecting the measure should not occur for most centers over shorter periods. Year to year variability in the SMR values was assessed across the years 2006, 2007, 2008 and 2009 based on the 5,280 dialysis centers for which an SMR is reported in the 2010 DFRs.

2016 Submission

The reliability of the Standardized Mortality Ratio (SMR) was assessed using data among ESRD dialysis

patients during 2010-2013. If the measure were a simple average across individuals in the facility, the usual approach for determining measure reliability would be a one-way analysis of variance (ANOVA), in which the between and within facility variation in the measure is determined. The inter-unit reliability (IUR) measures the proportion of the total variation of a measure that is attributable to the between-facility variation. The SMR, however, is not a simple average and we instead estimate the IUR using a bootstrap approach, which uses a resampling scheme to estimate the within facility variation that cannot be directly estimated by ANOVA. A small IUR (near 0) reveals that most of the variation of the measures between facilities is driven by random noise, indicating the measure would not be a good characterization of the differences among facilities, whereas a large IUR (near 1) indicates that most of the variation between facilities is due to the real difference between facilities.

Here we describe our approach to calculating IUR. Let $T_1,\ldots,T_N$ be the SMR for these facilities. Within each facility, select at random and with replacement B (say 100) bootstrap samples. That is, if the ith facility has n_i subjects, randomly draw with replacement n_i subjects from those in the same facility, find their corresponding SMR_i and repeat the process B times. Thus, for the ith facility, we have bootstrapped SMRs of $T_{i1}^*,\ldots, T_{i200}^*$. Let S_i^* be the sample variance of this bootstrap sample. From this it can be seen that

$$s_{t,w}^2 = \frac{\sum_{i=1}^{N}[(n_i - 1)S_i^{*2}]}{\sum_{i=1}^{N}(n_i - 1)}$$

is a bootstrap estimate of the within-facility variance in the SMR, namely, $\sigma_{t,w}^2$. Calling on formulas from the one way analysis of variance, an estimate of the overall variance of T_i is

$$s_t^2 = \frac{1}{n'(N-1)}\sum_{i=1}^{N} n_i(T_i - \bar{T})^2$$

where

$$\bar{T} = \sum n_i T_i / \sum n_i$$

is the weighted mean of the observed SMR and

$$n' = \frac{1}{N-1}\left(\sum n_i - \sum n_i^2 \Big/ \sum n_i\right)$$

is approximately the average facility size (number of patients per facility). Note that s_t^2 is the total variation of SMR and is an estimate of $\sigma_b^2 + \sigma_{t,w}^2$, where σ_b^2 is the between-facility variance, the true signal reflecting the differences across facilities. Thus, the estimated IUR, which is defined by

$$IUR = \frac{\sigma_b^2}{\sigma_b^2 + \sigma_{t,w}^2}$$

can be estimated with $(s_t^2 - s_{t,w}^2)/s_t^2$.

The SMR calculation only included facilities with at least 3 expected deaths for each year.

2a2.3. Statistical Results from Reliability Testing

2011 Submission

The correlation between SMR across adjacent years (2006 vs. 2007, 2007 vs 2008, and 2008 vs. 2009) ranged from 0.26 to 0.33, indicating that centers with large or small SMR tended to have larger or

smaller SMR on the following year. These correlations were highly significant. Similarly, there was persistence in SMRs that were significant from year to year.
For example, there were 4.6% of facilities that had an SMR significantly greater than 1.0 in 2006 (18.3% did not have an SMR). Among those facilities, 30% were again significantly larger than 1.0 in 2007. Of the 3.1% of facilities that were significantly less than 1.0 in 2006, 18% were found to be significantly less than 1.0 in 2007. Among the 74% of facilities that had an SMR not significantly different from 1.0 in 2006, 87% remained in that category in 2007. The measure is based on complete data and is not subject to judgment or rater variability. Hence the measures of inter-rater variability are not relevant here.

2016 Submission

Table 1: IUR for One-year SMR Overall and by Facility Size, 2010-2013

	2010		2011		2012		2013	
Facility Size (Number of patients)	IUR	N	IUR	N	IUR	N	IUR	N
All Facilities	0.32	5004	0.26	5155	0.30	5279	0.28	5409
Small (<=45)	0.07	1137	0.06	1205	0.03	1241	0.10	1256
Medium (46–85)	0.19	1924	0.16	1967	0.17	2018	0.17	2132
Large (>=86)	0.48	1943	0.39	1983	0.47	2020	0.42	2022

Table 2: IUR for Four-year SMR Overall and by Facility Size, 2010-2013

Facility Size (Number of patients)	IUR	N
All Facilities	0.59	5935
Small (<=135)	0.30	1242
Medium (136–305)	0.45	2320
Large (>=306)	0.73	2373

2a2.4. Interpretation

2011 Submission

This was not a question on the 2011 Submission Form.

2016 Submission

Overall, we found that IURs for the one-year SMR have a range of 0.26-0.32 across the years 2010, 2011, 2012, and 2013, which indicates that about thirty percent of the variation in the one-year SMR can be attributed to the between-facility differences and about seventy percent to within-facility variation. This value of IUR indicates a relatively **low degree of reliability**. When stratified by facility size, we find that, as expected, larger facilities have greater IUR.
Reliability improved when four-year data were used. Overall, we found that IUR for the four-year SMR for 2010-2013 is 0.59 which indicates that about sixty percent of the variation in the four-year SMR can be attributed to the between-facility differences (signal) and about forty percent to within-facility

variation (noise). This value of IUR indicates a **moderate degree of reliability**. When stratified by facility size, we find that, as expected, larger facilities have greater IUR.

2b2—Validity Testing

2b2.1. Level of Validity Testing

Critical data elements, Performance measure score, Systematic assessment of face validity of performance measure score as an indicator of quality or resource use

2b2.2. Method of Validity Testing

2011 Submission

Adjusted mortality and fractions of patients achieving K/DOQI guidelines for urea reduction ratios (URRs; > or =65%) and hematocrit levels (> or =33%) were computed for 2,858 dialysis facilities from 1999 to 2002 using national data for patients with end-stage renal disease. Linear and Poisson regression were used to study the relationship between K/DOQI compliance and mortality and between changes in compliance and changes in mortality.
Measure validity is also demonstrated by the relationship of the Standardized Mortality Ratio to other quality of care indicators, including hemoglobin greater than 10 g/dL, urea reduction ratio >= 65%, percent of patients dialyzing with a fistula, and percent of patients dialyzing with a catheter.

2016 Submission

Measure validity is demonstrated by the relationship of the Standardized Mortality Ratio to other quality of care indicators, including the Standardized Hospitalization Ratio (SHR) – Admissions, the Standardized Readmission Ratio (SRR), the Standardized Transfusion Ratio (STrR), percent of patients dialyzing with a fistula, percent of patients dialyzing with a catheter, and percent of patients with Kt/V >=1.2. Spearman's rho is reported for all variables. Because the correlations were approximately the same for the four years 2010-2013, we are reporting only the 2013 correlations.
The measure is also maintained on face validity. It was reviewed by a TEP in 2006 for potential implementation on DFC. The general consensus was the SMR captured meaningful information on survival that DFC users could use to assess facility quality. In 2015, a TEP was held specifically to consider prevalent comorbidity adjustments for inclusion in the measure. The TEP's recommendations are reflected in the risk adjustment methodology.

2b2.3. Statistical Results from Validity Testing

2011 Submission

In 2002, facilities in the lowest quintile of K/DOQI compliance for urea reduction ratio (URR) and hematocrit guidelines had 22% and 14% greater mortality rates ($P < 0.0001$) than facilities in the highest quintile, respectively. A 10-percentage point increase in fraction of patients with a URR of 65% or greater was associated with a 2.2% decrease in mortality ($P = 0.0006$), and a 10-percentage point increase in percentage of patients with a hematocrit of 33% or greater was associated with a 1.5% decrease in mortality ($P = 0.003$). Facilities in the highest tertiles of improvement for URR and hematocrit had a change in mortality rates that was 15% better than those observed for facilities in the lowest tertiles ($P < 0.0001$).
Please see the following publication for further details: Wolfe RA, Hulbert-Shearon TE, Ashby VB, Mahadevan S, Port FK. Improvements in dialysis patient mortality are associated with improvements in urea reduction ratio and hematocrit, 1999 to 2002. Am J Kidney Dis. 2005 Jan;45(1):127-35.

2016 Submission

SHR-Admissions: rho=0.20, p<.0001
SRR-Readmissions: rho=0.10, p<.0001
STrR: rho=0.21, p<.0001
AV Fistula: rho= -0.11, p<.0001
Catheter: rho=0.13, p<.0001
Hemodialysis patients with Kt/V>=1.2: rho= -0.04, p<.0001

2b2.4. Interpretation

2011 Submission

This was not a question on the 2011 Submission Form.

2016 Submission

As expected, the SMR is positively correlated with the SHR-Admissions (rho=0.20, p<.0001), SRR-Readmissions (rho=0.10, p<.0001), and the STrR (rho=0.21, p<.0001); higher standardized mortality rates in facilities are associated with higher standardized hospitalization rates, higher standardized readmissions rates and higher standardized transfusion rates. The SMR is negatively correlated with percent of patients in the facility with AV Fistula (rho= -0.11, p<.0001); lower standardized mortality rates are associated with higher rates of AV Fistula use. On the other hand, the SMR is positively correlated with catheter use (rho=0.13, p<.0001), indicating that higher values of SMR are associated with increased use of catheters. The SMR is also found to be negatively correlated (rho= -0.04, p<.0001) with the percent of hemodialysis patients with Kt/V>=1.2, again in the direction expected. Lower SMRs are associated with a higher percentage of patients receiving adequate dialysis dose.

2b3—Exclusion Analysis

2b3.1. Method of Testing Exclusion

N/A

2b3.2. Statistical Results From Testing Exclusion

N/A

2b3.3. Interpretation

N/A

2b4—Risk Adjustment or Stratification

2b4.1. Method of controlling for differences

Statistical risk model with 232 risk factors

2b4.2. Rationale why Risk Adjustment is not needed

N/A

2b4.3. Conceptual, Clinical, and Statistical Methods

The methods for development of the risk factor models have been published and documented previously (Wolfe 1992; Wolfe 2001). The final risk adjustment is based on a Cox or relative risk model. In this model, covariates are taken to act multiplicatively on the death rate and the adjustment model is fitted with facility defining strata so as to provide valid estimates even if the distribution of adjustment variables differs across facilities. Relevant references are Cox (1972) and Kalbfleisch and Prentice (2002). All analyses are performed using SAS.
In the SMR, adjustment is made for patient age, sex, race, ethnicity, cause of ESRD, duration of ESRD, nursing home status, BMI at incidence, comorbidities at incidence, prevalent comorbidities, and calendar year. The SMR is also adjusted for state population death rates.
Below we discuss factors considered for inclusion in the statistical risk model, with emphasis on new factors considered since the last cycle of NQF maintenance endorsement in 2011. We present results and discussion supporting the selection of specific risk factors in the model.
Risk adjustment factors were selected for testing based on several considerations, specifically clinical criteria, expert input, factors identified in the literature as associated with mortality, and data availability. We began with a large set of patient characteristics, comorbidities (at ESRD incidence and prevalent), anthropometrics, and other characteristics. Facility characteristics were also considered. Risk factors were evaluated for appropriateness of the adjustment. For instance, it is important not to adjust for factors that reflect the results of treatment. Factors considered appropriate and supported in the literature were then investigated with statistical models, including interactions between sets of adjusters, to determine if they were empirically related to mortality. Risk factors were also evaluated for face validity as potential predictors of mortality. Finally, SDS/SES factors were evaluated based on appropriateness (whether related to disparities in care), empirical association with the outcome, and support in published literature.

Consideration of prevalent comorbidities as risk adjusters, in addition to incident comorbidities, is in part a response to stakeholder interest to adjust for more current (prevalent) comorbidities to reflect the current health status of dialysis patients, and conditions associated with mortality. CMS contracted with UM-KECC to convene a Technical Expert Panel (TEP) in September 2015 to consider the addition of prevalent comorbidity risk adjustment. The summary report for the TEP can be found here: https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/MMS/TechnicalExpertPanels.html.
The TEP was charged with evaluating the potential of including prevalent comorbidities in the SMR and SHR risk adjustment models. In developing its recommendations, the TEP was asked to apply the criteria for risk-adjusters developed by the National Quality Forum (NQF): (1) Risk adjustment should be based on patient factors that influence the measured outcome and are present at the start of care; (2) Measures should not be adjusted for factors related to disparities in care or the quality of care; (3) Risk adjustment factors must be substantially related to the outcome being measured; (4) Risk adjustment factors should not reflect quality of care by the provider/facility being evaluated.

The TEP evaluated a list of prevalent comorbidities derived through the following process. First, the ESRD Hierarchical Condition Categories (ESRD-HCCs) were used as a starting point to identify ICD-9 diagnosis codes related to dialysis care. Those individual ICD-9 conditions that comprised the respective ESRD HCCs, with a prevalence of at least 0.1% in the patient population, were then selected for analysis to determine their statistical relationship to mortality and/or hospitalization. This step resulted in 555 comorbidity diagnoses (out of over 3000 ICD-9 diagnosis codes in the ESRD-HCCs). Next, an adaptive lasso variable selection method was applied to these 555 diagnoses to identify those with a statistically significant relationship to mortality and/or hospitalization ($p<0.05$). This process identified 242 diagnoses. The TEP members then scored each of these diagnoses as follows:

1. Very likely the result of dialysis facility care
2. Likely the result of dialysis facility care
3. May or may not be the result of dialysis facility care
4. Unlikely to be the result of dialysis facility care
5. Very likely not the result of dialysis facility care

The TEP established that comorbidities scored as "unlikely" or "very unlikely the result of facility care" by at least half of TEP members (simple majority) were judged as appropriate for inclusion as risk-adjusters. This process resulted in 210 conditions as risk adjustors. The TEP further recommended that: (1) comorbidities for inclusion as risk-adjusters in a particular year should be present in Medicare claims in the preceding calendar year; and (2) determination of a prevalent comorbidity required at least two outpatient claims or one inpatient claim. The set of prevalent comorbidities recommended by the TEP for inclusion as risk-adjusters is presented in the model results section.

Consideration of SES/SDS risk factors:

In addition to clinical factors, we evaluated patient and area-level SDS/SES factors as risk adjusters. These were in addition to the current SDS factors of race, ethnicity, and sex. Race and sex were included in the original SMR calculation and ethnicity was added to the model in 2005.

The relationships among individual SDS factors, socioeconomic disadvantage and mortality is well-established in the general population (Singh and Siahpush, 2006; Williams, 2006; Williams and Collins, 2001). Further, individual and market or area-level measures of deprivation have been shown to contribute independently to higher mortality (Smith et al., 1998).

Area-level income and residential segregation specifically have been shown to be associated with poorer outcomes, but particularly so for racial minorities, suggesting the interplay of patient-level (race) and area-level factors related to lower income, neighborhood poverty, segregation, levels of educational attainment, and unemployment levels that jointly influence key health outcomes in mortality and morbidity (Williams, 2006; Williams and Collins, 2001). For example, Williams (2006) explains that differences in health outcomes and mortality by race persist, even after accounting for levels of SES. This suggests the potential added effect of historical and institutional discrimination (e.g., segregation; restricted educational access; fewer health-related resources in poor neighborhoods; no insurance or Medicaid status) that have cumulatively over time led to reduced access to care. Residential segregation of blacks in the U.S., Williams and Collins argue, is a primary cause of SES differences that in turn have resulted in a high prevalence of chronic diseases and related differences in health care outcomes such as mortality (Williams and C Collins 2001, p 404-406).

The relationship between race and mortality, as well as both race and area-level SES factors and mortality in the dialysis population, is also well documented (e.g., Burrows et al, 2014; Crews et al , 2001; Eisenstein et al, 2009; Johns et al , 2014; Kucirka et al, 2010; Ricks et al, 2011; Kalbfleisch et al., 2015; Rodriguez et al, 2007; Kimmel et al, 2013; Streja et al, 2011; Yan et al., 2013; Yan et al, 2013). However, the direction of the relationship between race and mortality is inverted relative to the general population, with lower observed mortality in blacks on chronic dialysis compared to whites, although the relationship is mediated by sociodemographic and clinical factors (Norris et al., 2008; Powe, 2006; Cowie et al. 1994). For example, while black ESRD patients overall have been observed to have lower mortality compared to whites, some studies have shown this difference is attenuated or disappears

once accounting for one or more area level SES factors (Eisenstein et al 2009; Johns et al 2014; Rodriguez et al 2007; Crews et al., 2011; Ricks et al., 2011; Streja et al 2011; Johns et al 2014; Yan 2013; Yan et al 2014).

Differences based on clinical factors and Hispanic ethnicity have also been observed to impact lower mortality (Streja et al 2011; Johns et al 2014; Yan 2013; Yan et al 2013; Ricks et al 2011). Taken together race and ethnicity are shown to be strongly associated with mortality but in different clinical pathways after accounting for specific clinical markers of health status. Race was included as an adjuster in the prior version of SMR because accounting for within-facility racial differences helps to clarify disparities in quality of healthcare provided to patients with ESRD (Kalbfleisch et al., 2015).

Females in the general population have lower mortality rates (CDC National Vital Statistics Reports, 2012) than males. Adjustment for sex allows for a fair comparison between dialysis facilities with patient populations that have a different mix of males and females.

Maintaining employment is a challenge for dialysis patients which in turn can influence well-being and may have a proximal impact on outcomes such as mortality. For example, Curtin et al (AJKD 1996) found that measures of functional status were higher in patients that were employed.
Insurance status is also related to health outcomes but this has not been studied extensively within the dialysis population as it relates to mortality. However, some evidence suggests a link between dual eligibles and hospital utilization (Wright et al., 2015).

In sum these studies suggest notable associations with mortality differences when taking into account patient level SDS factors (race, sex, ethnicity), and area level SES factors. Additionally, employment status and type of insurance coverage (specifically Medicare-Medicaid dual eligibility) suggest a proximate relationship to health outcomes that may have downstream impacts on mortality.
Given these observed linkages, we tested these patient- and area-level SDS/SES variables based on the conceptual relationships as described above and demonstrated in the literature, as well as on the availability of data for the analyses. Measures of area-level socioeconomic deprivation are included as individual components from the Area Deprivation Index (Singh, 2003).

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2b4.4a. Statistical Results

Analyses of Comorbidities and other Clinical Factors

Table 3a presents the SMR model coefficients. Of note, it shows the coefficients on the prevalent comorbidities that were recommended by the TEP as additional risk adjusters (i.e., in addition to the risk adjusters in the SMR model since the 2011 endorsement maintenance review).

Table 3a. Model Coefficients, Data Years 2010–2013

Covariate	Coefficient	p-value
Comorbidities at start of ESRD		
At least of the comorbidities listed	0.15783	<.0001

Covariate	Coefficient	p-value
below		
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		
Hispanic	-0.31125	<.0001
Non-Hispanic ethnicity	Reference	
Unknown ethnicity	0.09259	0.0082
Ethnicity X race: nonwhite interaction		
Hispanic ethnicity	0.30208	<.0001

Covariate	Coefficient	p-value
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

Table 3b. Prevalent Comorbidity Coefficients, Data Years 2010–2013

ICD-9 Description	**ICD-9 Code**	**Coefficient**	**P-value**
Sarcoidosis	135	0.0498	0.1881
Malign neopl prostate	185	-0.06496	<.0001
Malign neopl thyroid	193	-0.24613	<.0001
Oth severe malnutrition	262	0.17484	<.0001
Chr airway obstruct NEC	496	0.16266	<.0001
Postinflam pulm fibrosis	515	0.15118	<.0001
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
Malig neo bladder NOS	1889	0.19631	<.0001
Malig neopl kidney	1890	-0.04592	0.0198
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
Protein-cal malnutr NOS	2639	0.19068	<.0001
Dis urea cycle metabol	2706	-0.01549	0.7273

ICD-9 Description	ICD-9 Code	Coefficient	P-value
Senile dementia uncomp	2900	0.07334	<.0001
Drug withdrawal	2920	0.13901	0.0014
Mental disor NEC oth dis	2948	0.16473	<.0001
Cereb degeneration NOS	3319	0.10725	<.0001
Aut neuropthy in oth dis	3371	0.02175	0.1983
Grand mal status	3453	-0.00454	0.8984
Anoxic brain damage	3481	0.2873	<.0001
Cerebral edema	3485	0.21974	<.0001
Idio periph neurpthy NOS	3569	0.03128	0.0003
Neuropathy in diabetes	3572	0.0258	0.0042
Intermed coronary synd	4111	0.05768	<.0001
Angina pectoris NEC/NOS	4139	0.00621	0.5314
Prim pulm hypertension	4160	0.05884	0.0002
Chr pulmon heart dis NEC	4168	0.1898	<.0001
Prim cardiomyopathy NEC	4254	0.23084	<.0001
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
Subdural hemorrhage	4321	0.13039	<.0001
Aortic atherosclerosis	4400	0.03595	0.0233
Lower extremity aneurysm	4423	0.02375	0.4642
Periph vascular dis NOS	4439	0.16444	<.0001
Stricture of artery	4471	-0.02833	0.0635
Oth inf vena cava thromb	4532	0.30687	<.0001
Emphysema NEC	4928	0.07809	<.0001
Bronchiectas w/o ac exac	4940	0.03515	0.3221
Food/vomit pneumonitis	5070	0.1607	<.0001
Lung involv in oth dis	5178	0.15956	0.0088
Regional enteritis NOS	5559	0.12126	0.0002
Ulceratve colitis unspcf	5569	0.02044	0.5561
Chr vasc insuff intest	5571	0.13302	<.0001
Paralytic ileus	5601	-0.01047	0.5007
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

ICD-9 Description	ICD-9 Code	Coefficient	P-value
Chronic skin ulcer NEC	7078	0.14188	<.0001
Syst lupus erythematosus	7100	0.19554	<.0001
Systemic sclerosis	7101	0.39484	<.0001
Rheumatoid arthritis	7140	0.0896	<.0001
Inflamm polyarthrop NOS	7149	-0.02268	0.6699
Sacroiliitis NEC	7202	0.04558	0.2878
Gangrene	7854	0.17237	<.0001
Cachexia	7994	0.33328	<.0001
Fracture of pubis-closed	8082	0.11422	0.0001
Pelvic fracture NOS-clos	8088	0.05103	0.1367
Fx neck of femur NOS-cl	8208	0.04397	0.0051
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
Candidal esophagitis	11284	0.21728	<.0001
Oth lymp unsp xtrndl org	20280	0.20078	<.0001
Mult mye w/o achv rmson	20300	0.41084	<.0001
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 hprosmlr 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

ICD-9 Description	ICD-9 Code	Coefficient	P-value
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
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 delusion	29020	0.1114	0.0105
Vascular dementia,uncomp	29040	0.10829	<.0001
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
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
Psymotr epil w/o int epi	34540	-0.05696	0.1739
Epilep NOS w/o intr epil	34590	0.10419	<.0001
Critical illness myopthy	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
Subendo infarct, initial	41071	0.28073	<.0001
AMI NEC, unspecified	41080	-0.00835	0.8738

ICD-9 Description	ICD-9 Code	Coefficient	P-value
AMI NOS, unspecified	41090	0.04091	0.0037
Ac ischemic hrt dis NEC	41189	0.07088	0.0013
Pulm embol/infarct NEC	41519	0.02084	0.2221
Atrial fibrillation	42731	0.24876	<.0001
Atrial flutter	42732	0.06245	<.0001
Sinoatrial node dysfunct	42781	-0.04157	<.0001
Crbl emblsm w infrct	43411	0.18777	<.0001
Crbl art ocl NOS w infrc	43491	0.12749	<.0001
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 ulcrtion	44023	0.05416	<.0001
Dsct of thoracic aorta	44101	0.11966	0.0452
Periph vascular dis NEC	44389	0.02878	0.0596
Deep phlebitis-leg NEC	45119	-0.04641	0.1151
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
Chronic obst asthma NOS	49320	0.01834	0.1388
Ch obst asth w (ac) exac	49322	0.01286	0.4885
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
Fecal impaction	56032	0.04821	0.1281
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
Ulcer other part of foot	70715	0.08756	<.0001

ICD-9 Description	ICD-9 Code	Coefficient	P-value
Ulcer oth part low limb	70719	0.16587	<.0001
Pyogen arthritis-unspec	71100	-0.04327	0.3753
Pyogen arthritis-l/leg	71106	0.02859	0.4542
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
Convulsions NEC	78039	0.09323	<.0001
Fx femur intrcaps NEC-cl	82009	-0.00952	0.7647
Fx femur NOS-closed	82100	-0.02136	0.4055
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
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
Less than 6 months of Medicare eligible claims in the previous calendar year		0.53332	<.0001

Most of the coefficient estimates for the prevalent comorbidities are positive and statistically significant, but several do not obtain statistical significance. The very large number of clinical factors in the model expectedly generates multicollinearity among covariates, likely resulting in some unexpected results in direction of coefficient sign and levels of statistical significance. Inclusion of this set of prevalent comorbidities reflects the consensus of the TEP that adjustment for all of these prevalent comorbidities,

in addition to incident comorbidities, is important to reflect the initial and current health condition of the patient in risk adjustment.

2b4.4b. Statistical Results for SDS factors

Table 4a below presents a sensitivity analysis assessing the inclusion of additional SES measures (the base model already includes race, sex, and ethnicity). It compares coefficients in the original (baseline) SMR model with and without adjustment for the SES measures.

Table 4a. Comparing coefficients between sensitivity models with and without SES adjustors, 2010-2013: Model coefficients

	Baseline SMR			SES-adjusted SMR	
Covariate	**Coefficient**	**P-value**		**Coefficient**	**P-value**
Medicare coverage*					
Medicare primary + Medicaid	NA	NA		0.01461	0.0044
Medicare primary + no Medicaid	NA	NA		Reference	-
Medicare secondary/HMO	NA	NA		0.27131	<.0001
Employment status 6 months prior to ESRD					
Unemployed	NA	NA		Reference	-
Employed	NA	NA		0.04617	<.0001
Other/Unknown	NA	NA		0.12512	<.0001
ADI element					
Home value (median)	NA	NA		0.02098	<.0001
Family income (median)	NA	NA		-0.01099	<.0001
Income disparity**	NA	NA		-0.00043	0.8072
Monthly mortgage (median)	NA	NA		-0.01234	0.3707
< 9 years of education (%)	NA	NA		-0.00135	0.0257
No high school diploma (%)	NA	NA		0.00346	<.0001
Home ownership rate (%)	NA	NA		0.00115	<.0001
Families below the poverty level (%)	NA	NA		0.00149	0.0093
Gross rent (median)	NA	NA		-0.03188	0.0617
Single-parent households with children <18 (%)	NA	NA		-0.00172	<.0001
Unemployment rate (%)	NA	NA		0.00194	0.1061
Comorbidities at start of ESRD					
At least one of the comorbidities listed below	0.15783	<.0001		0.15872	<.0001
Atherosclerotic heart disease	0.04559	<.0001		0.04497	<.0001
Other cardiac disease	0.06736	<.0001		0.06610	<.0001
Diabetes***	0.01596	0.0389		0.00909	0.2402
Congestive heart failure	0.12221	<.0001		0.12053	<.0001
Inability to ambulate	0.14953	<.0001		0.14973	<.0001
Chronic obstructive pulmonary disease	0.07399	<.0001		0.07118	<.0001
Inability to transfer	0.11727	<.0001		0.11738	<.0001
Malignant neoplasm, cancer	0.10791	<.0001		0.10938	<.0001
Peripheral vascular disease	0.05252	<.0001		0.05068	<.0001
Cerebrovascular disease, CVA, TIA	0.01484	0.0311		0.01500	0.0295
Tobacco use (current smoker)	0.10783	<.0001		0.10764	<.0001
Alcohol dependence	0.03135	0.0989		0.03031	0.1118
Drug dependence	0.07436	0.0008		0.07526	0.0008
No Medical Evidence (CMS-2728) Form	0.0115	0.7696		0.02392	0.5432
Cause of ESRD					
Diabetes	0.14834	<.0001		0.14697	<.0001
Missing	-0.02574	0.2855		-0.02566	0.2876

Covariate	Baseline SMR			SES-adjusted SMR	
	Coefficient	**P-value**		**Coefficient**	**P-value**
Sex: Female	-0.07704	<.0001		-0.07910	<.0001
Age					
Continuous (years)	-0.05786	0.0003		-0.04705	0.0049
Spline at 14 years	0.08753	<.0001		0.07640	<.0001
Spline at 60 years	0.00651	<.0001		0.00687	<.0001
Race: black X age interaction					
Continuous (years)	-0.0371	0.1983		-0.04956	0.0899
Spline at 14 years	0.03412	0.2384		0.04682	0.1104
Spline at 60 years	0.0009396	0.4437		0.00019	0.8764
In nursing home the previous year	0.31026	<.0001		0.30617	<.0001
Incident BMI					
Log BMI (continuous)	-0.48904	<.0001		-0.49342	<.0001
Log BMI (spline at 35)	0.57016	<.0001		0.57780	<.0001
BMI missing	0.14771	<.0001		0.09123	<.0001
Race					
White	Reference	-		Reference	-
Black	0.31856	0.4275		0.47373	0.2443
Asian/PI	-0.33283	<.0001		-0.32944	<.0001
Native American	-0.12939	0.0015		-0.14447	0.0004
Other/unknown	-0.25062	<.0001		-0.24259	<.0001
Time on ESRD					
< 1 year	-0.18009	<.0001		-0.15762	<.0001
1 to 2 years	-0.21764	<.0001		-0.22296	<.0001
2 to 3 years	-0.17079	<.0001		-0.17220	<.0001
3+ years	Reference	-		Reference	-
Calendar year					
2010	0.1289	<.0001		0.12868	<.0001
2011	0.10334	<.0001		0.10466	<.0001
2012	0.00509	0.3735		0.00637	0.2659
2013	Reference	-		Reference	-
Ethnicity					
Hispanic	-0.31125	<.0001		-0.31963	<.0001
Non-Hispanic ethnicity	Reference	-		Reference	-
Unknown ethnicity	0.09259	0.0082		0.04305	0.2247
Ethnicity X race: nonwhite interaction				0.04305	0.2247
Hispanic ethnicity	0.30208	<.0001		0.29982	<.0001
Unknown ethnicity	0.12773	0.0004		0.13890	0.0001
Race X diabetes as cause of ESRD interaction					
Asian/PI	0.04491	0.0405		0.04655	0.0342
Black	-0.08505	<.0001		-0.08224	<.0001
Native American	-0.00639	0.8865		-0.00422	0.9251
Other	0.10269	0.0266		0.09440	0.0422
Time with ESRD X diabetes as cause of ESRD interaction					
< 1 year	-0.20115	<.0001		-0.20451	<.0001
1 to 2 years	-0.11321	<.0001		-0.11674	<.0001
2 to 3 years	-0.04516	0.0004		-0.04722	0.0002
3+ years	Reference	-		Reference	-
Time on ESRD: < 1 year X race interaction					
Asian/PI	-0.13672	<.0001		-0.12823	<.0001
Black	0.03974	0.0003		0.03854	0.0005
Native American	-0.10883	0.0344		-0.08779	0.0889
Other	0.26902	<.0001		0.28112	<.0001

Covariate	Baseline SMR			SES-adjusted SMR	
	Coefficient	P-value		Coefficient	P-value
Time on ESRD: < 1 year X sex: female interaction	0.00915	0.3193		0.01012	0.2716
Sex: female X cause of ESRD: diabetes interaction	-0.00839	0.3009		-0.00766	0.3454
Race: black X sex: female interaction	0.06686	<.0001		0.06466	<.0001

*Patients without Medicare coverage or with unknown coverage type were excluded from the model.
**Log(100)*(the ratio of the number of households with less than $10,000 in income to the number of households with $50,000 or more in income).
***The diabetes indicator includes all diabetes comorbidities on CMS-2728 and diabetes as cause of ESRD.

Table 4b presents a sensitivity analysis of inclusion of additional SES measures. It compares coefficients for the prevalent comorbidities that were added into the baseline SMR model to the model with adjustment for additional SES measures.

Table 4b. Comparing coefficients between sensitivity models with and without SDS/SES adjustors, 2010-2013: Prevalent comorbidity coefficients

ICD-9 Description	ICD-9 Code	Baseline SMR		SES-adjusted SMR	
		Coefficient	P-value	Coefficient	P-value
Protein-cal malnutr NOS	2639	0.19068	<.0001	0.18507	<.0001
Aut neuropthy in oth dis	3371	0.02175	0.1983	0.01961	0.2463
Epilep NOS w/o intr epil	34590	0.10419	<.0001	0.09632	<.0001
Cerebral edema	3485	0.21974	<.0001	0.21941	<.0001
Subendo infarct, initial	41071	0.28073	<.0001	0.26653	<.0001
AMI NEC, unspecified	41080	-0.00835	0.8738	-0.00041	0.9938
AMI NOS, unspecified	41090	0.04091	0.0037	0.05808	<.0001
Intermed coronary synd	4111	0.05768	<.0001	0.05824	<.0001
Ac ischemic hrt dis NEC	41189	0.07088	0.0013	0.07115	0.0013
Angina pectoris NEC/NOS	4139	0.00621	0.5314	0.01037	0.2964
Cardiomyopath in oth dis	4258	0.04292	0.0329	0.04335	0.0312
Atriovent block complete	4260	0.15129	<.0001	0.15412	<.0001
Parox ventric tachycard	4271	0.18283	<.0001	0.18208	<.0001
Parox tachycardia NOS	4272	0.07202	0.0747	0.07677	0.0578
Atrial fibrillation	42731	0.24876	<.0001	0.24872	<.0001
Atrial flutter	42732	0.06245	<.0001	0.05850	<.0001
Sinoatrial node dysfunct	42781	-0.04157	<.0001	-0.03410	0.0007
Subdural hemorrhage	4321	0.13039	<.0001	0.13410	<.0001
Stricture of artery	4471	-0.02833	0.0635	-0.02009	0.1885
Paralytic ileus	5601	-0.01047	0.5007	-0.01566	0.3137
Convulsions NEC	78039	0.09323	<.0001	0.09773	<.0001
Gangrene	7854	0.17237	<.0001	0.16491	<.0001
Cachexia	7994	0.33328	<.0001	0.32915	<.0001
Candidal esophagitis	11284	0.21728	<.0001	0.21573	<.0001
Sarcoidosis	135	0.0498	0.1881	0.05122	0.1762
Malignant neopl rectum	1541	0.30273	<.0001	0.30444	<.0001
Mal neo liver, primary	1550	0.36764	<.0001	0.36945	<.0001
Mal neo upper lobe lung	1623	0.27901	<.0001	0.27482	<.0001
Mal neo bronch/lung NOS	1629	0.41213	<.0001	0.41821	<.0001
Malign neopl prostate	185	-0.06496	<.0001	-0.05553	0.0002
Malig neo bladder NOS	1889	0.19631	<.0001	0.20432	<.0001
Malig neopl kidney	1890	-0.04592	0.0198	-0.04201	0.0332

ICD-9 Description	ICD-9 Code	Baseline SMR		SES-adjusted SMR	
		Coefficient	P-value	Coefficient	P-value
Malign neopl thyroid	193	-0.24613	<.0001	-0.24139	<.0001
Secondary malig neo lung	1970	0.5234	<.0001	0.51907	<.0001
Second malig neo liver	1977	0.90921	<.0001	0.89766	<.0001
Secondary malig neo bone	1985	0.71735	<.0001	0.72095	<.0001
Malignant neoplasm NOS	1991	0.35314	<.0001	0.35642	<.0001
Oth lymp unsp xtrndl org	20280	0.20078	<.0001	0.19980	<.0001
Mult mye w/o achv rmson	20300	0.41084	<.0001	0.41119	<.0001
Ch lym leuk wo achv rmsn	20410	0.37957	<.0001	0.37275	<.0001
Essntial thrombocythemia	23871	0.12789	0.0003	0.12778	0.0003
Low grde myelody syn les	23872	0.15381	0.0017	0.15872	0.0012
Myelodysplastic synd NOS	23875	0.20555	<.0001	0.20504	<.0001
DMII wo cmp nt st uncntr	25000	0.0721	<.0001	0.08063	<.0001
DMII wo cmp uncntrld	25002	-0.01161	0.0705	-0.00322	0.616
DMII keto nt st uncntrld	25010	0.0982	0.0001	0.10744	<.0001
DMII ketoacd uncontrold	25012	0.14458	<.0001	0.13872	<.0001
DMI ketoacd uncontrold	25013	0.28449	<.0001	0.27018	<.0001
DMII hprosmlr uncontrold	25022	0.04571	0.2251	0.03856	0.3067
DMII renl nt st uncntrld	25040	0.03375	<.0001	0.03346	<.0001
DMI renl nt st uncntrld	25041	0.07679	<.0001	0.08050	<.0001
DMII ophth nt st uncntrl	25050	0.00575	0.482	0.00487	0.5519
DMI ophth uncntrld	25053	0.0629	0.0443	0.05910	0.0592
DMII neuro nt st uncntrl	25060	-0.00885	0.2742	-0.00427	0.5978
DMI neuro nt st uncntrld	25061	0.03226	0.0203	0.03699	0.0078
DMII neuro uncntrld	25062	-0.004	0.7193	-0.00338	0.7615
DMI neuro uncntrld	25063	0.05321	0.037	0.05173	0.0429
DMII circ nt st uncntrld	25070	-0.01444	0.0857	-0.00987	0.2409
DMI circ nt st uncntrld	25071	-0.02272	0.1652	-0.01331	0.4165
DMII circ uncntrld	25072	0.00435	0.7765	0.00623	0.6842
DMII oth nt st uncntrld	25080	0.12132	<.0001	0.11796	<.0001
DMI oth nt st uncntrld	25081	0.09973	<.0001	0.09945	<.0001
DMII oth uncntrld	25082	0.05006	0.0001	0.04745	0.0003
DMI oth uncntrld	25083	0.14618	<.0001	0.14627	<.0001
Glucocorticoid deficient	25541	0.31984	<.0001	0.31685	<.0001
Oth severe malnutrition	262	0.17484	<.0001	0.16782	<.0001
Dis urea cycle metabol	2706	-0.01549	0.7273	-0.01721	0.6988
Amyloidosis NEC	27739	0.32816	<.0001	0.32030	<.0001
Metabolism disorder NEC	27789	0.13233	0.0078	0.13012	0.0089
Morbid obesity	27801	0.00932	0.3779	0.00456	0.6664
Obesity hypovent synd	27803	-0.02953	0.3107	-0.03330	0.253
Sickle cell disease NOS	28260	0.61472	<.0001	0.60712	<.0001
Antin chemo indcd pancyt	28411	0.39212	<.0001	0.36961	<.0001
Other pancytopenia	28419	0.17159	<.0001	0.16941	<.0001
Neutropenia NOS	28800	0.19529	<.0001	0.19467	<.0001
Drug induced neutropenia	28803	0.29116	<.0001	0.29394	<.0001
Prim hypercoagulable st	28981	0.15977	<.0001	0.15749	<.0001
Senile dementia uncomp	2900	0.07334	<.0001	0.08098	<.0001
Senile delusion	29020	0.1114	0.0105	0.11073	0.011
Vascular dementia,uncomp	29040	0.10829	<.0001	0.11062	<.0001
Drug withdrawal	2920	0.13901	0.0014	0.13186	0.0024
Dementia w/o behav dist	29410	0.10461	<.0001	0.10741	<.0001
Dementia w behavior dist	29411	0.12167	<.0001	0.13003	<.0001
Demen NOS w/o behv dstrb	29420	0.15134	<.0001	0.15265	<.0001
Mental disor NEC oth dis	2948	0.16473	<.0001	0.16480	<.0001

ICD-9 Description	ICD-9 Code	Baseline SMR		SES-adjusted SMR	
		Coefficient	P-value	Coefficient	P-value
Schizophrenia NOS-unspec	29590	0.16904	<.0001	0.16688	<.0001
Depress psychosis-unspec	29620	0.08783	<.0001	0.08581	<.0001
Recurr depr psychos-unsp	29630	0.04595	0.0459	0.04318	0.0608
Recur depr psych-severe	29633	0.04953	0.0214	0.05826	0.0068
Bipolar disorder NOS	29680	0.03951	0.0718	0.03852	0.0792
Bipolar disorder NEC	29689	0.0765	0.1406	0.07663	0.14
Episodic mood disord NOS	29690	-0.0061	0.8254	-0.00805	0.7711
Alcoh dep NEC/NOS-unspec	30390	0.02262	0.4481	0.01772	0.5525
Alcoh dep NEC/NOS-remiss	30393	-0.0592	0.1194	-0.06103	0.1081
Opioid dependence-unspec	30400	0.23963	<.0001	0.23251	<.0001
Opioid dependence-contin	30401	0.10216	0.0083	0.09609	0.0131
Drug depend NOS-unspec	30490	0.09283	0.0412	0.09262	0.0415
Cereb degeneration NOS	3319	0.10725	<.0001	0.11542	<.0001
Grand mal status	3453	-0.00454	0.8984	-0.00611	0.8635
Psymotr epil w/o int epi	34540	-0.05696	0.1739	-0.05466	0.1919
Anoxic brain damage	3481	0.2873	<.0001	0.28681	<.0001
Idio periph neurpthy NOS	3569	0.03128	0.0003	0.03480	<.0001
Neuropathy in diabetes	3572	0.0258	0.0042	0.01952	0.0303
Critical illness myopthy	35981	-0.10948	0.0009	-0.10703	0.0011
Prolif diab retinopathy	36202	-0.056	<.0001	-0.04794	<.0001
Mod nonprolf db retinoph	36205	-0.10539	0.0017	-0.09839	0.0034
Diabetic macular edema	36207	-0.16216	<.0001	-0.15551	<.0001
Hyp ht dis NOS w ht fail	40291	-0.01224	0.5579	-0.00822	0.6944
Pulm embol/infarct NEC	41519	0.02084	0.2221	0.02418	0.1565
Prim pulm hypertension	4160	0.05884	0.0002	0.07312	<.0001
Chr pulmon heart dis NEC	4168	0.1898	<.0001	0.18235	<.0001
Prim cardiomyopathy NEC	4254	0.23084	<.0001	0.22949	<.0001
Crbl emblsm w infrct	43411	0.18777	<.0001	0.18506	<.0001
Crbl art ocl NOS w infrc	43491	0.12749	<.0001	0.13064	<.0001
Aortic atherosclerosis	4400	0.03595	0.0233	0.03158	0.0465
Athscl extrm ntv art NOS	44020	0.02718	0.0013	0.03302	<.0001
Ath ext ntv at w claudct	44021	0.02956	0.0173	0.03543	0.0044
Ath ext ntv at w rst pn	44022	0.0837	<.0001	0.08269	<.0001
Ath ext ntv art ulcrtion	44023	0.05416	<.0001	0.05839	<.0001
Dsct of thoracic aorta	44101	0.11966	0.0452	0.11933	0.0462
Lower extremity aneurysm	4423	0.02375	0.4642	0.02257	0.487
Periph vascular dis NEC	44389	0.02878	0.0596	0.03332	0.0294
Periph vascular dis NOS	4439	0.16444	<.0001	0.16631	<.0001
Deep phlebitis-leg NEC	45119	-0.04641	0.1151	-0.03405	0.2481
Oth inf vena cava thromb	4532	0.30687	<.0001	0.29469	<.0001
Ac DVT/emb prox low ext	45341	0.08701	<.0001	0.07657	0.0001
Ch DVT/embl low ext NOS	45350	0.05663	0.1025	0.05742	0.0979
Ch DVT/embl prox low ext	45351	0.03822	0.3528	0.03670	0.3723
Ch emblsm subclav veins	45375	0.16767	<.0001	0.16457	0.0001
Ac DVT/embl up ext	45382	0.07744	0.0026	0.07820	0.0023
Ac emblsm axillary veins	45384	0.07944	0.049	0.07311	0.0702
Ac embl internl jug vein	45386	0.08068	0.0006	0.07453	0.0016
Ac embl thorac vein NEC	45387	0.07384	0.0288	0.07472	0.0269
Esoph varice oth dis NOS	45621	0.18859	<.0001	0.18789	<.0001
Obs chr bronc w(ac) exac	49121	0.13193	<.0001	0.12911	<.0001
Obs chr bronc w ac bronc	49122	-0.0088	0.5824	-0.00995	0.5339
Emphysema NEC	4928	0.07809	<.0001	0.08582	<.0001
Chronic obst asthma NOS	49320	0.01834	0.1388	0.01747	0.1583

ICD-9 Description	ICD-9 Code	Baseline SMR		SES-adjusted SMR	
		Coefficient	P-value	Coefficient	P-value
Ch obst asth w (ac) exac	49322	0.01286	0.4885	0.01140	0.5388
Bronchiectas w/o ac exac	4940	0.03515	0.3221	0.04016	0.2583
Chr airway obstruct NEC	496	0.16266	<.0001	0.16095	<.0001
Food/vomit pneumonitis	5070	0.1607	<.0001	0.15828	<.0001
Postinflam pulm fibrosis	515	0.15118	<.0001	0.15382	<.0001
Lung involv in oth dis	5178	0.15956	0.0088	0.15551	0.0108
Ac resp flr fol trma/srg	51851	0.02845	0.355	0.02576	0.4026
Ot pul insuf fol trm/srg	51852	-0.06297	0.3178	-0.05118	0.4168
Other pulmonary insuff	51882	0.09857	<.0001	0.10648	<.0001
Chronic respiratory fail	51883	0.11434	<.0001	0.11153	<.0001
Acute & chronc resp fail	51884	0.12628	<.0001	0.11971	<.0001
Gastrostomy comp - mech	53642	0.15365	<.0001	0.15654	<.0001
Regional enteritis NOS	5559	0.12126	0.0002	0.11992	0.0002
Ulceratve colitis unspcf	5569	0.02044	0.5561	0.02618	0.4509
Chr vasc insuff intest	5571	0.13302	<.0001	0.12928	<.0001
Fecal impaction	56032	0.04821	0.1281	0.04974	0.1165
Intestinal obstruct NOS	5609	0.08494	<.0001	0.08695	<.0001
Alcohol cirrhosis liver	5712	0.15572	<.0001	0.15281	<.0001
Cirrhosis of liver NOS	5715	0.41697	<.0001	0.41478	<.0001
Hepatic encephalopathy	5722	0.31225	<.0001	0.30759	<.0001
Portal hypertension	5723	0.22903	<.0001	0.22448	<.0001
Oth sequela, chr liv dis	5728	0.2376	<.0001	0.23753	<.0001
Chronic pancreatitis	5771	0.17966	<.0001	0.17399	<.0001
Pressure ulcer, low back	70703	0.22465	<.0001	0.22107	<.0001
Pressure ulcer, hip	70704	0.24053	<.0001	0.24067	<.0001
Pressure ulcer, buttock	70705	0.09838	<.0001	0.10478	<.0001
Ulcer of lower limb NOS	70710	0.09412	<.0001	0.09780	<.0001
Ulcer other part of foot	70715	0.08756	<.0001	0.08939	<.0001
Ulcer oth part low limb	70719	0.16587	<.0001	0.16417	<.0001
Chronic skin ulcer NEC	7078	0.14188	<.0001	0.14378	<.0001
Syst lupus erythematosus	7100	0.19554	<.0001	0.19217	<.0001
Systemic sclerosis	7101	0.39484	<.0001	0.39577	<.0001
Pyogen arthritis-unspec	71100	-0.04327	0.3753	-0.03074	0.5285
Pyogen arthritis-l/leg	71106	0.02859	0.4542	0.02339	0.5399
Rheumatoid arthritis	7140	0.0896	<.0001	0.08839	<.0001
Inflamm polyarthrop NOS	7149	-0.02268	0.6699	-0.01212	0.8198
Sacroiliitis NEC	7202	0.04558	0.2878	0.05254	0.221
Ac osteomyelitis-unspec	73000	-0.04987	0.131	-0.04126	0.2117
Ac osteomyelitis-ankle	73007	-0.08917	<.0001	-0.08530	<.0001
Ac osteomyelitis NEC	73008	-0.03235	0.307	-0.02967	0.3489
Osteomyelitis NOS-hand	73024	0.24478	<.0001	0.25059	<.0001
Osteomyelitis NOS-ankle	73027	-0.12149	<.0001	-0.12727	<.0001
Path fx vertebrae	73313	0.22531	<.0001	0.22783	<.0001
Aseptic necrosis femur	73342	0.10754	0.0188	0.10703	0.0194
Asept necrosis bone NEC	73349	0.15539	0.006	0.15596	0.0058
Coma	78001	0.21242	<.0001	0.21663	<.0001
Fracture of pubis-closed	8082	0.11422	0.0001	0.11024	0.0002
Pelvic fracture NOS-clos	8088	0.05103	0.1367	0.06459	0.0593
Fx femur intrcaps NEC-cl	82009	-0.00952	0.7647	-0.01431	0.6523
Fx neck of femur NOS-cl	8208	0.04397	0.0051	0.05341	0.0007
Fx femur NOS-closed	82100	-0.02136	0.4055	-0.01357	0.5972
Amput below knee, unilat	8970	-0.09002	<.0001	-0.08001	<.0001
Amputat bk, unilat-compl	8971	-0.01234	0.7926	-0.00414	0.9299

ICD-9 Description	ICD-9 Code	Baseline SMR		SES-adjusted SMR	
		Coefficient	P-value	Coefficient	P-value
Amput above knee, unilat	8972	-0.11732	<.0001	-0.11178	<.0001
Amputat leg, unilat NOS	8974	-0.08497	0.064	-0.07749	0.0912
React-indwell urin cath	99664	0.05432	0.0555	0.05003	0.0778
Compl heart transplant	99683	0.09947	0.1582	0.10317	0.1429
Asymp hiv infectn status	V08	0.46221	<.0001	0.45689	<.0001
Heart transplant status	V421	0.19932	0.0002	0.19111	0.0003
Liver transplant status	V427	0.03733	0.2656	0.03314	0.3237
Trnspl status-pancreas	V4283	0.1358	0.0026	0.12049	0.0076
Gastrostomy status	V441	0.02576	0.2534	0.02395	0.288
Ileostomy status	V442	-0.07135	0.0349	-0.07559	0.0254
Colostomy status	V443	0.01882	0.4186	0.01801	0.4392
Urinostomy status NEC	V446	0.27221	<.0001	0.26452	<.0001
Respirator depend status	V4611	0.08244	<.0001	0.08209	<.0001
Status amput othr toe(s)	V4972	-0.02421	0.1067	-0.02797	0.0622
Status amput below knee	V4975	0.14259	<.0001	0.13869	<.0001
Status amput above knee	V4976	0.09281	<.0001	0.09153	<.0001
Atten to gastrostomy	V551	-0.05311	0.0197	-0.04863	0.0326
Long-term use of insulin	V5867	0.0585	<.0001	0.05185	<.0001
BMI 40.0-44.9, adult	V8541	-0.03968	0.0375	-0.04271	0.0252
Less than 6 months of Medicare eligible claims in the previous calendar year	—	0.53332	<.0001	0.44731	<.0001

Patient-level SDS: Compared with men, women were less likely to die (OR=0.92; p<0.01). Patients of Asian/PI, Native American and Other/unknown race, respectively, all had lower odds of mortality compared to the reference group of white patients (OR=0.72, p<0.01; OR= 0.87, p<0.01; OR=0.78, p<0.01). Mortality in Black patients was not significantly different from the reference group. We did find that Hispanic patients had lower odds of mortality (OR=0.73, p<0.01), consistent with observations in previous studies

Patient-level SES: Patients employed prior to ESRD incidence, and patients with unknown employment status (OR=1.13, p<0.01) had higher odds of mortality (OR=1.05; p<0.01) compared to unemployed patients. Note that for employment categories, the "Other/Unknown" category represents a diverse patient group with regard to SES, such as students, homemakers and those who are retired. Compared with Medicare-only patients, patients with both Medicare and Medicaid (OR=1.01; p=.004) and patients with Medicare as secondary/Medicare HMO (OR=1.31; p<0.01) had higher odds of mortality. The result for dually eligible patients having higher mortality is consistent with the hypothesis that this insurance category, on average, represents an at-risk group, but further examination is needed for the higher odds of mortality for patients with Medicare as secondary payer or HMO. It is possible that these patients represent a larger portion of incident ESRD patients, which has a known higher mortality in the first year of ESRD.

Area-level SES: Areas with high measures of deprivation are likely to have higher mortality as demonstrated in the literature for the general population as well as for the ESRD population. In general, we observed small effects on odds of mortality, in the expected direction, for most of the individual

indicators of area deprivation, with several achieving statistical significance. This included a low percentage of the population with a high school diploma. The percentage of single parent households with children <18 years however had a slightly negative impact on odds of mortality. But this could be attributed to being a generally a younger population that qualifies for social assistance and Medicaid. Overall the results provide nominal support for the postulated relationships between indicators of area-level deprivation and mortality. Further analysis would need to be conducted to determine any differences in impact when combining these factors into a composite measure of area-level deprivation. But this will be subject to data availability.

The figure below shows the correlation between facility SMRs with and without adjustment for patient and area-level SES.

Figure 1. Correlation between SMR with and without SES adjustment, 2010-2013

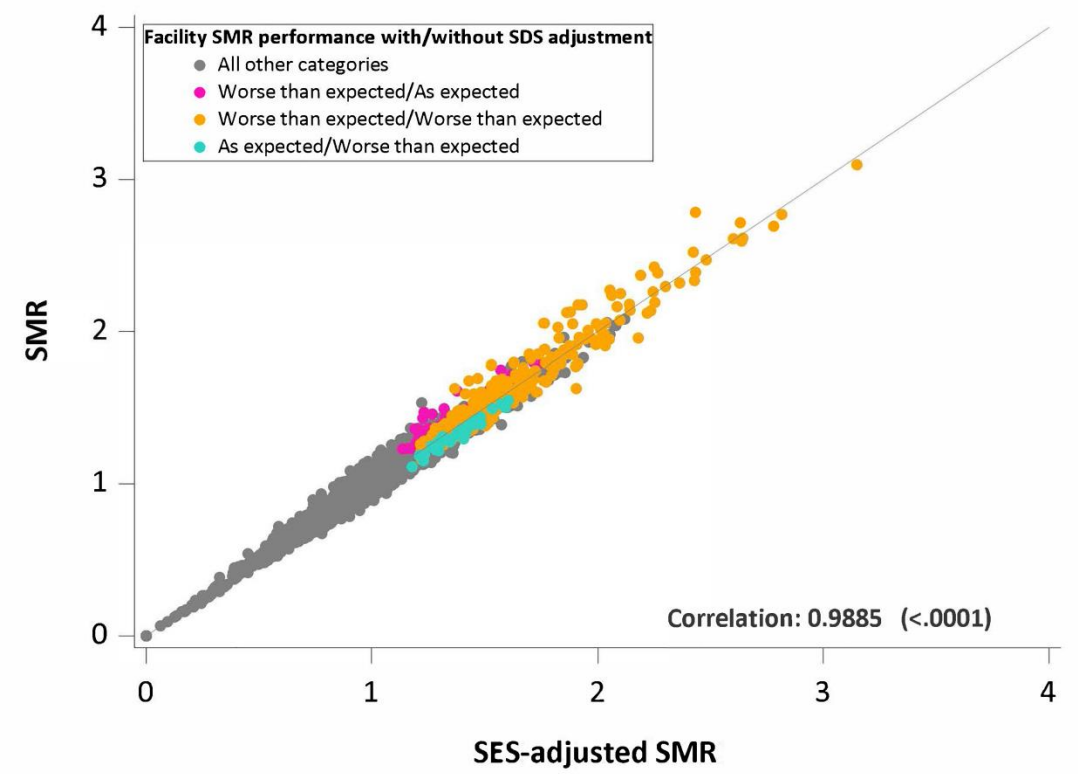


Table 5. Flagging rates, by model with and without all SES adjustors: 2010-2013

	With SES			
Without SDS *(current model)*	Better than Expected	As Expected	Worse than Expected	**Total**
Better than Expected	400	57	0	**457 (7.7%)**
As Expected	52	4938	33	**5023 (84.7%)**
Worse than Expected	0	57	393	**450 (7.6%)**
Total	**452 (7.6%)**	**5052 (85.2%)**	**426 (7.2%)**	—

After adjustment for patient and area-level SES, 199 facilities (3.4%) changed performance categories. Ninety (1.5%) facilities were down-graded, and 109 (1.8%) were upgraded.

These analyses indicate that some patient-level SES variables affect expected death rates, while most patient and area-level SES indicators have at most minimal effect. Furthermore, SMRs with and without adjustment for patient SES and area SES are highly correlated (0.9885, $p<0.0001$), and adjustment for SES shifts facility performance only slightly. This suggests SES does not contribute much to the flagging profiles for facility performance.

Risk adjustment for SES factors would probably reduce the likelihood of penalizing facilities serving a disproportionately larger disadvantaged patient population, resulting in lower quality performance scores and incentive payment reductions for the facility. At the same time, risk adjustment for SES may improve access to care for disadvantaged patients, by guarding against the potential providers may be otherwise less willing to take on these patients because of their higher comorbidity burden. This in effect comes with the risk of effectively holding providers to different (more relaxed) standards for expected patient outcomes, and relatedly may reduce access to the highest quality care for disadvantaged patients. Not adjusting for these sociodemographic and SES factors minimizes the likelihood of reinforcing disparities and counters the notion that different standards in care are acceptable in these populations. In the absence of definitive evidence demonstrating that socioeconomic risk adjustment does not result in differential access to care, we believe that the most appropriate decision is not to risk adjust for socioeconomic factors. Our primary goal should be to implement quality measures that result in the highest quality of patient care and equitable access for all patients to that care.

In the final SMR model we continue to include race, ethnicity, and sex (SDS factors) for risk adjustment based on results from the literature, discussed in section 2b4.3. Patient level SES factors are not included in the final risk adjusted model. Given the very small impact of area-level SES factors we decided not to include these as risk adjustments in the final model. While other studies have shown the association between these patient and area-level SES factors and mortality, further work is needed to demonstrate that differences based on these factors are not related to facility care, in order to prevent disparities in care.

2b4.5. Method Used to Develop the Statistical Model or Stratification Approach

See 2b4.3.

2b4.6. Statistical Risk Model Discrimination Statistics (e.g., c-statistic, R^2)

In this model, the C-Index=0.724 which suggests good predictive ability of the risk model.

2b4.7. Statistical Risk Model Calibration Statistics (e.g., Hosmer-Lemeshow statistic)

N/A

2b4.8. Statistical Risk Model Calibration—Risk decile plots or calibration curves

See Figure 2 in 2b4.10.

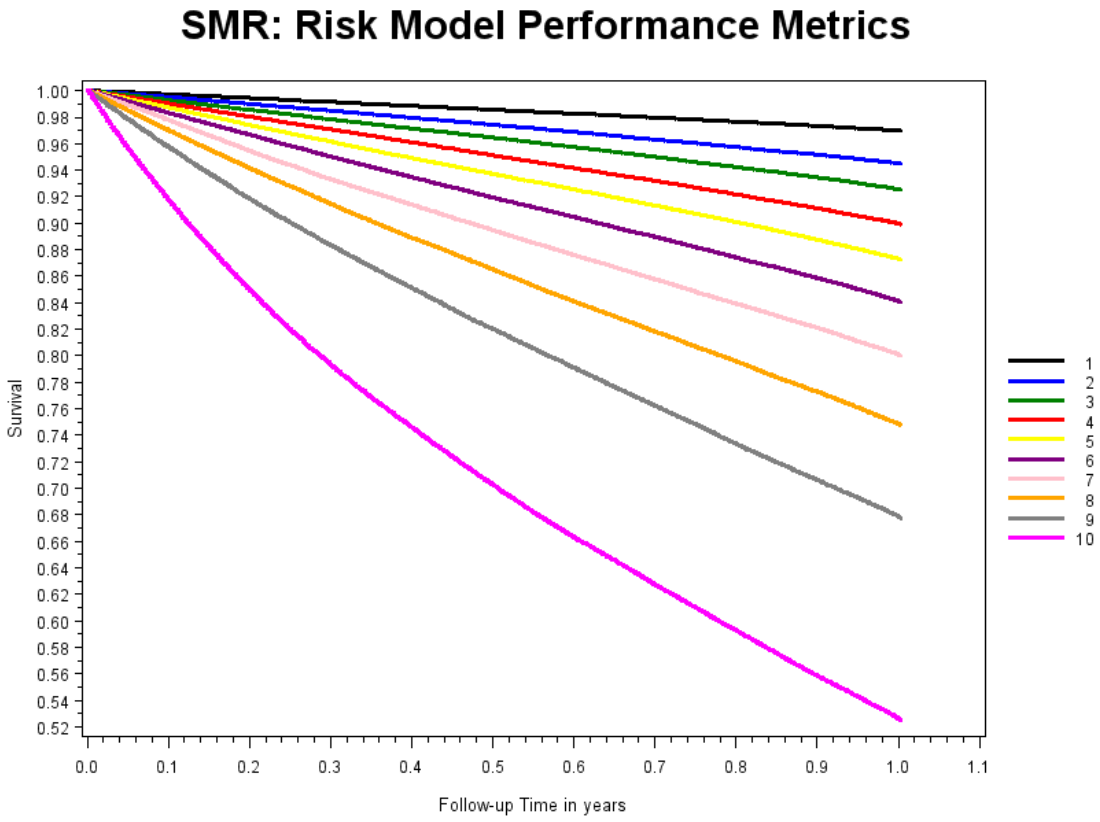
2b4.9. Results of Risk stratification Analysis

N/A

2b4.10. Interpretation

Figure 2 is the decile plot showing estimates of cumulative rates by years. The plot shows that the risk factors in the model are discriminating well between patients. There is good separation among all 10 groups and the ordering is as predicted by the model (patients predicted to be at lower risk have the best survival rates). The absolute differences between the groups is also large with survival at one year ranging from 96% for those patients predicted to have the lowest mortality rates (group 1) down to 60% for those predicted to have the lowest rates of survival (group 10).

Figure2. Decile plot for SMR



2b4.11. Optional Additional Testing for Risk Adjustment

N/A

2b5—Identification of statistically significant and clinically meaningful differences

2b5.1. Method for determining

The p-value for a given facility is a measure of the strength of the evidence against the hypothesis that the mortality rate for this facility is identical to that seen nationally overall, having adjusted for the patient mix. Thus, the p-value is the probability that the facility's SMR would deviate from 1.00 (national rate) by at least as much as the facility's observed SMR. In practice, the p-value is computed using a Poisson approximation under which the distribution of the number of deaths in the facility is Poisson with a mean value equal to E, the expected number of deaths as computed from the Cox model. Accordingly, if the observed number, O, is greater than E, then p-value = 2 * Pr(X>=O) where X has a

Poisson distribution with mean E. Similarly, if O<E, the p-value = 2 * Pr(X <=O) where X has a Poisson distribution with mean E.

2b5.2. Statistical Results

Table 6. Number and percentage of facilities by classification of the 2013 SMR. Categories stratified by facility size.

Number of patients	Better than expected	As expected	Worse than expected
<=45	0.48% (26)	21.09% (1141)	0.54% (29)
45-85	1.09% (59)	37.93% (2052)	1.50% (81)
>=86	2.03% (110)	33.48% (1811)	1.87% (101)

Table 7. Number and percentage of facilities by classification of the 2010-2013 SMR. Categories stratified by facility size.

Number of patients	Better than expected	As expected	Worse than expected
<=135	0.69% (41)	19.05% (1131)	1.18% (70)
136-305	2.21% (131)	34.38% (2041)	2.49% (148)
>=306	4.80 % (285)	31.28% (1857)	3.91% (232)

2b5.3. Interpretation

Facilities are flagged if they have outcomes that are extreme when compared to the variation in national death rates adjusted for patient case-mix.

For both the one-year SMR and four-year SMR, a majority of facilities had mortality that was “As Expected.” Overall, for the 2013 SMR, approximately 3.6% of facilities had SMR that was “Better than expected,” while 3.9% of all facilities had SMR that was “Worse than expected.” Across all facilities, for the 2010-2013 SMR, approximately 7.7% of facilities had a SMR that was “Better than expected,” while 7.6% of facilities had a SMR that was “Worse than expected.”

2b6—Comparability of performance scores

2b6.1. Method of testing conducted to demonstrate comparability

N/A

2b6.2. Statistical Results

N/A

2b6.3. Interpretation

N/A

Feasibility:

3a.1. How are the data elements needed to compute measure scores generated

Generated or collected by and used by healthcare personnel during the provision of care (e.g., blood pressure, lab value, diagnosis, depression score)

3b.1. Are the data elements needed for the measure as specified available electronically
ALL data elements are in defined fields in a combination of electronic sources

3b.3. If this is an eMeasure, provide a summary of the feasibility assessment
Attachment:

3c.1. Describe what you have learned or modified as a result of testing
N/A

3c.2. Describe any fees, licensing, or other requirements
N/A

Usability and Use

4.1—Current and Planned Use

4a.1. Program, sponsor, purpose, geographic area, accountable entities, patients
Public Reporting: Dialysis Facility Compare (DFC)

Purpose: Dialysis Facility Compare helps patients find detailed information about Medicare-certified dialysis facilities. They can compare the services and the quality of care that facilities provide.

Geographic area: United States

Number of accountable entities: All Medicare-certified dialysis facilities who are eligible for the measure, and have at least 3 expected deaths during 2010-2013. For the most recent DFC report, that was 5916 facilities.

Patients included: All patients who meet the requirements to be included in the measure.

4a.2. If not publicly reported or used for accountability, reasons
N/A

4a.3. If not, provide a credible plan for implementation
N/A

4b.1. Progress on improvement
Mortality rates have decreased over time as evidenced by the coefficients for calendar year from the SMR model. The mortality rate for 2011 was 2.6% lower compared to 2010 (p-value<0.0001), and the rates for 2012 and 2013 were lower compared to 2010 at 12.4% and 13.0%, respectively (p-value <0.0001).

2011: Coefficient = -0.026, P-value = <0.0001
2012: Coefficient = -0.124, P-value = <0.0001
2013: Coefficient = -0.130, P-value = <0.0001

4b.2. If no improvement was demonstrated, what are the reasons
N/A

Related and Competing Measures:

5—Relation to Other NQF-Endorsed Measures

5.1a. The measure titles and NQF numbers are listed here
1463 : Standardized Hospitalization Ratio for Dialysis Facilities
2496 : Standardized Readmission Ratio (SRR) for dialysis facilities

5.1b. If the measures are not NQF-endorsed, indicate the measure title
N/A

5a—Harmonization

5a.1. Are the measure specifications completely harmonized
No

5a.2. If not completely harmonized, identify the differences rationale, and impact
The specifications are not completely harmonized. Each measure assesses different outcomes as reflected in certain differences across the measure specifications. SMR, and SHR and SRR are harmonized to the population they measure (Medicare-covered ESRD patients), methods (SMR and SHR) and certain risk adjustment factors specific to the ESRD population. SMR and SHR adjust for the same comorbidity risk factors, a similar set of patient characteristics, and use fixed effects in their modeling approach. The differences between SMR and SHR and SRR reflect adjustment for factors specific to the outcome of each respective measure. Both SMR and SHR adjust for a set of prevalent comorbidities (observed in a prior year), however the complete set of comorbidities for SMR differs from SRR. SRR, a measure of hospital utilization adjusts for planned readmissions; and for discharging hospital, acknowledging that for readmission, hospitals also bear accountability for properly coordinating care with the dialysis facility. These risk adjustments in SRR account for those characteristics specifically associated with readmission, and do not apply to SMR. Only SMR adjusts for state death rates, race, and ethnicity to account for these respective differences related to mortality outcomes and that are deemed outside of a facility's control.

5b—Competing measures

5b.1 Describe why this measure is superior to competing measures
N/A

Additional Information:

Co.1. —Measure Steward Point of Contact

Co.1.1. Organization
Centers for Medicare & Medicaid Services

Co.1.2. First Name
Sophia

Co.1.3. Last Name
Chan

Co.1.4. Email Address
Sophia.Chan@cms.hhs.gov

Co.1.5. Phone Number
410-786-5050

Co.2. —Developer Point of Contact (indicate if same as Measure Steward Point of Contact

Co.2.1. Organization
University of Michigan Kidney Epidemiology and Cost Center

Co.2.2. First Name
Casey

Co.2.3. Last Name
Parrotte

Co.2.4. Email Address
parrotte@med.umich.edu

Co.2.5. Phone Number
N/A

Ad.1. Workgroup/Expert Panel Involved in Measure Development
The following is a list of TEP members who participated in the End-Stage Renal Disease Evaluation of Potential Prevalent Comorbidity Adjustments in the Standardized Hospitalization Ratio (SHR) and the Standardized Mortality Ratio (SMR) TEP. In this advisory role, the primary duty of the TEP was to review any existing measures in terms of comorbidities included as adjusters, and determine if there was sufficient evidence to support the inclusion of specific proposed comorbidities as measure adjusters, and relatedly, suggest measure specifications.

Caroline Steward, APRN, CCRN, CNN
Advanced Practice Nurse (Hemodialysis)
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Trenton, NJ

Dana Miskulin, MD, MS
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Outcomes Monitoring Program, Dialysis Clinic Inc.
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Chronic Disease Research Group
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Cincinnati Children's Hospital Medical Center
Program Director
University of Cincinnati
Cincinnati, OH

Roberta Wager, MSN, RN
Renal Care Coordinator
Fresenius Medical Care
Member of Forum of ESRD Networks Beneficiary Council
Forum of ESRD Networks
Boerne, TX

Danielle Ward
Member of Forum of ESRD Networks Beneficiary Council
Forum of ESRD Networks
Board Member

Network 6
Wake Forest, NC

Ad.2. Year the Measure Was First Released
1995

Ad.3. Month and Year of Most Recent Revision
04, 2016

Ad.4. What is your frequency for review/update of this measure?
Annually

Ad.5. When is your next scheduled review/update for this measure?
04, 2017

Ad.6. Copyright Statement

Ad.7. Disclaimers

Ad.8. Additional Information/Comments

S.15. Detailed risk model specifications

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 ($ß_j$) 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

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

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, $ß_1, ß_2, \ldots, ß_p$ and the corresponding predicted value for the i^{th} patient-record is given by

$$X_i ß = ß_1 x_{i1} + ß_2 x_{i2} + \ldots + ß_p x_{ip}. \qquad (1)$$

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

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

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:

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

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 = Obs/Exp.

S.15. Detailed risk model specifications

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		
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 c

Prevalent Comorbidity Coefficients, Data Years 2010–2013

ICD-9 Description	ICD-9 Code	Coefficient	P-value
Sarcoidosis	135	0.0498	0.1881
Malign neopl prostate	185	-0.06496	<.0001
Malign neopl thyroid	193	-0.24613	<.0001
Oth severe malnutrition	262	0.17484	<.0001
Chr airway obstruct NEC	496	0.16266	<.0001
Postinflam pulm fibrosis	515	0.15118	<.0001
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
Malig neo bladder NOS	1889	0.19631	<.0001
Malig neopl kidney	1890	-0.04592	0.0198
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
Protein-cal malnutr NOS	2639	0.19068	<.0001
Dis urea cycle metabol	2706	-0.01549	0.7273
Senile dementia uncomp	2900	0.07334	<.0001
Drug withdrawal	2920	0.13901	0.0014
Mental disor NEC oth dis	2948	0.16473	<.0001
Cereb degeneration NOS	3319	0.10725	<.0001
Aut neuropthy in oth dis	3371	0.02175	0.1983
Grand mal status	3453	-0.00454	0.8984
Anoxic brain damage	3481	0.2873	<.0001
Cerebral edema	3485	0.21974	<.0001
Idio periph neurpthy NOS	3569	0.03128	0.0003
Neuropathy in diabetes	3572	0.0258	0.0042
Intermed coronary synd	4111	0.05768	<.0001
Angina pectoris NEC/NOS	4139	0.00621	0.5314
Prim pulm hypertension	4160	0.05884	0.0002
Chr pulmon heart dis NEC	4168	0.1898	<.0001
Prim cardiomyopathy NEC	4254	0.23084	<.0001
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
Subdural hemorrhage	4321	0.13039	<.0001

Aortic atherosclerosis	4400	0.03595	0.0233
Lower extremity aneurysm	4423	0.02375	0.4642
Periph vascular dis NOS	4439	0.16444	<.0001
Stricture of artery	4471	-0.02833	0.0635
Oth inf vena cava thromb	4532	0.30687	<.0001
Emphysema NEC	4928	0.07809	<.0001
Bronchiectas w/o ac exac	4940	0.03515	0.3221
Food/vomit pneumonitis	5070	0.1607	<.0001
Lung involv in oth dis	5178	0.15956	0.0088
Regional enteritis NOS	5559	0.12126	0.0002
Ulceratve colitis unspcf	5569	0.02044	0.5561
Chr vasc insuff intest	5571	0.13302	<.0001
Paralytic ileus	5601	-0.01047	0.5007
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
Chronic skin ulcer NEC	7078	0.14188	<.0001
Syst lupus erythematosus	7100	0.19554	<.0001
Systemic sclerosis	7101	0.39484	<.0001
Rheumatoid arthritis	7140	0.0896	<.0001
Inflamm polyarthrop NOS	7149	-0.02268	0.6699
Sacroiliitis NEC	7202	0.04558	0.2878
Gangrene	7854	0.17237	<.0001
Cachexia	7994	0.33328	<.0001
Fracture of pubis-closed	8082	0.11422	0.0001
Pelvic fracture NOS-clos	8088	0.05103	0.1367
Fx neck of femur NOS-cl	8208	0.04397	0.0051
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
Candidal esophagitis	11284	0.21728	<.0001
Oth lymp unsp xtrndl org	20280	0.20078	<.0001
Mult mye w/o achv rmson	20300	0.41084	<.0001
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 hprosmlr 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
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 delusion	29020	0.1114	0.0105
Vascular dementia,uncomp	29040	0.10829	<.0001
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
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
Psymotr epil w/o int epi	34540	-0.05696	0.1739
Epilep NOS w/o intr epil	34590	0.10419	<.0001
Critical illness myopthy	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
Subendo infarct, initial	41071	0.28073	<.0001
AMI NEC, unspecified	41080	-0.00835	0.8738
AMI NOS, unspecified	41090	0.04091	0.0037
Ac ischemic hrt dis NEC	41189	0.07088	0.0013
Pulm embol/infarct NEC	41519	0.02084	0.2221
Atrial fibrillation	42731	0.24876	<.0001
Atrial flutter	42732	0.06245	<.0001
Sinoatrial node dysfunct	42781	-0.04157	<.0001
Crbl emblsm w infrct	43411	0.18777	<.0001
Crbl art ocl NOS w infrc	43491	0.12749	<.0001
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 ulcrtion	44023	0.05416	<.0001
Dsct of thoracic aorta	44101	0.11966	0.0452
Periph vascular dis NEC	44389	0.02878	0.0596
Deep phlebitis-leg NEC	45119	-0.04641	0.1151
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
Chronic obst asthma NOS	49320	0.01834	0.1388
Ch obst asth w (ac) exac	49322	0.01286	0.4885
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
Fecal impaction	56032	0.04821	0.1281
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
Ulcer other part of foot	70715	0.08756	<.0001
Ulcer oth part low limb	70719	0.16587	<.0001
Pyogen arthritis-unspec	71100	-0.04327	0.3753
Pyogen arthritis-l/leg	71106	0.02859	0.4542
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
Convulsions NEC	78039	0.09323	<.0001
Fx femur intrcaps NEC-cl	82009	-0.00952	0.7647
Fx femur NOS-closed	82100	-0.02136	0.4055
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
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
Less than 6 months of Medicare eligible claims in the previous calendar year		0.53332	<.0001

ICD-9 to 10 Mapping: Adjustments

ICD9DX	ICD9::ICD9DX_desc	ICD10CM	ICD10::ICD10CM_desc
11284	Candidal esophagitis	B3781	B3781 Candidal esophagitis
135	Sarcoidosis	D869	D869 Sarcoidosis, unspecified
1541	Malignant neoplasm of rectum	C20	C20 Malignant neoplasm of rectum
1550	Malignant neoplasm of liver, primary	C220	C220 Liver cell carcinoma
1550	Malignant neoplasm of liver, primary	C222	C222 Hepatoblastoma
1550	Malignant neoplasm of liver, primary	C227	C227 Other specified carcinomas of liver
1550	Malignant neoplasm of liver, primary	C228	C228 Malignant neoplasm of liver, primary, unspecified as to type
1623	Malignant neoplasm of upper lobe, bronchus or lun	C3410	C3410 Malignant neoplasm of upper lobe, unspecified bronchus or lung
1629	Malignant neoplasm of bronchus and lung, unspecif	C3490	C3490 Malignant neoplasm of unspecified part of unspecified bronchus or lung
185	Malignant neoplasm of prostate	C61	C61 Malignant neoplasm of prostate
1889	Malignant neoplasm of bladder, part unspecified	C679	C679 Malignant neoplasm of bladder, unspecified
1890	Malignant neoplasm of kidney, except pelvis	C649	C649 Malignant neoplasm of unspecified kidney, except renal pelvis
193	Malignant neoplasm of thyroid gland	C73	C73 Malignant neoplasm of thyroid gland
1970	Secondary malignant neoplasm of lung	C7800	C7800 Secondary malignant neoplasm of unspecified lung
1977	Malignant neoplasm of liver, secondary	C787	C787 Secondary malignant neoplasm of liver and intrahepatic bile duct
1985	Secondary malignant neoplasm of bone and bone m	C7951	C7951 Secondary malignant neoplasm of bone
1985	Secondary malignant neoplasm of bone and bone m	C7952	C7952 Secondary malignant neoplasm of bone marrow
1991	Other malignant neoplasm without specification of	C801	C801 Malignant (primary) neoplasm, unspecified
20280	Other malignant lymphomas, unspecified site, extra	C8580	C8580 Other specified types of non-Hodgkin lymphoma, unspecified site
20280	Other malignant lymphomas, unspecified site, extra	C8589	C8589 Other specified types of non-Hodgkin lymphoma, extranodal and solid organ sites
20300	Multiple myeloma, without mention of having achie	C9000	C9000 Multiple myeloma not having achieved remission
20410	Chronic lymphoid leukemia, without mention of hav	C9110	C9110 Chronic lymphocytic leukemia of B-cell type not having achieved remission
23871	Essential thrombocythemia	D473	D473 Essential (hemorrhagic) thrombocythemia
23872	Low grade myelodysplastic syndrome lesions	D460	D460 Refractory anemia without ring sideroblasts, so stated
23872	Low grade myelodysplastic syndrome lesions	D461	D461 Refractory anemia with ring sideroblasts
23872	Low grade myelodysplastic syndrome lesions	D4620	D4620 Refractory anemia with excess of blasts, unspecified
23872	Low grade myelodysplastic syndrome lesions	D4621	D4621 Refractory anemia with excess of blasts 1
23872	Low grade myelodysplastic syndrome lesions	D46A	D46A Refractory cytopenia with multilineage dysplasia
23872	Low grade myelodysplastic syndrome lesions	D46B	D46B Refractory cytopenia with multilineage dysplasia and ring sideroblasts
23875	Myelodysplastic syndrome, unspecified	D469	D469 Myelodysplastic syndrome, unspecified
25000	Diabetes mellitus without mention of complication,	E119	E119 Type 2 diabetes mellitus without complications
25002	Diabetes mellitus without mention of complication,	E1165	E1165 Type 2 diabetes mellitus with hyperglycemia
25010	Diabetes with ketoacidosis, type II or unspecified ty	E1169	E1169 Type 2 diabetes mellitus with other specified complication
25010	Diabetes with ketoacidosis, type II or unspecified ty	E1310	E1310 Other specified diabetes mellitus with ketoacidosis without coma
25012	Diabetes with ketoacidosis, type II or unspecified ty	E1165	E1165 Type 2 diabetes mellitus with hyperglycemia
25012	Diabetes with ketoacidosis, type II or unspecified ty	E1169	E1169 Type 2 diabetes mellitus with other specified complication
25012	Diabetes with ketoacidosis, type II or unspecified ty	E1310	E1310 Other specified diabetes mellitus with ketoacidosis without coma
25013	Diabetes with ketoacidosis, type I [juvenile type], ur	E1010	E1010 Type 1 diabetes mellitus with ketoacidosis without coma
25013	Diabetes with ketoacidosis, type I [juvenile type], ur	E1065	E1065 Type 1 diabetes mellitus with hyperglycemia
25022	Diabetes with hyperosmolarity, type II or unspecifie	E1100	E1100 Type 2 diabetes mellitus with hyperosmolarity without nonketotic hyperglycemic-hyperosmolar com
25022	Diabetes with hyperosmolarity, type II or unspecifie	E1165	E1165 Type 2 diabetes mellitus with hyperglycemia
25040	Diabetes with renal manifestations, type II or unspe	E1129	E1129 Type 2 diabetes mellitus with other diabetic kidney complication
25041	Diabetes with renal manifestations, type I [juvenile t	E1029	E1029 Type 1 diabetes mellitus with other diabetic kidney complication
25050	Diabetes with ophthalmic manifestations, type II or	E11311	E11311 Type 2 diabetes mellitus with unspecified diabetic retinopathy with macular edema
25050	Diabetes with ophthalmic manifestations, type II or	E11319	E11319 Type 2 diabetes mellitus with unspecified diabetic retinopathy without macular edema
25050	Diabetes with ophthalmic manifestations, type II or	E1136	E1136 Type 2 diabetes mellitus with diabetic cataract
25050	Diabetes with ophthalmic manifestations, type II or	E1139	E1139 Type 2 diabetes mellitus with other diabetic ophthalmic complication
25053	Diabetes with ophthalmic manifestations, type I [juv	E10311	E10311 Type 1 diabetes mellitus with unspecified diabetic retinopathy with macular edema
25053	Diabetes with ophthalmic manifestations, type I [juv	E10319	E10319 Type 1 diabetes mellitus with unspecified diabetic retinopathy without macular edema
25053	Diabetes with ophthalmic manifestations, type I [juv	E1036	E1036 Type 1 diabetes mellitus with diabetic cataract
25053	Diabetes with ophthalmic manifestations, type I [juv	E1039	E1039 Type 1 diabetes mellitus with other diabetic ophthalmic complication
25053	Diabetes with ophthalmic manifestations, type I [juv	E1065	E1065 Type 1 diabetes mellitus with hyperglycemia
25060	Diabetes with neurological manifestations, type II or	E1140	E1140 Type 2 diabetes mellitus with diabetic neuropathy, unspecified
25061	Diabetes with neurological manifestations, type I [ju	E1040	E1040 Type 1 diabetes mellitus with diabetic neuropathy, unspecified
25062	Diabetes with neurological manifestations, type II or	E1140	E1140 Type 2 diabetes mellitus with diabetic neuropathy, unspecified
25062	Diabetes with neurological manifestations, type II or	E1165	E1165 Type 2 diabetes mellitus with hyperglycemia
25063	Diabetes with neurological manifestations, type I [ju	E1040	E1040 Type 1 diabetes mellitus with diabetic neuropathy, unspecified
25063	Diabetes with neurological manifestations, type I [ju	E1065	E1065 Type 1 diabetes mellitus with hyperglycemia
25070	Diabetes with peripheral circulatory disorders, type	E1151	E1151 Type 2 diabetes mellitus with diabetic peripheral angiopathy without gangrene
25071	Diabetes with peripheral circulatory disorders, type	E1051	E1051 Type 1 diabetes mellitus with diabetic peripheral angiopathy without gangrene
25072	Diabetes with peripheral circulatory disorders, type	E1151	E1151 Type 2 diabetes mellitus with diabetic peripheral angiopathy without gangrene
25072	Diabetes with peripheral circulatory disorders, type	E1165	E1165 Type 2 diabetes mellitus with hyperglycemia
25080	Diabetes with other specified manifestations, type I	E11618	E11618 Type 2 diabetes mellitus with other diabetic arthropathy
25080	Diabetes with other specified manifestations, type I	E11620	E11620 Type 2 diabetes mellitus with diabetic dermatitis
25080	Diabetes with other specified manifestations, type I	E11621	E11621 Type 2 diabetes mellitus with foot ulcer
25080	Diabetes with other specified manifestations, type I	E11622	E11622 Type 2 diabetes mellitus with other skin ulcer
25080	Diabetes with other specified manifestations, type I	E11628	E11628 Type 2 diabetes mellitus with other skin complications
25080	Diabetes with other specified manifestations, type I	E11630	E11630 Type 2 diabetes mellitus with periodontal disease
25080	Diabetes with other specified manifestations, type I	E11638	E11638 Type 2 diabetes mellitus with other oral complications
25080	Diabetes with other specified manifestations, type I	E11649	E11649 Type 2 diabetes mellitus with hypoglycemia without coma
25080	Diabetes with other specified manifestations, type I	E1165	E1165 Type 2 diabetes mellitus with hyperglycemia
25080	Diabetes with other specified manifestations, type I	E1169	E1169 Type 2 diabetes mellitus with other specified complication
25081	Diabetes with other specified manifestations, type I	E10618	E10618 Type 1 diabetes mellitus with other diabetic arthropathy
25081	Diabetes with other specified manifestations, type I	E10620	E10620 Type 1 diabetes mellitus with diabetic dermatitis
25081	Diabetes with other specified manifestations, type I	E10621	E10621 Type 1 diabetes mellitus with foot ulcer
25081	Diabetes with other specified manifestations, type I	E10622	E10622 Type 1 diabetes mellitus with other skin ulcer
25081	Diabetes with other specified manifestations, type I	E10628	E10628 Type 1 diabetes mellitus with other skin complications
25081	Diabetes with other specified manifestations, type I	E10630	E10630 Type 1 diabetes mellitus with periodontal disease
25081	Diabetes with other specified manifestations, type I	E10638	E10638 Type 1 diabetes mellitus with other oral complications
25081	Diabetes with other specified manifestations, type I	E10649	E10649 Type 1 diabetes mellitus with hypoglycemia without coma
25081	Diabetes with other specified manifestations, type I	E1065	E1065 Type 1 diabetes mellitus with hyperglycemia
25081	Diabetes with other specified manifestations, type I	E1069	E1069 Type 1 diabetes mellitus with other specified complication
25082	Diabetes with other specified manifestations, type I	E1165	E1165 Type 2 diabetes mellitus with hyperglycemia
25082	Diabetes with other specified manifestations, type I	E1169	E1169 Type 2 diabetes mellitus with other specified complication
25083	Diabetes with other specified manifestations, type I	E1065	E1065 Type 1 diabetes mellitus with hyperglycemia
25083	Diabetes with other specified manifestations, type I	E1069	E1069 Type 1 diabetes mellitus with other specified complication
25541	Glucocorticoid deficiency	E271	E271 Primary adrenocortical insufficiency

25541	Glucocorticoid deficiency	E272	E272 Addisonian crisis
25541	Glucocorticoid deficiency	E2740	E2740 Unspecified adrenocortical insufficiency
262	Other severe protein-calorie malnutrition	E43	E43 Unspecified severe protein-calorie malnutrition
2639	Unspecified protein-calorie malnutrition	E46	E46 Unspecified protein-calorie malnutrition
2706	Disorders of urea cycle metabolism	E7220	E7220 Disorder of urea cycle metabolism, unspecified
2706	Disorders of urea cycle metabolism	E7222	E7222 Arginosuccinic aciduria
2706	Disorders of urea cycle metabolism	E7223	E7223 Citrullinemia
2706	Disorders of urea cycle metabolism	E7229	E7229 Other disorders of urea cycle metabolism
27739	Other amyloidosis	E851	E851 Neuropathic heredofamilial amyloidosis
27739	Other amyloidosis	E853	E853 Secondary systemic amyloidosis
27739	Other amyloidosis	E858	E858 Other amyloidosis
27789	Other specified disorders of metabolism	C965	C965 Multifocal and unisystemic Langerhans-cell histiocytosis
27789	Other specified disorders of metabolism	C966	C966 Unifocal Langerhans-cell histiocytosis
27789	Other specified disorders of metabolism	E7139	E7139 Other disorders of fatty-acid metabolism
27789	Other specified disorders of metabolism	E803	E803 Defects of catalase and peroxidase
27789	Other specified disorders of metabolism	E8889	E8889 Other specified metabolic disorders
27789	Other specified disorders of metabolism	E889	E889 Metabolic disorder, unspecified
27801	Morbid obesity	E6601	E6601 Morbid (severe) obesity due to excess calories
27803	Obesity hypoventilation syndrome	E662	E662 Morbid (severe) obesity with alveolar hypoventilation
28260	Sickle-cell disease, unspecified	D571	D571 Sickle-cell disease without crisis
28411	Antineoplastic chemotherapy induced pancytopenia	D61810	D61810 Antineoplastic chemotherapy induced pancytopenia
28419	Other pancytopenia	D61818	D61818 Other pancytopenia
28800	Neutropenia, unspecified	D709	D709 Neutropenia, unspecified
28803	Drug induced neutropenia	D701	D701 Agranulocytosis secondary to cancer chemotherapy
28803	Drug induced neutropenia	D702	D702 Other drug-induced agranulocytosis
28981	Primary hypercoagulable state	D6851	D6851 Activated protein C resistance
28981	Primary hypercoagulable state	D6852	D6852 Prothrombin gene mutation
28981	Primary hypercoagulable state	D6859	D6859 Other primary thrombophilia
28981	Primary hypercoagulable state	D6861	D6861 Antiphospholipid syndrome
28981	Primary hypercoagulable state	D6862	D6862 Lupus anticoagulant syndrome
2900	Senile dementia, uncomplicated	F0390	F0390 Unspecified dementia without behavioral disturbance
29020	Senile dementia with delusional features	F0390	F0390 Unspecified dementia without behavioral disturbance
29020	Senile dementia with delusional features	F05	F05 Delirium due to known physiological condition
29040	Vascular dementia, uncomplicated	F0150	F0150 Vascular dementia without behavioral disturbance
2920	Drug withdrawal	F19939	F19939 Other psychoactive substance use, unspecified with withdrawal, unspecified
29410	Dementia in conditions classified elsewhere without	F0280	F0280 Dementia in other diseases classified elsewhere without behavioral disturbance
29411	Dementia in conditions classified elsewhere with be	F0281	F0281 Dementia in other diseases classified elsewhere with behavioral disturbance
29420	Dementia, unspecified, without behavioral disturba	F0390	F0390 Unspecified dementia without behavioral disturbance
2948	Other persistent mental disorders due to conditions	F060	F060 Psychotic disorder with hallucinations due to known physiological condition
2948	Other persistent mental disorders due to conditions	F068	F068 Other specified mental disorders due to known physiological condition
29590	Unspecified schizophrenia, unspecified	F209	F209 Schizophrenia, unspecified
29620	Major depressive affective disorder, single episode,	F329	F329 Major depressive disorder, single episode, unspecified
29630	Major depressive affective disorder, recurrent episc	F339	F339 Major depressive disorder, recurrent, unspecified
29633	Major depressive affective disorder, recurrent episc	F332	F332 Major depressive disorder, recurrent severe without psychotic features
29680	Bipolar disorder, unspecified	F319	F319 Bipolar disorder, unspecified
29689	Other bipolar disorders	F3181	F3181 Bipolar II disorder
29690	Unspecified episodic mood disorder	F39	F39 Unspecified mood [affective] disorder
30390	Other and unspecified alcohol dependence, unspeci	F1020	F1020 Alcohol dependence, uncomplicated
30393	Other and unspecified alcohol dependence, in remis	F1021	F1021 Alcohol dependence, in remission
30400	Opioid type dependence, unspecified	F1120	F1120 Opioid dependence, uncomplicated
30401	Opioid type dependence, continuous	F1120	F1120 Opioid dependence, uncomplicated
30490	Unspecified drug dependence, unspecified	F1920	F1920 Other psychoactive substance dependence, uncomplicated
3319	Cerebral degeneration, unspecified	G319	G319 Degenerative disease of nervous system, unspecified
3371	Peripheral autonomic neuropathy in disorders classi	G990	G990 Autonomic neuropathy in diseases classified elsewhere
3453	Grand mal status	G40301	G40301 Generalized idiopathic epilepsy and epileptic syndromes, not intractable, with status epilepticus
34540	Localization-related (focal) (partial) epilepsy and epi	G40201	G40201 Localization-related (focal) (partial) symptomatic epilepsy and epileptic syndromes with complex pa
34540	Localization-related (focal) (partial) epilepsy and epi	G40209	G40209 Localization-related (focal) (partial) symptomatic epilepsy and epileptic syndromes with complex pa
34590	Epilepsy, unspecified, without mention of intractabl	G40901	G40901 Epilepsy, unspecified, not intractable, with status epilepticus
34590	Epilepsy, unspecified, without mention of intractabl	G40909	G40909 Epilepsy, unspecified, not intractable, without status epilepticus
3481	Anoxic brain damage	G931	G931 Anoxic brain damage, not elsewhere classified
3485	Cerebral edema	G936	G936 Cerebral edema
3569	Unspecified hereditary and idiopathic peripheral ne	G609	G609 Hereditary and idiopathic neuropathy, unspecified
3572	Polyneuropathy in diabetes	E0842	E0842 Diabetes mellitus due to underlying condition with diabetic polyneuropathy
3572	Polyneuropathy in diabetes	E0942	E0942 Drug or chemical induced diabetes mellitus with neurological complications with diabetic polyneurop
3572	Polyneuropathy in diabetes	E1042	E1042 Type 1 diabetes mellitus with diabetic polyneuropathy
3572	Polyneuropathy in diabetes	E1142	E1142 Type 2 diabetes mellitus with diabetic polyneuropathy
3572	Polyneuropathy in diabetes	E1342	E1342 Other specified diabetes mellitus with diabetic polyneuropathy
35981	Critical illness myopathy	G7281	G7281 Critical illness myopathy
36202	Proliferative diabetic retinopathy	E11359	E11359 Type 2 diabetes mellitus with proliferative diabetic retinopathy without macular edema
36205	Moderate nonproliferative diabetic retinopathy	E11339	E11339 Type 2 diabetes mellitus with moderate nonproliferative diabetic retinopathy without macular eden
36207	Diabetic macular edema	E11311	E11311 Type 2 diabetes mellitus with unspecified diabetic retinopathy with macular edema
40291	Unspecified hypertensive heart disease with heart f	I110	I110 Hypertensive heart disease with heart failure
41071	Subendocardial infarction, initial episode of care	I214	I214 Non-ST elevation (NSTEMI) myocardial infarction
41080	Acute myocardial infarction of other specified sites,	I2129	I2129 ST elevation (STEMI) myocardial infarction involving other sites
41090	Acute myocardial infarction of unspecified site, epis	I213	I213 ST elevation (STEMI) myocardial infarction of unspecified site
4111	Intermediate coronary syndrome	I200	I200 Unstable angina
41189	Other acute and subacute forms of ischemic heart d	I248	I248 Other forms of acute ischemic heart disease
4139	Other and unspecified angina pectoris	I208	I208 Other forms of angina pectoris
4139	Other and unspecified angina pectoris	I209	I209 Angina pectoris, unspecified
41519	Other pulmonary embolism and infarction	I2699	I2699 Other pulmonary embolism without acute cor pulmonale
4160	Primary pulmonary hypertension	I270	I270 Primary pulmonary hypertension
4168	Other chronic pulmonary heart diseases	I272	I272 Other secondary pulmonary hypertension
4168	Other chronic pulmonary heart diseases	I2789	I2789 Other specified pulmonary heart diseases
4254	Other primary cardiomyopathies	I425	I425 Other restrictive cardiomyopathy
4254	Other primary cardiomyopathies	I428	I428 Other cardiomyopathies
4258	Cardiomyopathy in other diseases classified elsewhe	I43	I43 Cardiomyopathy in diseases classified elsewhere
4260	Atrioventricular block, complete	I442	I442 Atrioventricular block, complete
4271	Paroxysmal ventricular tachycardia	I472	I472 Ventricular tachycardia
4272	Paroxysmal tachycardia, unspecified	I479	I479 Paroxysmal tachycardia, unspecified
42731	Atrial fibrillation	I4891	I4891 Unspecified atrial fibrillation

42732	Atrial flutter	I4892	I4892 Unspecified atrial flutter
42781	Sinoatrial node dysfunction	I495	I495 Sick sinus syndrome
42781	Sinoatrial node dysfunction	R001	R001 Bradycardia, unspecified
4321	Subdural hemorrhage	I6200	I6200 Nontraumatic subdural hemorrhage, unspecified
43411	Cerebral embolism with cerebral infarction	I6340	I6340 Cerebral infarction due to embolism of unspecified cerebral artery
43491	Cerebral artery occlusion, unspecified with cerebral	I6350	I6350 Cerebral infarction due to unspecified occlusion or stenosis of unspecified cerebral artery
4400	Atherosclerosis of aorta	I700	I700 Atherosclerosis of aorta
44020	Atherosclerosis of native arteries of the extremities,	I70209	I70209 Unspecified atherosclerosis of native arteries of extremities, unspecified extremity
44021	Atherosclerosis of native arteries of the extremities	I70219	I70219 Atherosclerosis of native arteries of extremities with intermittent claudication, unspecified extremity
44022	Atherosclerosis of native arteries of the extremities	I70229	I70229 Atherosclerosis of native arteries of extremities with rest pain, unspecified extremity
44023	Atherosclerosis of native arteries of the extremities	I7025	I7025 Atherosclerosis of native arteries of other extremities with ulceration
44101	Dissection of aorta, thoracic	I7101	I7101 Dissection of thoracic aorta
4423	Aneurysm of artery of lower extremity	I724	I724 Aneurysm of artery of lower extremity
44389	Other specified peripheral vascular diseases	I7389	I7389 Other specified peripheral vascular diseases
4439	Peripheral vascular disease, unspecified	I739	I739 Peripheral vascular disease, unspecified
4471	Stricture of artery	I771	I771 Stricture of artery
45119	Phlebitis and thrombophlebitis of deep veins of low	I80209	I80209 Phlebitis and thrombophlebitis of unspecified deep vessels of unspecified lower extremity
4532	Other venous embolism and thrombosis of inferior v	I82220	I82220 Acute embolism and thrombosis of inferior vena cava
4532	Other venous embolism and thrombosis of inferior v	I82221	I82221 Chronic embolism and thrombosis of inferior vena cava
45341	Acute venous embolism and thrombosis of deep ves	I82419	I82419 Acute embolism and thrombosis of unspecified femoral vein
45341	Acute venous embolism and thrombosis of deep ves	I82429	I82429 Acute embolism and thrombosis of unspecified iliac vein
45341	Acute venous embolism and thrombosis of deep ves	I82439	I82439 Acute embolism and thrombosis of unspecified popliteal vein
45341	Acute venous embolism and thrombosis of deep ves	I824Y9	I824Y9 Acute embolism and thrombosis of unspecified deep veins of unspecified proximal lower extremity
45350	Chronic venous embolism and thrombosis of unspec	I82509	I82509 Chronic embolism and thrombosis of unspecified deep veins of unspecified lower extremity
45350	Chronic venous embolism and thrombosis of unspec	I82599	I82599 Chronic embolism and thrombosis of other specified deep vein of unspecified lower extremity
45351	Chronic venous embolism and thrombosis of deep v	I82519	I82519 Chronic embolism and thrombosis of unspecified femoral vein
45351	Chronic venous embolism and thrombosis of deep v	I82529	I82529 Chronic embolism and thrombosis of unspecified iliac vein
45351	Chronic venous embolism and thrombosis of deep v	I82539	I82539 Chronic embolism and thrombosis of unspecified popliteal vein
45351	Chronic venous embolism and thrombosis of deep v	I825Y9	I825Y9 Chronic embolism and thrombosis of unspecified deep veins of unspecified proximal lower extremity
45375	Chronic venous embolism and thrombosis of subcla	I82B29	I82B29 Chronic embolism and thrombosis of unspecified subclavian vein
45382	Acute venous embolism and thrombosis of deep vei	I82629	I82629 Acute embolism and thrombosis of deep veins of unspecified upper extremity
45384	Acute venous embolism and thrombosis of axillary v	I82A19	I82A19 Acute embolism and thrombosis of unspecified axillary vein
45386	Acute venous embolism and thrombosis of internal	I82C19	I82C19 Acute embolism and thrombosis of unspecified internal jugular vein
45387	Acute venous embolism and thrombosis of other th	I82290	I82290 Acute embolism and thrombosis of other thoracic veins
45621	Esophageal varices in diseases classified elsewhere,	I8510	I8510 Secondary esophageal varices without bleeding
49121	Obstructive chronic bronchitis with (acute) exacerba	J441	J441 Chronic obstructive pulmonary disease with (acute) exacerbation
49122	Obstructive chronic bronchitis with acute bronchitis	J440	J440 Chronic obstructive pulmonary disease with acute lower respiratory infection
4928	Other emphysema	J439	J439 Emphysema, unspecified
49320	Chronic obstructive asthma, unspecified	J449	J449 Chronic obstructive pulmonary disease, unspecified
49322	Chronic obstructive asthma with (acute) exacerbatio	J441	J441 Chronic obstructive pulmonary disease with (acute) exacerbation
4940	Bronchiectasis without acute exacerbation	J479	J479 Bronchiectasis, uncomplicated
496	Chronic airway obstruction, not elsewhere classified	J449	J449 Chronic obstructive pulmonary disease, unspecified
5070	Pneumonitis due to inhalation of food or vomitus	J690	J690 Pneumonitis due to inhalation of food and vomit
515	Postinflammatory pulmonary fibrosis	J8410	J8410 Pulmonary fibrosis, unspecified
515	Postinflammatory pulmonary fibrosis	J8489	J8489 Other specified interstitial pulmonary diseases
5178	Lung involvement in other diseases classified elsewh	J99	J99 Respiratory disorders in diseases classified elsewhere
51851	Acute respiratory failure following trauma and surg	J95821	J95821 Acute postprocedural respiratory failure
51851	Acute respiratory failure following trauma and surg	J9600	J9600 Acute respiratory failure, unspecified whether with hypoxia or hypercapnia
51852	Other pulmonary insufficiency, not elsewhere classi	J951	J951 Acute pulmonary insufficiency following thoracic surgery
51852	Other pulmonary insufficiency, not elsewhere classi	J952	J952 Acute pulmonary insufficiency following nonthoracic surgery
51852	Other pulmonary insufficiency, not elsewhere classi	J953	J953 Chronic pulmonary insufficiency following surgery
51882	Other pulmonary insufficiency, not elsewhere classi	J80	J80 Acute respiratory distress syndrome
51883	Chronic respiratory failure	J9610	J9610 Chronic respiratory failure, unspecified whether with hypoxia or hypercapnia
51884	Acute and chronic respiratory failure	J9620	J9620 Acute and chronic respiratory failure, unspecified whether with hypoxia or hypercapnia
53642	Mechanical complication of gastrostomy	K9423	K9423 Gastrostomy malfunction
5559	Regional enteritis of unspecified site	K5090	K5090 Crohn's disease, unspecified, without complications
5569	Ulcerative colitis, unspecified	K5190	K5190 Ulcerative colitis, unspecified, without complications
5571	Chronic vascular insufficiency of intestine	K551	K551 Chronic vascular disorders of intestine
5601	Paralytic ileus	K560	K560 Paralytic ileus
5601	Paralytic ileus	K567	K567 Ileus, unspecified
56032	Fecal impaction	K5641	K5641 Fecal impaction
5609	Unspecified intestinal obstruction	K5660	K5660 Unspecified intestinal obstruction
5712	Alcoholic cirrhosis of liver	K7030	K7030 Alcoholic cirrhosis of liver without ascites
5715	Cirrhosis of liver without mention of alcohol	K740	K740 Hepatic fibrosis
5715	Cirrhosis of liver without mention of alcohol	K7460	K7460 Unspecified cirrhosis of liver
5715	Cirrhosis of liver without mention of alcohol	K7469	K7469 Other cirrhosis of liver
5722	Hepatic encephalopathy	K7290	K7290 Hepatic failure, unspecified without coma
5722	Hepatic encephalopathy	K7291	K7291 Hepatic failure, unspecified with coma
5723	Portal hypertension	K766	K766 Portal hypertension
5728	Other sequelae of chronic liver disease	K7210	K7210 Chronic hepatic failure without coma
5728	Other sequelae of chronic liver disease	K7290	K7290 Hepatic failure, unspecified without coma
5771	Chronic pancreatitis	K861	K861 Other chronic pancreatitis
70703	Pressure ulcer, lower back	L89139	L89139 Pressure ulcer of right lower back, unspecified stage
70703	Pressure ulcer, lower back	L89149	L89149 Pressure ulcer of left lower back, unspecified stage
70703	Pressure ulcer, lower back	L89159	L89159 Pressure ulcer of sacral region, unspecified stage
70704	Pressure ulcer, hip	L89209	L89209 Pressure ulcer of unspecified hip, unspecified stage
70705	Pressure ulcer, buttock	L89309	L89309 Pressure ulcer of unspecified buttock, unspecified stage
70710	Ulcer of lower limb, unspecified	L97909	L97909 Non-pressure chronic ulcer of unspecified part of unspecified lower leg with unspecified severity
70715	Ulcer of other part of foot	L97509	L97509 Non-pressure chronic ulcer of other part of unspecified foot with unspecified severity
70719	Ulcer of other part of lower limb	L97809	L97809 Non-pressure chronic ulcer of other part of unspecified lower leg with unspecified severity
7078	Chronic ulcer of other specified sites	L98419	L98419 Non-pressure chronic ulcer of buttock with unspecified severity
7078	Chronic ulcer of other specified sites	L98429	L98429 Non-pressure chronic ulcer of back with unspecified severity
7100	Systemic lupus erythematosus	M3210	M3210 Systemic lupus erythematosus, organ or system involvement unspecified
7101	Systemic sclerosis	M340	M340 Progressive systemic sclerosis
7101	Systemic sclerosis	M341	M341 CR(E)ST syndrome
7101	Systemic sclerosis	M349	M349 Systemic sclerosis, unspecified
71100	Pyogenic arthritis, site unspecified	M0000	M0000 Staphylococcal arthritis, unspecified joint
71100	Pyogenic arthritis, site unspecified	M0010	M0010 Pneumococcal arthritis, unspecified joint
71100	Pyogenic arthritis, site unspecified	M0020	M0020 Other streptococcal arthritis, unspecified joint
71100	Pyogenic arthritis, site unspecified	M0080	M0080 Arthritis due to other bacteria, unspecified joint

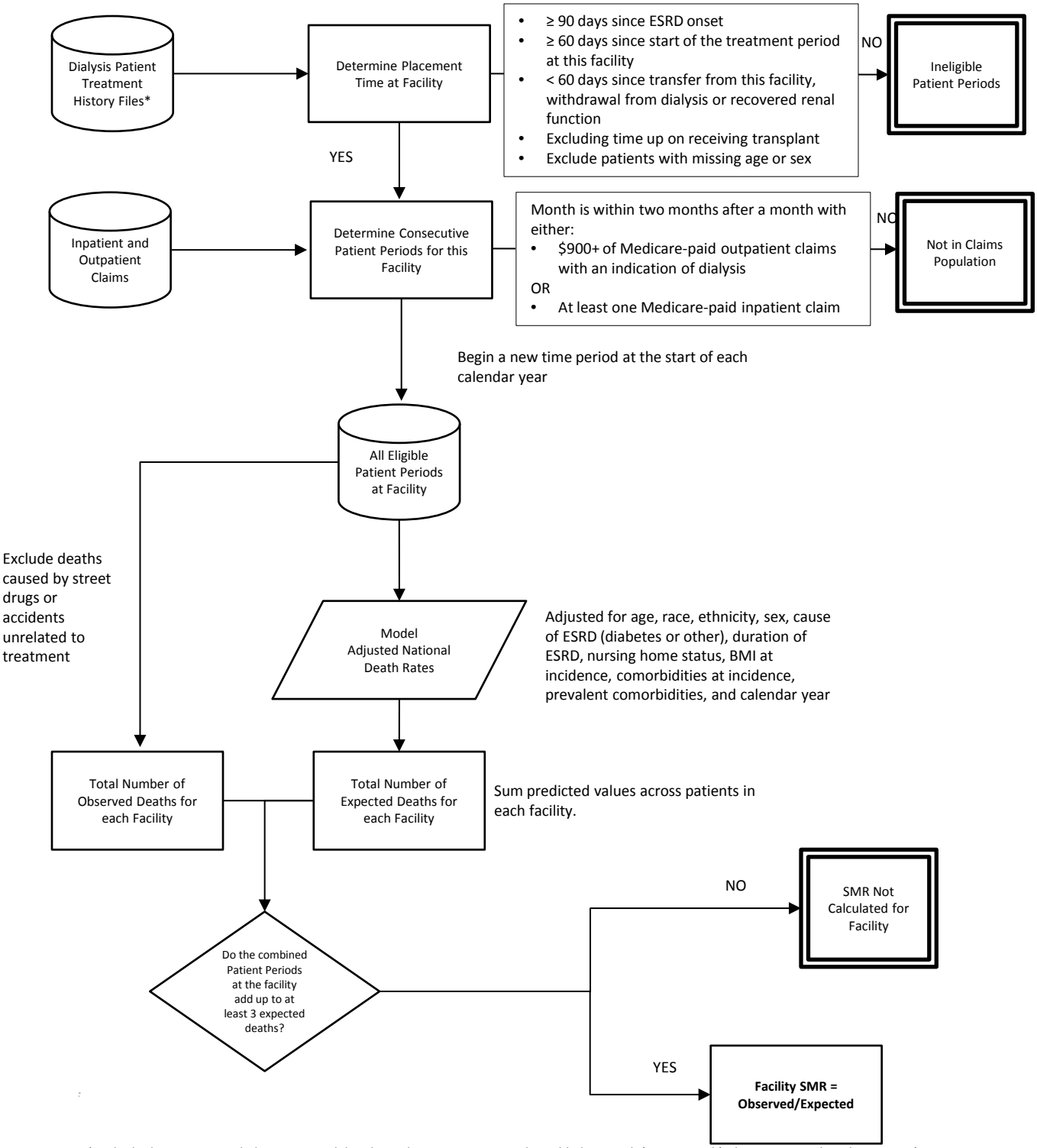
71100	Pyogenic arthritis, site unspecified	M009	M009 Pyogenic arthritis, unspecified
71106	Pyogenic arthritis, lower leg	M00069	M00069 Staphylococcal arthritis, unspecified knee
71106	Pyogenic arthritis, lower leg	M00169	M00169 Pneumococcal arthritis, unspecified knee
71106	Pyogenic arthritis, lower leg	M00269	M00269 Other streptococcal arthritis, unspecified knee
71106	Pyogenic arthritis, lower leg	M00869	M00869 Arthritis due to other bacteria, unspecified knee
7140	Rheumatoid arthritis	M069	M069 Rheumatoid arthritis, unspecified
7149	Unspecified inflammatory polyarthropathy	M064	M064 Inflammatory polyarthropathy
7202	Sacroiliitis, not elsewhere classified	M461	M461 Sacroiliitis, not elsewhere classified
73000	Acute osteomyelitis, site unspecified	M8610	M8610 Other acute osteomyelitis, unspecified site
73000	Acute osteomyelitis, site unspecified	M8620	M8620 Subacute osteomyelitis, unspecified site
73007	Acute osteomyelitis, ankle and foot	M86179	M86179 Other acute osteomyelitis, unspecified ankle and foot
73007	Acute osteomyelitis, ankle and foot	M86279	M86279 Subacute osteomyelitis, unspecified ankle and foot
73008	Acute osteomyelitis, other specified sites	M8618	M8618 Other acute osteomyelitis, other site
73008	Acute osteomyelitis, other specified sites	M8628	M8628 Subacute osteomyelitis, other site
73024	Unspecified osteomyelitis, hand	M869	M869 Osteomyelitis, unspecified
73027	Unspecified osteomyelitis, ankle and foot	M869	M869 Osteomyelitis, unspecified
73313	Pathologic fracture of vertebrae	M4850XA	M4850XA Collapsed vertebra, not elsewhere classified, site unspecified, initial encounter for fracture
73313	Pathologic fracture of vertebrae	M8008XA	M8008XA Age-related osteoporosis with current pathological fracture, vertebra(e), initial encounter for fract
73313	Pathologic fracture of vertebrae	M8448XA	M8448XA Pathological fracture, other site, initial encounter for fracture
73313	Pathologic fracture of vertebrae	M8468XA	M8468XA Pathological fracture in other disease, other site, initial encounter for fracture
73342	Aseptic necrosis of head and neck of femur	M87059	M87059 Idiopathic aseptic necrosis of unspecified femur
73349	Aseptic necrosis of bone, other	M8708	M8708 Idiopathic aseptic necrosis of bone, other site
78001	Coma	R4020	R4020 Unspecified coma
78039	Other convulsions	R569	R569 Unspecified convulsions
7854	Gangrene	I96	I96 Gangrene, not elsewhere classified
7994	Cachexia	R64	R64 Cachexia
8082	Closed fracture of pubis	S32501A	S32501A Unspecified fracture of right pubis, initial encounter for closed fracture
8082	Closed fracture of pubis	S32502A	S32502A Unspecified fracture of left pubis, initial encounter for closed fracture
8082	Closed fracture of pubis	S32509A	S32509A Unspecified fracture of unspecified pubis, initial encounter for closed fracture
8088	Closed unspecified fracture of pelvis	S329XXA	S329XXA Fracture of unspecified parts of lumbosacral spine and pelvis, initial encounter for closed fracture
82009	Other closed transcervical fracture of neck of femur	S72099A	S72099A Other fracture of head and neck of unspecified femur, initial encounter for closed fracture
8208	Closed fracture of unspecified part of neck of femur	S72009A	S72009A Fracture of unspecified part of neck of unspecified femur, initial encounter for closed fracture
82100	Closed fracture of unspecified part of femur	S7290XA	S7290XA Unspecified fracture of unspecified femur, initial encounter for closed fracture
8970	Traumatic amputation of leg(s) (complete) (partial),	S88119A	S88119A Complete traumatic amputation at level between knee and ankle, unspecified lower leg, initial enco
8970	Traumatic amputation of leg(s) (complete) (partial),	S88129A	S88129A Partial traumatic amputation at level between knee and ankle, unspecified lower leg, initial encoun
8971	Traumatic amputation of leg(s) (complete) (partial),	S88119A	S88119A Complete traumatic amputation at level between knee and ankle, unspecified lower leg, initial enco
8971	Traumatic amputation of leg(s) (complete) (partial),	S88129A	S88129A Partial traumatic amputation at level between knee and ankle, unspecified lower leg, initial encoun
8972	Traumatic amputation of leg(s) (complete) (partial),	S78019A	S78019A Complete traumatic amputation at unspecified hip joint, initial encounter
8972	Traumatic amputation of leg(s) (complete) (partial),	S78029A	S78029A Partial traumatic amputation at unspecified hip joint, initial encounter
8972	Traumatic amputation of leg(s) (complete) (partial),	S78119A	S78119A Complete traumatic amputation at level between unspecified hip and knee, initial encounter
8972	Traumatic amputation of leg(s) (complete) (partial),	S78129A	S78129A Partial traumatic amputation at level between unspecified hip and knee, initial encounter
8972	Traumatic amputation of leg(s) (complete) (partial),	S78919A	S78919A Complete traumatic amputation of unspecified hip and thigh, level unspecified, initial encounter
8972	Traumatic amputation of leg(s) (complete) (partial),	S78929A	S78929A Partial traumatic amputation of unspecified hip and thigh, level unspecified, initial encounter
8972	Traumatic amputation of leg(s) (complete) (partial),	S88019A	S88019A Complete traumatic amputation at knee level, unspecified lower leg, initial encounter
8972	Traumatic amputation of leg(s) (complete) (partial),	S88029A	S88029A Partial traumatic amputation at knee level, unspecified lower leg, initial encounter
8974	Traumatic amputation of leg(s) (complete) (partial),	S78919A	S78919A Complete traumatic amputation of unspecified hip and thigh, level unspecified, initial encounter
8974	Traumatic amputation of leg(s) (complete) (partial),	S78929A	S78929A Partial traumatic amputation of unspecified hip and thigh, level unspecified, initial encounter
8974	Traumatic amputation of leg(s) (complete) (partial),	S88919A	S88919A Complete traumatic amputation of unspecified lower leg, level unspecified, initial encounter
8974	Traumatic amputation of leg(s) (complete) (partial),	S88929A	S88929A Partial traumatic amputation of unspecified lower leg, level unspecified, initial encounter
99664	Infection and inflammatory reaction due to indwelli	T8351XA	T8351XA Infection and inflammatory reaction due to indwelling urinary catheter, initial encounter
99683	Complications of transplanted heart	T8620	T8620 Unspecified complication of heart transplant
99683	Complications of transplanted heart	T8621	T8621 Heart transplant rejection
99683	Complications of transplanted heart	T8622	T8622 Heart transplant failure
V08	Asymptomatic human immunodeficiency virus [HIV]	Z21	Z21 Asymptomatic human immunodeficiency virus [HIV] infection status
V421	Heart replaced by transplant	Z941	Z941 Heart transplant status
V427	Liver replaced by transplant	Z944	Z944 Liver transplant status
V4283	Pancreas replaced by transplant	Z9483	Z9483 Pancreas transplant status
V441	Gastrostomy status	Z931	Z931 Gastrostomy status
V442	Ileostomy status	Z932	Z932 Ileostomy status
V443	Colostomy status	Z933	Z933 Colostomy status
V446	Other artificial opening of urinary tract status	Z936	Z936 Other artificial openings of urinary tract status
V4611	Dependence on respirator, status	Z9911	Z9911 Dependence on respirator [ventilator] status
V4972	Other toe(s) amputation status	Z89429	Z89429 Acquired absence of other toe(s), unspecified side
V4975	Below knee amputation status	Z89519	Z89519 Acquired absence of unspecified leg below knee
V4976	Above knee amputation status	Z89619	Z89619 Acquired absence of unspecified leg above knee
V551	Attention to gastrostomy	Z431	Z431 Encounter for attention to gastrostomy
V5867	Long-term (current) use of insulin	Z794	Z794 Long term (current) use of insulin
V8541	Body Mass Index 40.0-44.9, adult	Z6841	Z6841 Body mass index (BMI) 40.0-44.9, adult

APPENDIX

Standardized Mortality Ratio for Dialysis Facilities

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



*Multiple data sources include CMS Consolidated Renal Operations in a Web-enabled Network (CROWNWeb), the CMS Annual Facility Survey (Form CMS-2744), Medicare dialysis and hospital payment records, 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 Dialysis Facility Compare (DFC) and the Social Security Death Master File.