# Report for the

# Standardized Hospitalization Ratio

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# Introduction

In 2013, the Centers for Medicare and Medicaid Services (CMS) rolled out a new approach to ensuring safe and adequate health care delivery to its patients: the CMS Quality Strategy (CMS, 2013). The CMS strategy is designed to align with the six goals of the Department of Health and Human Services' (HHS) National Quality Strategy. The CMS strategy is framed in the following way: "To improve, a broad-based and seamless reform approach is necessary to address challenges in our healthcare system—escalating costs, inadequate coverage and inefficient care of variable quality" (CMS, 2013).

Hospitalization rates are an important indicator of patient morbidity and quality of life. On average, dialysis patients are admitted to the hospital twice a year and spend an average of 11.2 days in the hospital per year [1]. Hospitalizations account for approximately 40 percent of total Medicare expenditures for ESRD patients [1]. Measures of the frequency of hospitalization have the potential to help efforts to control escalating medical costs, and to play an important role in identifying potential problems and helping facilities provide cost-effective health care.
At the end of 2013 there were 661,648 patients being dialyzed, of which 117,162 were new (incident) ESRD patients [1]. In 2013, total Medicare costs for the ESRD program were $30.9 billion, a 1.6% increase from 2012 [1]. Correspondingly, hospitalization costs for ESRD patients are very high with Medicare costs of over $10.3 billion in 2013.

Hospitalization measures have been in use in the Dialysis Facility Reports (formerly Unit-Specific Reports) since 1995. 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. In particular, the SHR for Admissions is used by ESRD state surveyors in conjunction with other standard criteria for prioritizing and selecting facilities to survey and has been found to be predictive of citations in the past (ESRD State Outcomes List). The SHR is also a public reporting measure on the Centers for Medicare and Medicaid Services (CMS) Dialysis Facility Compare website.

The Standardized Hospitalization Ratio (SHR) for Admissions is designed to reflect the number of hospital admissions for the patients at a dialysis facility, relative to the number of hospital admissions that would be expected based on overall national rates and the characteristics of the patients at that facility. Numerically, the SHR is calculated as the ratio of two numbers: the numerator ("observed") is the actual number of hospital admissions for the patients in a facility over a specified time period, and the denominator ("expected") is the number of hospital admissions that would have been expected for the same patients if they were in a facility conforming to the national norm.

# Methods

## Overview

The denominator of SHR, the expected number of hospital admissions, is calculated from a Cox model for recurrent events, adjusting for age, sex, diabetes, duration of ESRD, nursing home status, a set of prevalent comorbidities, comorbidities at incidence, BMI at incidence, and calendar year. The SHR is not adjusted for race and ethnicity. Duration of ESRD is divided into six intervals with cut points at 6 months, 1 year, 2 years, 3 years and 5 years, and hospitalization rates are estimated separately within each interval. For each patient, the time at risk in each ESRD interval is multiplied by the (risk-adjusted) national admissions rate for that interval, and a sum over the intervals gives the expected number of admissions for each patient in a facility.

The SHR is an overall measure of hospital use and is composed of many different causes or reasons for hospitalization. In 2007, a Technical Expert Panel (TEP) was convened; the TEP provided advice on various aspects of the hospitalization measure, including adjustment factors. The TEP considered the possibility of devising cause specific SHRs, but recommended the use of overall SHR measures due to various reasons including the lack of clear research to indicate what causes should be selected as indicative of poor ESRD care and issues associated with inter-rater reliability in assessing cause of hospitalization. The TEP reached a strong consensus that the overall measures should give a reliable and valid measure that would typically be related to quality of care. In addition to the 2007 TEP, CMS contracted with UM-KECC to convene a Technical Expert Panel (TEP) in September 2015 to consider the addition of prevalent comorbidity risk adjustment. This resulted in the addition of a set of prevalent comorbidities to the SHR, described further in the risk adjustment section.

The SHR (NQF 1463) is currently endorsed by the National Quality Forum (NQF), with initial endorsement given in 2011, and the SHRs for most dialysis facilities in the United States are posted on the Centers for Medicare and Medicaid Services' (CMS) Dialysis Facility Compare (DFC) website.


## Data Sources

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.

### Handling of Hospital Admissions from Medicare Inpatient Claims

In calculating the SHR, Medicare inpatient claims that are adjacent to or overlap with another claim are collapsed into one record. Specifically, if the admission date of an inpatient record is within one day of a previous admission's discharge date, these adjacent inpatient records are collapsed into one inpatient record that takes on the first hospitalization's admission date and the following hospitalization's discharge date. Similarly, if an inpatient record overlaps with another inpatient record, the two records are collapsed into one record where the earliest admission date between the two records becomes the new admission date and the latest discharge date between the two records becomes the new discharge date.

# Outcome Definition

The outcome for this measure is admission to a hospital among Medicare eligible dialysis patients.

# Cohort Definition and Inclusion Criteria

## Assignment of Patients to Facilities

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, which largely align with those for the Standardized Mortality Ratio (SMR) and the Standardized Transfusion Ratio (STrR). We detail patient inclusion criteria, facility assignment and how to count days at risk, all of which are required for the risk adjustment model.

### 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 during the first 90 days of ESRD.

In order to exclude patients who only received temporary dialysis therapy, we assigned patients to a facility only after they had been on dialysis there for at least 60 days. This 60 day period is used any time a patient begins therapy at a new facility whether the patient transferred from another facility, started ESRD for the first time, or returned to dialysis after a transplant. That is, hospitalizations during the first 60 days of dialysis at a facility do not affect the SHR 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 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.  In particular, a patient is attributed to their current facility on day 91 of ESRD if that facility had treated him or her for at least 60 days. If on day 91, the facility had treated a patient for fewer than 60 days, we wait until the patient reaches day 60 of 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 are removed from facilities three days prior to transplant in order to exclude the transplant hospitalization. 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 CROWNWeb/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 Medicare Dialysis Patients

After patient treatment histories are defined as described above, periods of follow-up in time since ESRD onset are created for each patient. In order to adjust for duration of ESRD appropriately, we define 6 time intervals with cut points at 6 months, 1 year, 2 years, 3 years and 5 years. A new time period

begins each time the patient is determined to be at a different facility, or at the start of each calendar year or  when crossing any of the above cut points.

Since hospitalization data tend not to be as complete as mortality data, we include only patients whose Medicare billing records should include all hospitalizations. To achieve this goal, we require that patients reach a certain level of Medicare-paid dialysis bills to be included in the hospitalization statistics, or that patients have Medicare-paid inpatient claims during the period. Specifically, months within a given dialysis patient-period are used for SHR 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.

The number of days at risk in each of these patient-ESRD-year-facility time periods is used to calculate the expected number of hospital admissions for the patient during that period. The SHR for a facility is the ratio of the total number of observed hospitalizations to the total number of expected hospitalizations during all time periods at the facility.

## Risk Adjustment
### Approach to Risk Adjustment
The risk adjustment is based on a Cox or relative risk model. The adjustment is made for patient age, sex, diabetes, duration of ESRD, nursing home status, BMI at incidence, comorbidities at incidence, a set of prevalent comorbidities, and calendar year. In this model, covariates are taken to act multiplicatively on the admission 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), Kalbfleisch and Prentice (2002), Lawless and Nadeau (1995), Lin et al. (2000), Cook and Lawless (2007) and Liu, Schaubel and Kalbfleisch (2010). All analyses are done using SAS.

In general, adjustment factors for the SHR were selected based on several considerations.  We began with a large set of patient characteristics, including demographics, comorbidities at ESRD incidence, a set of prevalent comorbidities, and other characteristics. Factors considered appropriate were then investigated with statistical models, including interactions between sets of adjusters, to determine if they were related to hospitalizations. Factors related to the SHR were also evaluated for face validity before being included. This evaluation included advice provided by two Technical Expert Panels, as described below.  Finally, SDS/SES factors were evaluated based on appropriateness (whether related to disparities in care), empirical association with the outcome, and as supported in published literature.

In 2007, a Technical Expert Panel was convened; the TEP provided advice on various aspects of the SHR, including adjustment factors. The 2007 Hospitalization TEP felt that facility characteristics are generally not appropriate for use as adjusters, but should be evaluated for their potential as proxies for patient characteristics. The TEP also recommended that facility market characteristics, such as local hospital utilization rates, should not be considered as risk adjusters.

More recently, there has been great interest among dialysis care providers and other stakeholders in adjusting for more current (prevalent) comorbidities to reflect the current health status of dialysis patients, and specifically inclusion of conditions associated with hospitalization.  In response, 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. Specific objectives included: (1) review of the comorbidity adjustment (determined at ESRD incidence) in the current NQF endorsed SMR and SHR measures; and (2) consideration of what, if any, prevalent comorbidities would be appropriate to include in each measure.  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.

Reflecting these criteria, 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 diagnoses comorbidities (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

This scoring exercise aimed at identifying a set of prevalent comorbidities not likely the result of facility care and therefore potentially appropriate as risk adjusters for SHR and SMR.  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 below.

## Adjustment in the SHR
The regression model used to compute a facility's "expected" number of hospitalizations for the SHR measure contains many factors thought to be associated with hospitalization rates. Specifically, the model adjusts for patient age, sex, diabetes as cause of ESRD, duration of ESRD, nursing home status, BMI at incidence, comorbidities at incidence, prevalent comorbidities, and calendar year. The stage 1 model allows the baseline hospitalization rates to vary between strata, which are defined by facilities, but assumes that the regression coefficients are the same across all strata; this approach is robust to possible differences between facilities in the patient mix being treated.  In essence, it avoids a possible confounding between facility effects and patient covariates as can arise, for example, if patients with

favorable values of the covariate tend to be treated at facilities with better treatment policies and outcomes. Thus, for example, if patients with diabetes as a cause of ESRD tended to be treated at better facilities, one would underestimate the effect of diabetes unless the model is adjusted for facility. In this model, facility adjustment is done by stratification.

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

- Age: We determine each patient's age from the birth date provided in the CROWNWeb and REMIS databases. Medicare claims and his/her Medical Evidence Form (CMS-2728) are used as check to verify birthdate (in the event of an error in the first three sources).
- Sex: We determine each patient's sex from CROWNWeb and REMIS databases, or SRTR.
- Diabetes as cause of ESRD: We determine each patient's primary cause of ESRD from his/her CMS-2728, and the CROWNWeb and REMIS databases.  Duration of ESRD: We determine each patient's length of time since start of ESRD treatment using his/her CMS-2728, claims history (all claim types), the SIMS database and the SRTR database and categorize as 91 days-6 months, 6 months-1 year, 1-2 years, 2-3 years, 3-5 years, or 5+ years as of the period start date.
- Nursing home status: 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.
- Comorbidities at incidence are determined using a selection of comorbidities reported on the 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 covariate in the model.
- Prevalent comorbidities: We identify a patient's prevalent comorbidities based on claims from the previous calendar year. The comorbidities adjusted for in are listed later in this report.
- Calendar year

Categorical indicator variables are included as covariates in the stage I model to account for records with missing values for cause of ESRD, comorbidities at incidence (missing CMS-2728), and BMI. These variables have a value of 1 if the patient is missing the corresponding variable and a value of 0 otherwise. Another categorical indicator variable is included as a covariate in the stage 1 model to flag records where the patient has at least one of the incident comorbidities listed earlier. This variable has a value of 1 if the patient has at least one of the comorbidities and a value of 0 otherwise.
Beside main effects, two-way interaction terms between age, sex and duration and cause of ESRD are also included:

- Diabetes as cause of ESRD*Duration of ESRD
- Diabetes as cause of ESRD*Sex
- Diabetes as cause of ESRD*Age
- Age*Sex

## Evaluation of Patient-level and Area-level Sociodemographic (SDS) and Socioeconomic (SES) factors and hospitalization

Age and sex are currently in the SHR. We also evaluated other patient and area-level SDS and SES factors (race, ethnicity; insurance status, employment status, and area-level deprivation indicators) not in SHR, to assess their respective impact on hospitalization.

**Patient-level SDS:** Compared with males, females were more likely to experience a hospital admission (OR=1.06; p<0.01). However the interaction of female sex and age demonstrated the highest odds were observed in the age 15 – 24, 25-44, and 45-59 age groups, with a decreasing gradient, and the 45-59 age group showing the most diminished impact. There was no significant difference in the oldest female-age-specific group. These results suggest the possibility of an unidentified biologic effect or, alternatively, confounding by an unmeasured association for younger females. Hispanics were less likely to be admitted to the hospital (OR=0.92; p<0.01) than non-Hispanics. Compared with white patients, Asian/PI (OR=0.81, p<0.01), Native American (OR=0.97, p<0.01) and black (OR=0.94, p<0.01) patients were less likely to be admitted to the hospital. The results for ethnicity and race are consistent with prior studies within the dialysis setting.

**Patient-level SES:** Compared with Medicare-only patients, patients with both Medicare and Medicaid (OR=1.08; p<0.01) and patients with Medicare as secondary/Medicare HMO (OR=2.66, p<0.01) were more likely to be hospitalized. The result for dually eligible patients having higher odds of hospitalization is consistent with the hypothesis that this insurance category, on average, represents an at-risk group. Further examination is needed for the higher odds of hospitalization for patients with Medicare as secondary payer or HMO.  It is possible that these patients represent a larger portion of incident ESRD patients, which have a known higher risk of complications in the first year of ESRD.
Patients who were employed prior to ESRD incidence were more likely to be admitted to the hospital (OR=1.05; p<0.01) than unemployed patients. Note that for employment categories, the "Other/Unknown" category also had higher odds of hospital admission. We note this represents diverse patient groups with regard to SES, such as students, homemakers and those who are retired.  The higher odds of hospitalization may be associated with unmeasured risk characteristics of this diverse group but that will require further empirical examination based on data availability.

**Area-level SES:** Overall, measures of area-level deprivation had very low impact on the odds of hospitalization. Among statistically significant impacts were measures of low median family income (OR=0.998, p=0.0188), the percentage of families below the poverty level (OR=1.001, p=0.002), the percentage of individuals without a high school diploma (OR=1.002, p<0.01), and the area-level unemployment rate (OR=1.002, p<0.01). In general the magnitude of the effects of the individual indicators was very small. In addition to the very small coefficients, a few were not in the expected direction suggesting potential collinearity with other SES or SDS factors in the model.

**Conclusions:** Race, ethnicity and patient level SES factors are not included in the final risk adjusted SHR model.  While adjustment for these factors would account for different outcomes by race and ethnicity and SES factors, and guard against barriers in access to care, adjustment would also introduce the potential unintended consequence of allowing access to lower quality of care. Additionally, race and Hispanic ethnicity were observed to indicate lower risk of hospitalization.  Including race and Hispanic ethnicity did not contribute substantially to the SHR, nor did patient-level measures of SES.

Given the very small impact of area-level SES factors we also 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 SDS/SES factors and hospitalization, 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. Patients in lower SES strata are typically in poorer health as they face greater resource limitations as a result of their limited access to primary care. Adjusting for SES would effectively further comprise the quality of care received as it would lower standards of care based on an assumption these patients will just generally always be sicker.

## Model for Calculating Expected Hospitalization

The denominator of the SHR stems from a proportional rates model (Lawless and Nadeau, 1995; Lin et al., 2000; Kalbfleisch and Prentice, 2002). This is the recurrent event analog of the well-known proportional hazards or Cox model (Cox, 1972; Kalbfleisch and Prentice, 2002).  To accommodate large-scale data, we adopt a model with piecewise constant baseline rates (e.g. Cook and Lawless, 2007) and the computational methodology developed in Liu, Schaubel and Kalbfleisch (2012).

The modeling process has two stages. At stage I, a stratified model is fitted to the national data with piecewise-constant baseline rates and stratification by facility.  Specifically, the model is of the following form

$$Pr(\text{hospital admission on day } t \text{ given covariates } X) = r_{0k}(t)\exp(\beta'X_{ik})$$

where $X_{ik}$ is the vector of covariates for the $i^{\text{th}}$ patient in the $k^{\text{th}}$ facility and $\beta$ is the vector of regression coefficients.  Time t is measured from the start of ESRD. The baseline rate function $r_{0k}(t)$ is specific to the $k^{\text{th}}$ facility, and is assumed to be a step function with break points at 6 months, 1 year, 2 years, 3 years and 5 years since the onset of dialysis. This model allows the baseline hospitalization rates to vary between strata (facilities), but assumes that the regression coefficients are the same across all strata; this approach is robust to possible differences between facilities in the patient mix being treated.  The stratification on facilities is important in this phase to avoid bias due to possible confounding between covariates and facility effects.

At stage II, the relative risk estimates from the first stage are used to create offsets and an unstratified model is fitted to obtain estimates of an overall baseline rate function. That is, we estimate a common baseline rate of admissions, $r_0(t)$,  across all facilities by considering the model

$$Pr(\text{hospital admission on day } t \text{ given covariates } X) = r_0(t) \, R_{ik,}$$

where $R_{ik} = \exp(\beta'X_{ik})$ is the estimated relative risk  for patient i in facility k obtained from the stage I. In our computation, we assume the baseline to be a step function with 6 unknown parameters, $\alpha_1, ..., \alpha_6$, to estimate. These estimates are used to compute the expected number of admissions given a patient's characteristics.

Specifically, let $t_{iks}$ represent the number of days that patient i from facility k is under observation in the $s^{\text{th}}$ time interval with estimated rate $\alpha_s$. The corresponding expected number of hospital admissions in the $s^{\text{th}}$ interval for this patient is calculated as

$$E_{iks} = \alpha_s \, t_{iks} \, R_{ik} \, .$$

It should be noted that $t_{iks}$ and hence $E_{iks}$ can be 0 if patient i from facility k is never at risk during the $s^{\text{th}}$ time interval.   Summing the $E_{iks}$ over all 6 intervals and all $N_k$ patients in facility k gives

$$\text{Exp} = \sum_{i=1}^{N_k} \sum_{s=1}^{6} E_{iks} = \sum_{i=1}^{N_k} \sum_{s=1}^{6} \alpha_s t_{iks} R_{ik} \; ,$$

which is the expected number of hospital admissions during follow-up at that facility.

Let Obs be the observed total number of hospital admissions at this facility. The SHR for hospital admissions is the ratio of the observed total admissions to this expected value, or

$$SHR = Obs/Exp$$

## Missing Data

Patients with missing data are not excluded from the model. For the purposes of calculation, missing values for the comorbidity index and BMI are replaced with mean values for patients of similar age and identical race, sex, and cause of ESRD. Missing values for cause of ESRD are replaced with the other/unknown category. No patients were missing age, sex, or date of first ESRD treatment. Indicator variables identifying patients with missing values for cause of ESRD, comorbidity index, and BMI are also included as covariates in the model.

# Calculation of SHR P-Values and Confidence Intervals

To adjust for over-dispersion of the data, we compute the p-value for our estimates using the empirical null distribution, a robust approach that takes account of the natural random variation among facilities that is not accounted for in the model (Efron, 2004; Kalbfleisch and Wolfe, 2013).  Our algorithm consists of the following concrete steps. First, we fit an over-dispersed Poisson model (e.g., SAS PROC GENMOD with link=log, dist=poisson and scale=dscale) for the number of hospital admissions

$$\log(E[n_{ik}]) = \log(E_{ik}) + \theta_k,$$

where $n_{ik}$ is the observed number of events for patient $i$ in facility $k$, $E_{ik}$ is the expected number of events for patient $i$ in facility $k$ and $\theta_k$ is the facility-specific intercept. Here, i ranges over the number of patients $\underline{N_k}$ who are treated in the $k$th facility.  The natural log of the SHR for the $k$th facility is then given by the corresponding estimate of $\theta_k$. The standard error of $\theta_k$ is obtained from the robust estimate of variance arising from the overdispersed Poisson model.

Second, we obtain a z-score for each facility by dividing the natural log of its SHR by the standard error from the general linear model described above. These z-scores are then grouped into quartiles based on the number of patient years at risk for Medicare patients in each facility. Finally, using robust estimates of location and scale based on the normal curve fitted to the center of the z-scores for the SHR, we derive the mean and variance of a normal empirical null distribution for each quartile. This empirical null distribution is then used to calculate the p-value for a facility's SHR.

## Example

The uncertainty or confidence intervals are obtained by applying the following steps:

- From the general linear model we obtain the natural log of the SHR (ln SHR) as well as its standard error, (SE).  From the empirical null, we obtain a mean ($\mu$) and a standard deviation ($\sigma$). The 95% uncertainty interval for the 'true' log standardized hospitalization ratio for this facility is

$$\ln SHR - \mu * SE \ \pm \ 1.96 * \sigma * SE.$$

  Note that 1.96 is the critical point from the standard normal distribution for a 95% interval.

- Exponentiating the endpoints of this interval gives the uncertainty interval for the true SHR.

For example, consider a hypothetical facility whose SHR is 0.927 for which ln SHR = -0.076 with corresponding standard error, SE = 0.118. This facility falls in a quartile where the empirical null has $\mu$ = -0.143 and $\sigma$ = 1.479. The corresponding uncertainty interval for the log SHR is

$$-0.076 - (-0.143)*0.118 \pm 1.96*0.118*1.479 = (-0.401, 0.283).$$

The 95% interval for the true SHR is then 0.67 to 1.33.

## Flagging rules for Dialysis Facility Compare (DFC)
As currently implemented for DFC, for reporting purposes we identify outlier facilities from amongst those with at least 5 patient-years at risk during the time period.  If the 95% interval lies entirely above the value of 1.00 (i.e. both endpoints exceed 1.00), the facility is said to have outcomes that are "worse than expected". On the other hand, if the 95% interval lies entirely below the value 1.00, the facility is said to be better than expected. If the interval contains the value 1.00, the facility is said to have outcomes that are "as expected. For other purposes (e.g. QIP) other scoring methods may be used.

# Results

**Table 1. Model Coefficients, Data Years 2010–2013.**

| Covariate | Coefficient | P-value |
|---|---|---|
| **Comorbidities at start of ESRD** | | |
|    At least one of the comorbidities listed below | 0.08624 | <.0001 |
|    Atherosclerotic heart disease | 0.04999 | <.0001 |
|    Other cardiac disease | 0.04395 | <.0001 |
|    Diabetes* | -0.02026 | <.0001 |
|    Congestive heart failure | 0.04269 | <.0001 |
|    Inability to ambulate | 0.02042 | <.0001 |
|    Chronic obstructive pulmonary disease | 0.05646 | <.0001 |
|    Inability to transfer | 0.02401 | <.0001 |
|    Malignant neoplasm, cancer | 0.04102 | <.0001 |
|    Peripheral vascular disease | 0.04104 | <.0001 |
|    Cerebrovascular disease, CVA, TIA | 0.01904 | <.0001 |
|    Tobacco use (current smoker) | 0.08539 | <.0001 |
|    Alcohol dependence | 0.01285 | 0.036 |
|    Drug dependence | 0.17361 | <.0001 |
|    No Medical Evidence (CMS-2728) Form | 0.15316 | <.0001 |
| **Cause of ESRD** | | |
|    Diabetes | 0.03848 | <.0001 |
|    Missing | -0.03547 | <.0001 |
| **Sex:** Female | 0.07156 | <.0001 |
| **Age** | | |
|    0-14 | 0.48884 | <.0001 |
|    15-24 | 0.13135 | <.0001 |
|    25-44 | -0.0678 | <.0001 |
|    45-59 | -0.065 | <.0001 |
|    60-74 | Reference | |
|    75+ | 0.10178 | <.0001 |
| **BMI** | | |
|    Log BMI | -0.15032 | <.0001 |

| Covariate | Coefficient | P-value |
|---|---|---|
| BMI missing | 0.01656 | 0.0002 |
| **Calendar year** | | |
| 2010 | Reference | |
| 2011 | -0.02546 | <.0001 |
| 2012 | -0.12676 | <.0001 |
| 2013 | -0.16265 | <.0001 |
| **In nursing home the previous year** | 0.20788 | <.0001 |
| **Diabetes as cause of ESRD X time on ESRD interaction term** | | |
| 91 days-6 months | Reference | |
| 6 months-1 year | 0.03417 | <.0001 |
| 1-2 years | 0.01166 | 0.0737 |
| 2-3 years | 0.00139 | 0.8356 |
| 3-5 years | -0.01549 | 0.0147 |
| 5+ years | -0.06398 | <.0001 |
| **Cause of ESRD: diabetes X sex: female interaction term** | -0.02622 | <.0001 |
| **Age X diabetes as cause of ESRD interaction term** | | |
| 0-14 | -0.93749 | <.0001 |
| 15-24 | 0.16727 | <.0001 |
| 25-44 | 0.15502 | <.0001 |
| 45-59 | 0.05013 | <.0001 |
| 60-74 | Reference | |
| 75+ | -0.03426 | <.0001 |
| **Age X female sex interaction term** | | |
| 0-14 | -0.13038 | 0.0002 |
| 15-24 | 0.24562 | <.0001 |
| 25-44 | 0.12877 | <.0001 |
| 45-59 | 0.03139 | <.0001 |
| 60-74 | Reference | |
| 75+ | -0.00664 | 0.0685 |

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

**Table 2. Prevalent Comorbidity Coefficients, Data Years 2010–2013.**

| ICD-9 Description | ICD-9 Code | Coefficient | P-value |
|---|---|---|---|
| Sarcoidosis | 135 | 0.0624 | <.0001 |
| Malign neopl prostate | 185 | -0.03133 | <.0001 |
| Malign neopl thyroid | 193 | -0.04837 | 0.0087 |
| Oth severe malnutrition | 262 | 0.0382 | <.0001 |
| Chr airway obstruct NEC | 496 | 0.1908 | <.0001 |
| Postinflam pulm fibrosis | 515 | 0.11769 | <.0001 |
| Malignant neopl rectum | 1541 | 0.1335 | <.0001 |
| Mal neo liver, primary | 1550 | 0.12225 | <.0001 |
| Mal neo upper lobe lung | 1623 | 0.08088 | <.0001 |
| Mal neo bronch/lung NOS | 1629 | 0.13617 | <.0001 |
| Malig neo bladder NOS | 1889 | 0.10792 | <.0001 |
| Malig neopl kidney | 1890 | 0.02548 | 0.0004 |
| Secondary malig neo lung | 1970 | 0.17282 | <.0001 |
| Second malig neo liver | 1977 | 0.38071 | <.0001 |
| Secondary malig neo bone | 1985 | 0.29043 | <.0001 |
| Malignant neoplasm NOS | 1991 | 0.13518 | <.0001 |
| Protein-cal malnutr NOS | 2639 | 0.10345 | <.0001 |
| Dis urea cycle metabol | 2706 | 0.06036 | 0.0002 |
| Senile dementia uncomp | 2900 | -0.02563 | 0.0001 |
| Drug withdrawal | 2920 | 0.26748 | <.0001 |
| Mental disor NEC oth dis | 2948 | 0.04058 | <.0001 |
| Cereb degeneration NOS | 3319 | 0.08582 | <.0001 |
| Aut neuropthy in oth dis | 3371 | 0.02621 | <.0001 |
| Grand mal status | 3453 | 0.01548 | 0.1722 |
| Anoxic brain damage | 3481 | -0.03408 | 0.0008 |
| Cerebral edema | 3485 | 0.09181 | <.0001 |
| Idio periph neurpthy NOS | 3569 | 0.09859 | <.0001 |
| Neuropathy in diabetes | 3572 | 0.04133 | <.0001 |
| Intermed coronary synd | 4111 | 0.2052 | <.0001 |
| Angina pectoris NEC/NOS | 4139 | 0.12568 | <.0001 |
| Prim pulm hypertension | 4160 | -0.01251 | 0.0316 |
| Chr pulmon heart dis NEC | 4168 | 0.15189 | <.0001 |
| Prim cardiomyopathy NEC | 4254 | 0.16394 | <.0001 |
| Cardiomyopath in oth dis | 4258 | 0.16331 | <.0001 |
| Atriovent block complete | 4260 | 0.02671 | 0.0001 |
| Parox ventric tachycard | 4271 | 0.09607 | <.0001 |
| Parox tachycardia NOS | 4272 | 0.06145 | <.0001 |
| Subdural hemorrhage | 4321 | 0.03408 | 0.0004 |
| Aortic atherosclerosis | 4400 | 0.09852 | <.0001 |

| ICD-9 Description | ICD-9 Code | Coefficient | P-value |
|---|---|---|---|
| Lower extremity aneurysm | 4423 | 0.10898 | <.0001 |
| Periph vascular dis NOS | 4439 | 0.09731 | <.0001 |
| Stricture of artery | 4471 | 0.00238 | 0.6534 |
| Oth inf vena cava thromb | 4532 | 0.2153 | <.0001 |
| Emphysema NEC | 4928 | 0.05787 | <.0001 |
| Bronchiectas w/o ac exac | 4940 | 0.06175 | <.0001 |
| Food/vomit pneumonitis | 5070 | 0.05726 | <.0001 |
| Lung involv in oth dis | 5178 | 0.17403 | <.0001 |
| Regional enteritis NOS | 5559 | 0.17154 | <.0001 |
| Ulceratve colitis unspcf | 5569 | 0.06821 | <.0001 |
| Chr vasc insuff intest | 5571 | 0.15765 | <.0001 |
| Paralytic ileus | 5601 | 0.10245 | <.0001 |
| Intestinal obstruct NOS | 5609 | 0.10671 | <.0001 |
| Alcohol cirrhosis liver | 5712 | 0.05621 | <.0001 |
| Cirrhosis of liver NOS | 5715 | 0.20344 | <.0001 |
| Hepatic encephalopathy | 5722 | 0.17945 | <.0001 |
| Portal hypertension | 5723 | 0.20086 | <.0001 |
| Oth sequela, chr liv dis | 5728 | 0.14523 | <.0001 |
| Chronic pancreatitis | 5771 | 0.38153 | <.0001 |
| Chronic skin ulcer NEC | 7078 | 0.07843 | <.0001 |
| Syst lupus erythematosus | 7100 | 0.24781 | <.0001 |
| Systemic sclerosis | 7101 | 0.12899 | <.0001 |
| Rheumatoid arthritis | 7140 | 0.10921 | <.0001 |
| Inflamm polyarthrop NOS | 7149 | 0.02641 | 0.1369 |
| Sacroiliitis NEC | 7202 | 0.16649 | <.0001 |
| Gangrene | 7854 | 0.05466 | <.0001 |
| Cachexia | 7994 | 0.14375 | <.0001 |
| Fracture of pubis-closed | 8082 | 0.06248 | <.0001 |
| Pelvic fracture NOS-clos | 8088 | -0.01048 | 0.4819 |
| Fx neck of femur NOS-cl | 8208 | -0.02685 | <.0001 |
| Amput below knee, unilat | 8970 | -0.10393 | <.0001 |
| Amputat bk, unilat-compl | 8971 | -0.10582 | <.0001 |
| Amput above knee, unilat | 8972 | -0.08573 | <.0001 |
| Amputat leg, unilat NOS | 8974 | -0.077 | <.0001 |
| Candidal esophagitis | 11284 | 0.1985 | <.0001 |
| Oth lymp unsp xtrndl org | 20280 | 0.14363 | <.0001 |
| Mult mye w/o achv rmson | 20300 | 0.19204 | <.0001 |
| Ch lym leuk wo achv rmsn | 20410 | 0.25565 | <.0001 |
| Essntial thrombocythemia | 23871 | 0.10421 | <.0001 |
| Low grde myelody syn les | 23872 | 0.14376 | <.0001 |

| ICD-9 Description | ICD-9 Code | Coefficient | P-value |
|---|---|---|---|
| Myelodysplastic synd NOS | 23875 | 0.17806 | <.0001 |
| DMII wo cmp nt st uncntr | 25000 | 0.11986 | <.0001 |
| DMII wo cmp uncntrld | 25002 | 0.02111 | <.0001 |
| DMII keto nt st uncntrld | 25010 | 0.03729 | <.0001 |
| DMII ketoacd uncontrold | 25012 | 0.13424 | <.0001 |
| DMI ketoacd uncontrold | 25013 | 0.25355 | <.0001 |
| DMII hprosmlr uncontrold | 25022 | 0.12376 | <.0001 |
| DMII renl nt st uncntrld | 25040 | 0.0746 | <.0001 |
| DMI renl nt st uncntrld | 25041 | 0.04644 | <.0001 |
| DMII ophth nt st uncntrl | 25050 | 0.00743 | 0.0064 |
| DMI ophth uncntrld | 25053 | 0.05823 | <.0001 |
| DMII neuro nt st uncntrl | 25060 | 0.05824 | <.0001 |
| DMI neuro nt st uncntrld | 25061 | 0.04909 | <.0001 |
| DMII neuro uncntrld | 25062 | 0.07612 | <.0001 |
| DMI neuro uncntrld | 25063 | 0.13715 | <.0001 |
| DMII circ nt st uncntrld | 25070 | -0.04017 | <.0001 |
| DMI circ nt st uncntrld | 25071 | -0.05298 | <.0001 |
| DMII circ uncntrld | 25072 | -0.02251 | <.0001 |
| DMII oth nt st uncntrld | 25080 | 0.08205 | <.0001 |
| DMI oth nt st uncntrld | 25081 | 0.02286 | 0.0002 |
| DMII oth uncntrld | 25082 | 0.03781 | <.0001 |
| DMI oth uncntrld | 25083 | 0.00729 | 0.3939 |
| Glucocorticoid deficient | 25541 | 0.17576 | <.0001 |
| Amyloidosis NEC | 27739 | 0.15827 | <.0001 |
| Metabolism disorder NEC | 27789 | 0.21983 | <.0001 |
| Morbid obesity | 27801 | 0.07927 | <.0001 |
| Obesity hypovent synd | 27803 | -0.05432 | <.0001 |
| Sickle cell disease NOS | 28260 | 0.71791 | <.0001 |
| Antin chemo indcd pancyt | 28411 | 0.10449 | 0.0005 |
| Other pancytopenia | 28419 | 0.1945 | <.0001 |
| Neutropenia NOS | 28800 | 0.16551 | <.0001 |
| Drug induced neutropenia | 28803 | 0.14431 | <.0001 |
| Prim hypercoagulable st | 28981 | 0.18562 | <.0001 |
| Senile delusion | 29020 | -0.11382 | <.0001 |
| Vascular dementia,uncomp | 29040 | -0.00174 | 0.8249 |
| Dementia w/o behav dist | 29410 | 0.01212 | 0.0613 |
| Dementia w behavior dist | 29411 | -0.02334 | 0.0177 |
| Demen NOS w/o behv dstrb | 29420 | 0.04516 | <.0001 |
| Schizophrenia NOS-unspec | 29590 | 0.15532 | <.0001 |
| Depress psychosis-unspec | 29620 | 0.17524 | <.0001 |

| ICD-9 Description | ICD-9 Code | Coefficient | P-value |
|---|---|---|---|
| Recurr depr psychos-unsp | 29630 | 0.08526 | <.0001 |
| Recur depr psych-severe | 29633 | 0.07789 | <.0001 |
| Bipolar disorder NOS | 29680 | 0.19198 | <.0001 |
| Bipolar disorder NEC | 29689 | 0.08524 | <.0001 |
| Episodic mood disord NOS | 29690 | 0.07786 | <.0001 |
| Alcoh dep NEC/NOS-unspec | 30390 | 0.16788 | <.0001 |
| Alcoh dep NEC/NOS-remiss | 30393 | 0.07322 | <.0001 |
| Opioid dependence-unspec | 30400 | 0.25245 | <.0001 |
| Opioid dependence-contin | 30401 | 0.18003 | <.0001 |
| Drug depend NOS-unspec | 30490 | 0.27902 | <.0001 |
| Psymotr epil w/o int epi | 34540 | -0.08114 | <.0001 |
| Epilep NOS w/o intr epil | 34590 | 0.19176 | <.0001 |
| Critical illness myopthy | 35981 | -0.09196 | <.0001 |
| Prolif diab retinopathy | 36202 | -0.08631 | <.0001 |
| Mod nonprolf db retinoph | 36205 | -0.07697 | <.0001 |
| Diabetic macular edema | 36207 | -0.0601 | <.0001 |
| Hyp ht dis NOS w ht fail | 40291 | 0.03839 | <.0001 |
| Subendo infarct, initial | 41071 | 0.18348 | <.0001 |
| AMI NEC, unspecified | 41080 | 0.03986 | 0.0367 |
| AMI NOS, unspecified | 41090 | -0.03149 | <.0001 |
| Ac ischemic hrt dis NEC | 41189 | 0.11644 | <.0001 |
| Pulm embol/infarct NEC | 41519 | 0.13237 | <.0001 |
| Atrial fibrillation | 42731 | 0.13302 | <.0001 |
| Atrial flutter | 42732 | 0.08346 | <.0001 |
| Sinoatrial node dysfunct | 42781 | -0.00923 | 0.0206 |
| Crbl emblsm w infrct | 43411 | 0.01754 | 0.0772 |
| Crbl art ocl NOS w infrc | 43491 | 0.07113 | <.0001 |
| Athscl extrm ntv art NOS | 44020 | 0.00141 | 0.6632 |
| Ath ext ntv at w claudct | 44021 | 0.04379 | <.0001 |
| Ath ext ntv at w rst pn | 44022 | 0.09607 | <.0001 |
| Ath ext ntv art ulcrtion | 44023 | 0.02268 | <.0001 |
| Dsct of thoracic aorta | 44101 | 0.23712 | <.0001 |
| Periph vascular dis NEC | 44389 | 0.01881 | 0.0012 |
| Deep phlebitis-leg NEC | 45119 | 0.00269 | 0.7906 |
| Ac DVT/emb prox low ext | 45341 | 0.12676 | <.0001 |
| Ch DVT/embl low ext NOS | 45350 | 0.12558 | <.0001 |
| Ch DVT/embl prox low ext | 45351 | 0.09937 | <.0001 |
| Ch emblsm subclav veins | 45375 | 0.17741 | <.0001 |
| Ac DVT/embl up ext | 45382 | 0.08862 | <.0001 |
| Ac emblsm axillary veins | 45384 | 0.10835 | <.0001 |

| ICD-9 Description | ICD-9 Code | Coefficient | P-value |
|---|---|---|---|
| Ac embl internl jug vein | 45386 | 0.16307 | <.0001 |
| Ac embl thorac vein NEC | 45387 | 0.13445 | <.0001 |
| Esoph varice oth dis NOS | 45621 | 0.19764 | <.0001 |
| Obs chr bronc w(ac) exac | 49121 | 0.16393 | <.0001 |
| Obs chr bronc w ac bronc | 49122 | 0.11419 | <.0001 |
| Chronic obst asthma NOS | 49320 | 0.10527 | <.0001 |
| Ch obst asth w (ac) exac | 49322 | 0.10999 | <.0001 |
| Ac resp flr fol trma/srg | 51851 | -0.04255 | 0.0003 |
| Ot pul insuf fol trm/srg | 51852 | -0.0827 | 0.0003 |
| Other pulmonary insuff | 51882 | 0.13098 | <.0001 |
| Chronic respiratory fail | 51883 | 0.0293 | <.0001 |
| Acute & chronc resp fail | 51884 | 0.02507 | <.0001 |
| Gastrostomy comp - mech | 53642 | 0.10042 | <.0001 |
| Fecal impaction | 56032 | 0.09744 | <.0001 |
| Pressure ulcer, low back | 70703 | 0.0362 | <.0001 |
| Pressure ulcer, hip | 70704 | 0.09173 | <.0001 |
| Pressure ulcer, buttock | 70705 | 0.00396 | 0.4043 |
| Ulcer of lower limb NOS | 70710 | 0.01138 | 0.0098 |
| Ulcer other part of foot | 70715 | 0.04066 | <.0001 |
| Ulcer oth part low limb | 70719 | 0.03358 | <.0001 |
| Pyogen arthritis-unspec | 71100 | 0.03922 | 0.0151 |
| Pyogen arthritis-l/leg | 71106 | 0.11218 | <.0001 |
| Ac osteomyelitis-unspec | 73000 | -0.04005 | 0.0005 |
| Ac osteomyelitis-ankle | 73007 | -0.03799 | <.0001 |
| Ac osteomyelitis NEC | 73008 | -0.01851 | 0.102 |
| Osteomyelitis NOS-hand | 73024 | 0.05835 | 0.0001 |
| Osteomyelitis NOS-ankle | 73027 | -0.03107 | <.0001 |
| Path fx vertebrae | 73313 | 0.1329 | <.0001 |
| Aseptic necrosis femur | 73342 | 0.20291 | <.0001 |
| Asept necrosis bone NEC | 73349 | 0.17431 | <.0001 |
| Coma | 78001 | 0.02143 | 0.1083 |
| Convulsions NEC | 78039 | 0.10277 | <.0001 |
| Fx femur intrcaps NEC-cl | 82009 | 0.03652 | 0.0079 |
| Fx femur NOS-closed | 82100 | -0.05632 | <.0001 |
| React-indwell urin cath | 99664 | 0.15093 | <.0001 |
| Compl heart transplant | 99683 | 0.02305 | 0.3552 |
| Asymp hiv infectn status | V08 | 0.37403 | <.0001 |
| Heart transplant status | V421 | 0.26702 | <.0001 |
| Liver transplant status | V427 | 0.16234 | <.0001 |
| Trnspl status-pancreas | V4283 | 0.14978 | <.0001 |

| ICD-9 Description | ICD-9 Code | Coefficient | P-value |
|---|---|---|---|
| Gastrostomy status | V441 | 0.02184 | 0.0173 |
| Ileostomy status | V442 | 0.12312 | <.0001 |
| Colostomy status | V443 | 0.13378 | <.0001 |
| Urinostomy status NEC | V446 | 0.33981 | <.0001 |
| Respirator depend status | V4611 | -0.02597 | 0.001 |
| Status amput othr toe(s) | V4972 | 0.031 | <.0001 |
| Status amput below knee | V4975 | 0.02473 | <.0001 |
| Status amput above knee | V4976 | 0.01774 | 0.0036 |
| Atten to gastrostomy | V551 | -0.03053 | 0.0012 |
| Long-term use of insulin | V5867 | 0.12534 | <.0001 |
| BMI 40.0-44.9, adult | V8541 | 0.03116 | <.0001 |
| Less than 6 months of Medicare eligible claims in the previous calendar year | | 0.73799 | <.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 substantial multicollinearity among the covariates, likely resulting in some unexpected results in the direction of the 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 current health condition of the patient in risk adjustment.

## Reliability Testing

The reliability of the SHR was assessed using data among Medicare 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 SHR, 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.

Overall, we found that IURs for the one-year SHRs have a range of 0.70-0.72 across the years 2010, 2011, 2012 and 2013, which indicates that over two-thirds of the variation in the one-year SHR can be attributed to the between-facility differences and less than one-third to within-facility variation. The SHR calculation only included facilities with at least 5 patient years at risk.

**Table 3: IUR for one-year SHR, 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 | 0.72 | 5407 | 0.71 | 5583 | 0.70 | 5709 | 0.70 | 5864 |
| Small (<=50) | 0.54 | 1864 | 0.51 | 1921 | 0.48 | 1977 | 0.46 | 2028 |
| Medium (51–87) | 0.65 | 1702 | 0.63 | 1785 | 0.58 | 1825 | 0.57 | 1930 |
| Large (>=88) | 0.81 | 1841 | 0.81 | 1877 | 0.81 | 1907 | 0.82 | 1906 |

## Validity Testing

We have assessed the validity of the measure through various comparisons of this measure with other quality measures in use, using Spearman correlations.

The measure is also maintained on face validity. Hospitalization measures were reviewed by a TEP in 2007 and overall measures based on admissions and on days were recommended for inclusion in the Dialysis Facility Reports.  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. In addition, hospitalization is a major cost factor in the management of ESRD patients as noted earlier, further establishing a very strong case for face validity of the SHR admissions measure.

The SHR Admissions measure is correlated with the Standardized Mortality Ratio (SMR) for each individual year from 2010-2013, where Spearman's correlation coefficient ranged from 0.27 to 0.30, with all four correlations being highly significant ($p<0.0001$). Also for each year from 2011-2013, the SHR was correlated with the Standardized Readmission Ratio (SRR) (Spearman's rho=0.54, 0.50, 0.48; $p<0.0001$).

In addition, SHR Admissions is negatively correlated in each of the four years with percent of patients in the facility with AV Fistula (Spearman's rho= -0.12, -0.15, -0.12, -0.13). Thus higher values of SHR are associated with lower usage of AV Fistulas. Further, SHR admissions is positively correlated in each of the four years with percent of patients with catheter >= 90 days (Spearman's rho=0.21, 0.21, 0.18, 0.16), indicating that higher values of SHR are associated with increased use of catheters. These correlations are all highly significant ($p<0.001$). For each year of 2010 through 2013, the SHR Admissions is also found to be negatively correlated with the percent of hemodialysis patients with Kt/V>=1.2, again in the direction expected (Spearman's rho= -0.11, -0.13, -0.10,-0.11; $p<0.0001$). Lower SHRs are associated with a higher percentage of patients receiving adequate dialysis dose.

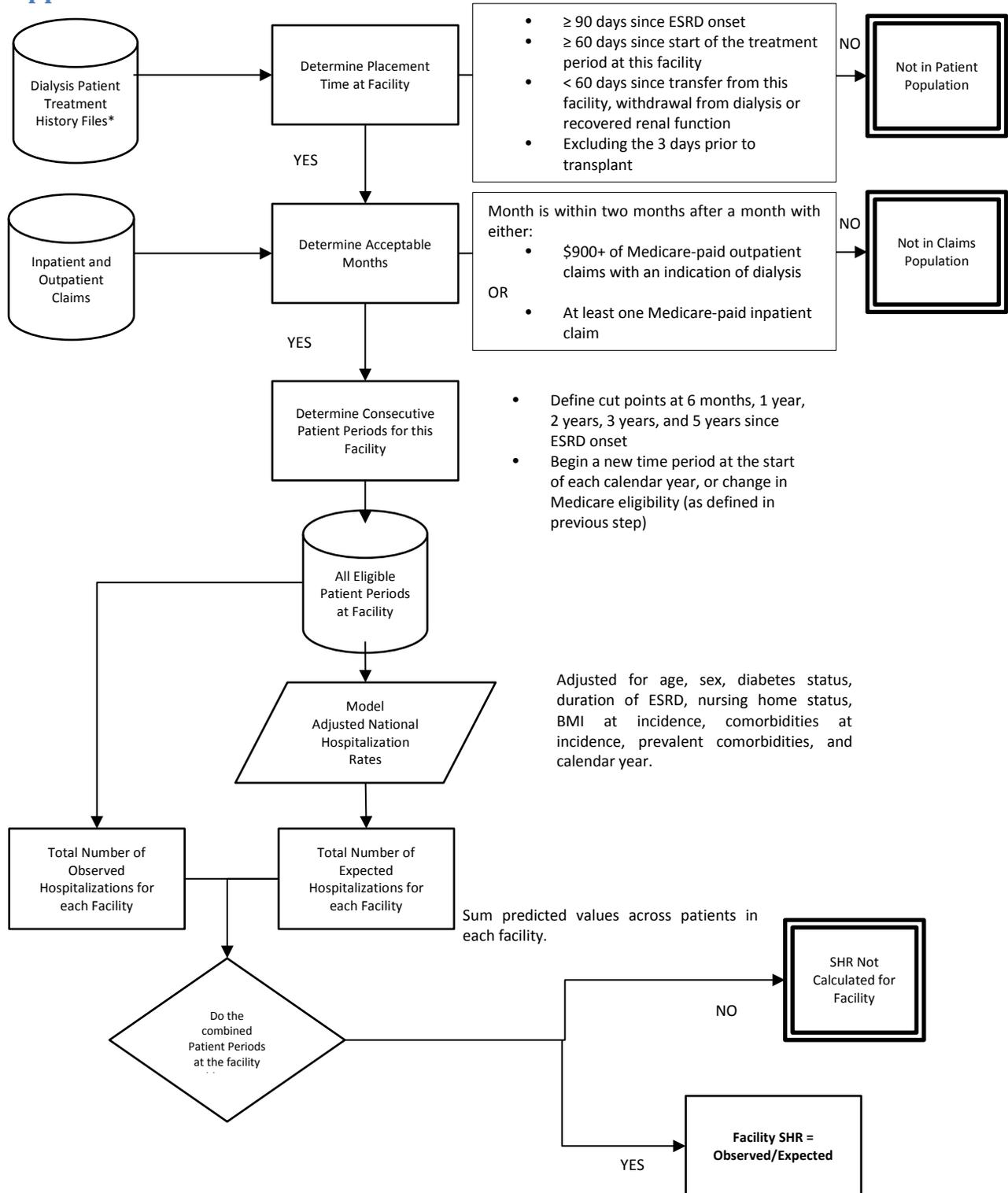The SHR correlates with outcomes, processes of care, and causes of hospitalization that are commonly thought to be potentially related to poor quality of care. Higher hospitalization was associated with higher facility mortality rates; and similarly with higher readmissions. We found higher values of SHR are associated with lower usage of AV Fistulas, higher catheter use, and suboptimal dialysis adequacy.

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# Appendix

## Appendix I. Measure Calculation Flow Chart

**Dialysis Patient Treatment History Files\*** → **Determine Placement Time at Facility**

- ≥ 90 days since ESRD onset
- ≥ 60 days since start of the treatment period at this facility
- < 60 days since transfer from this facility, withdrawal from dialysis or recovered renal function
- Excluding the 3 days prior to transplant

→ NO → **Not in Patient Population**

YES ↓

**Inpatient and Outpatient Claims** → **Determine Acceptable Months**

Month is within two months after a month with either:
- $900+ of Medicare-paid outpatient claims with an indication of dialysis

OR
- At least one Medicare-paid inpatient claim

→ NO → **Not in Claims Population**

YES ↓

**Determine Consecutive Patient Periods for this Facility**

- Define cut points at 6 months, 1 year, 2 years, 3 years, and 5 years since ESRD onset
- Begin a new time period at the start of each calendar year, or change in Medicare eligibility (as defined in previous step)

↓

**All Eligible Patient Periods at Facility**

↓

**Model Adjusted National Hospitalization Rates**

Adjusted for age, sex, diabetes status, duration of ESRD, nursing home status, BMI at incidence, comorbidities at incidence, prevalent comorbidities, and calendar year.

↓

**Total Number of Observed Hospitalizations for each Facility**

**Total Number of Expected Hospitalizations for each Facility**

Sum predicted values across patients in each facility.

↓

**Do the combined Patient Periods at the facility...**

→ NO → **SHR Not Calculated for Facility**

YES → **Facility SHR = Observed/Expected**

\*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.

## Appendix II. ICD-9 to ICD-10 Crosswalk

| 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 lung | C3410 | C3410   Malignant neoplasm of upper lobe, unspecified bronchus or lung |
| 1629 | Malignant neoplasm of bronchus and lung, unspecified | 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 marrow | C7951 | C7951   Secondary malignant neoplasm of bone |
| 1985 | Secondary malignant neoplasm of bone and bone marrow | C7952 | C7952   Secondary malignant neoplasm of bone marrow |
| 1991 | Other malignant neoplasm without specification of site | C801 | C801    Malignant (primary) neoplasm, unspecified |
| 20280 | Other malignant lymphomas, unspecified site, extranodal and solid organ sites | C8580 | C8580   Other specified types of non-Hodgkin lymphoma, unspecified site |
| 20280 | Other malignant lymphomas, unspecified site, extranodal and solid organ sites | C8589 | C8589   Other specified types of non-Hodgkin lymphoma, extranodal and solid organ sites |
| 20300 | Multiple myeloma, without mention of having achieved remission | C9000 | C9000   Multiple myeloma not having achieved remission |
| 20410 | Chronic lymphoid leukemia, without mention of having achieved remission | 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 |

| ICD9DX | ICD9::ICD9DX_desc | ICD10CM | ICD10::ICD10CM_desc |
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| 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, type II or unspecified type, not stated as uncontrolled | E119 | E119   Type 2 diabetes mellitus without complications |
| 25002 | Diabetes mellitus without mention of complication, type II or unspecified type, uncontrolled | E1165 | E1165   Type 2 diabetes mellitus with hyperglycemia |
| 25010 | Diabetes with ketoacidosis, type II or unspecified type, not stated as uncontrolled | E1169 | E1169   Type 2 diabetes mellitus with other specified complication |
| 25010 | Diabetes with ketoacidosis, type II or unspecified type, not stated as uncontrolled | E1310 | E1310   Other specified diabetes mellitus with ketoacidosis without coma |
| 25012 | Diabetes with ketoacidosis, type II or unspecified type, uncontrolled | E1165 | E1165   Type 2 diabetes mellitus with hyperglycemia |
| 25012 | Diabetes with ketoacidosis, type II or unspecified type, uncontrolled | E1169 | E1169   Type 2 diabetes mellitus with other specified complication |
| 25012 | Diabetes with ketoacidosis, type II or unspecified type, uncontrolled | E1310 | E1310   Other specified diabetes mellitus with ketoacidosis without coma |
| 25013 | Diabetes with ketoacidosis, type I [juvenile type], uncontrolled | E1010 | E1010   Type 1 diabetes mellitus with ketoacidosis without coma |
| 25013 | Diabetes with ketoacidosis, type I [juvenile type], uncontrolled | E1065 | E1065   Type 1 diabetes mellitus with hyperglycemia |
| 25022 | Diabetes with hyperosmolarity, type II or unspecified type, uncontrolled | E1100 | E1100   Type 2 diabetes mellitus with hyperosmolarity without nonketotic hyperglycemic-hyperosmolar coma (NKHHC) |
| 25022 | Diabetes with hyperosmolarity, type II or unspecified type, uncontrolled | E1165 | E1165   Type 2 diabetes mellitus with hyperglycemia |
| 25040 | Diabetes with renal manifestations, type II or unspecified type, not stated as uncontrolled | E1129 | E1129   Type 2 diabetes mellitus with other diabetic kidney complication |
| 25041 | Diabetes with renal manifestations, type I [juvenile type], not stated as uncontrolled | E1029 | E1029   Type 1 diabetes mellitus with other diabetic kidney complication |
| 25050 | Diabetes with ophthalmic manifestations, type II or unspecified type, not stated as uncontrolled | E11311 | E11311  Type 2 diabetes mellitus with unspecified diabetic retinopathy with macular edema |
| 25050 | Diabetes with ophthalmic manifestations, type II or unspecified type, not stated as uncontrolled | E11319 | E11319  Type 2 diabetes mellitus with unspecified diabetic retinopathy without macular edema |
| 25050 | Diabetes with ophthalmic manifestations, type II or unspecified type, not stated as uncontrolled | E1136 | E1136   Type 2 diabetes mellitus with diabetic cataract |
| 25050 | Diabetes with ophthalmic manifestations, type II or unspecified type, not stated as uncontrolled | E1139 | E1139   Type 2 diabetes mellitus with other diabetic ophthalmic complication |
| 25053 | Diabetes with ophthalmic manifestations, type I [juvenile type], uncontrolled | E10311 | E10311  Type 1 diabetes mellitus with unspecified diabetic retinopathy with macular edema |
| 25053 | Diabetes with ophthalmic manifestations, type I [juvenile type], uncontrolled | E10319 | E10319  Type 1 diabetes mellitus with unspecified diabetic retinopathy without macular edema |

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| 25053 | Diabetes with ophthalmic manifestations, type I [juvenile type], uncontrolled | E1036 | E1036   Type 1 diabetes mellitus with diabetic cataract |
| 25053 | Diabetes with ophthalmic manifestations, type I [juvenile type], uncontrolled | E1039 | E1039   Type 1 diabetes mellitus with other diabetic ophthalmic complication |
| 25053 | Diabetes with ophthalmic manifestations, type I [juvenile type], uncontrolled | E1065 | E1065   Type 1 diabetes mellitus with hyperglycemia |
| 25060 | Diabetes with neurological manifestations, type II or unspecified type, not stated as uncontrolled | E1140 | E1140   Type 2 diabetes mellitus with diabetic neuropathy, unspecified |
| 25061 | Diabetes with neurological manifestations, type I [juvenile type], not stated as uncontrolled | E1040 | E1040   Type 1 diabetes mellitus with diabetic neuropathy, unspecified |
| 25062 | Diabetes with neurological manifestations, type II or unspecified type, uncontrolled | E1140 | E1140   Type 2 diabetes mellitus with diabetic neuropathy, unspecified |
| 25062 | Diabetes with neurological manifestations, type II or unspecified type, uncontrolled | E1165 | E1165   Type 2 diabetes mellitus with hyperglycemia |
| 25063 | Diabetes with neurological manifestations, type I [juvenile type], uncontrolled | E1040 | E1040   Type 1 diabetes mellitus with diabetic neuropathy, unspecified |
| 25063 | Diabetes with neurological manifestations, type I [juvenile type], uncontrolled | E1065 | E1065   Type 1 diabetes mellitus with hyperglycemia |
| 25070 | Diabetes with peripheral circulatory disorders, type II or unspecified type, not stated as uncontrolled | E1151 | E1151   Type 2 diabetes mellitus with diabetic peripheral angiopathy without gangrene |
| 25071 | Diabetes with peripheral circulatory disorders, type I [juvenile type], not stated as uncontrolled | E1051 | E1051   Type 1 diabetes mellitus with diabetic peripheral angiopathy without gangrene |
| 25072 | Diabetes with peripheral circulatory disorders, type II or unspecified type, uncontrolled | E1151 | E1151   Type 2 diabetes mellitus with diabetic peripheral angiopathy without gangrene |
| 25072 | Diabetes with peripheral circulatory disorders, type II or unspecified type, uncontrolled | E1165 | E1165   Type 2 diabetes mellitus with hyperglycemia |
| 25080 | Diabetes with other specified manifestations, type II or unspecified type, not stated as uncontrolled | E11618 | E11618  Type 2 diabetes mellitus with other diabetic arthropathy |
| 25080 | Diabetes with other specified manifestations, type II or unspecified type, not stated as uncontrolled | E11620 | E11620  Type 2 diabetes mellitus with diabetic dermatitis |
| 25080 | Diabetes with other specified manifestations, type II or unspecified type, not stated as uncontrolled | E11621 | E11621  Type 2 diabetes mellitus with foot ulcer |
| 25080 | Diabetes with other specified manifestations, type II or unspecified type, not stated as uncontrolled | E11622 | E11622  Type 2 diabetes mellitus with other skin ulcer |
| 25080 | Diabetes with other specified manifestations, type II or unspecified type, not stated as uncontrolled | E11628 | E11628  Type 2 diabetes mellitus with other skin complications |
| 25080 | Diabetes with other specified manifestations, type II or unspecified type, not stated as uncontrolled | E11630 | E11630  Type 2 diabetes mellitus with periodontal disease |
| 25080 | Diabetes with other specified manifestations, type II or unspecified type, not stated as uncontrolled | E11638 | E11638  Type 2 diabetes mellitus with other oral complications |

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| 25080 | Diabetes with other specified manifestations, type II or unspecified type, not stated as uncontrolled | E11649 | E11649  Type 2 diabetes mellitus with hypoglycemia without coma |
| 25080 | Diabetes with other specified manifestations, type II or unspecified type, not stated as uncontrolled | E1165 | E1165   Type 2 diabetes mellitus with hyperglycemia |
| 25080 | Diabetes with other specified manifestations, type II or unspecified type, not stated as uncontrolled | E1169 | E1169   Type 2 diabetes mellitus with other specified complication |
| 25081 | Diabetes with other specified manifestations, type I [juvenile type], not stated as uncontrolled | E10618 | E10618  Type 1 diabetes mellitus with other diabetic arthropathy |
| 25081 | Diabetes with other specified manifestations, type I [juvenile type], not stated as uncontrolled | E10620 | E10620  Type 1 diabetes mellitus with diabetic dermatitis |
| 25081 | Diabetes with other specified manifestations, type I [juvenile type], not stated as uncontrolled | E10621 | E10621  Type 1 diabetes mellitus with foot ulcer |
| 25081 | Diabetes with other specified manifestations, type I [juvenile type], not stated as uncontrolled | E10622 | E10622  Type 1 diabetes mellitus with other skin ulcer |
| 25081 | Diabetes with other specified manifestations, type I [juvenile type], not stated as uncontrolled | E10628 | E10628  Type 1 diabetes mellitus with other skin complications |
| 25081 | Diabetes with other specified manifestations, type I [juvenile type], not stated as uncontrolled | E10630 | E10630  Type 1 diabetes mellitus with periodontal disease |
| 25081 | Diabetes with other specified manifestations, type I [juvenile type], not stated as uncontrolled | E10638 | E10638  Type 1 diabetes mellitus with other oral complications |
| 25081 | Diabetes with other specified manifestations, type I [juvenile type], not stated as uncontrolled | E10649 | E10649  Type 1 diabetes mellitus with hypoglycemia without coma |
| 25081 | Diabetes with other specified manifestations, type I [juvenile type], not stated as uncontrolled | E1065 | E1065   Type 1 diabetes mellitus with hyperglycemia |
| 25081 | Diabetes with other specified manifestations, type I [juvenile type], not stated as uncontrolled | E1069 | E1069   Type 1 diabetes mellitus with other specified complication |
| 25082 | Diabetes with other specified manifestations, type II or unspecified type, uncontrolled | E1165 | E1165   Type 2 diabetes mellitus with hyperglycemia |
| 25082 | Diabetes with other specified manifestations, type II or unspecified type, uncontrolled | E1169 | E1169   Type 2 diabetes mellitus with other specified complication |
| 25083 | Diabetes with other specified manifestations, type I [juvenile type], uncontrolled | E1065 | E1065   Type 1 diabetes mellitus with hyperglycemia |
| 25083 | Diabetes with other specified manifestations, type I [juvenile type], uncontrolled | 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 |

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| 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 behavioral disturbance | F0280 | F0280  Dementia in other diseases classified elsewhere without behavioral disturbance |

| ICD9DX | ICD9::ICD9DX_desc | ICD10CM | ICD10::ICD10CM_desc |
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| 29411 | Dementia in conditions classified elsewhere with behavioral disturbance | F0281 | F0281   Dementia in other diseases classified elsewhere with behavioral disturbance |
| 29420 | Dementia, unspecified, without behavioral disturbance | F0390 | F0390   Unspecified dementia without behavioral disturbance |
| 2948 | Other persistent mental disorders due to conditions classified elsewhere | F060 | F060   Psychotic disorder with hallucinations due to known physiological condition |
| 2948 | Other persistent mental disorders due to conditions classified elsewhere | 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, unspecified | F329 | F329   Major depressive disorder, single episode, unspecified |
| 29630 | Major depressive affective disorder, recurrent episode, unspecified | F339 | F339   Major depressive disorder, recurrent, unspecified |
| 29633 | Major depressive affective disorder, recurrent episode, severe, without mention of psychotic behavior | 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, unspecified | F1020 | F1020  Alcohol dependence, uncomplicated |
| 30393 | Other and unspecified alcohol dependence, in remission | 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 classified elsewhere | 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 epileptic syndromes with complex partial seizures, without mention of intractable epilepsy | G40201 | G40201 Localization-related (focal) (partial) symptomatic epilepsy and epileptic syndromes with complex partial seizures, not intractable, with status epilepticus |
| 34540 | Localization-related (focal) (partial) epilepsy and epileptic syndromes with complex partial seizures, without mention of intractable epilepsy | G40209 | G40209 Localization-related (focal) (partial) symptomatic epilepsy and epileptic syndromes with complex partial seizures, not intractable, without status epilepticus |
| 34590 | Epilepsy, unspecified, without mention of intractable epilepsy | G40901 | G40901 Epilepsy, unspecified, not intractable, with status epilepticus |
| 34590 | Epilepsy, unspecified, without mention of intractable epilepsy | G40909 | G40909 Epilepsy, unspecified, not intractable, without status epilepticus |
| 3481 | Anoxic brain damage | G931 | G931   Anoxic brain damage, not elsewhere classified |

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| 3485 | Cerebral edema | G936 | G936   Cerebral edema |
| 3569 | Unspecified hereditary and idiopathic peripheral neuropathy | 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 polyneuropathy |
| 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 edema |
| 36207 | Diabetic macular edema | E11311 | E11311  Type 2 diabetes mellitus with unspecified diabetic retinopathy with macular edema |
| 40291 | Unspecified hypertensive heart disease with heart failure | 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, episode of care unspecified | I2129 | I2129   ST elevation (STEMI) myocardial infarction involving other sites |
| 41090 | Acute myocardial infarction of unspecified site, episode of care unspecified | 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 disease, other | 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 elsewhere | I43 | I43   Cardiomyopathy in diseases classified elsewhere |
| 4260 | Atrioventricular block, complete | I442 | I442   Atrioventricular block, complete |
| 4271 | Paroxysmal ventricular tachycardia | I472 | I472   Ventricular tachycardia |

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| 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 infarction | 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, unspecified | I70209 | I70209  Unspecified atherosclerosis of native arteries of extremities, unspecified extremity |
| 44021 | Atherosclerosis of native arteries of the extremities with intermittent claudication | I70219 | I70219  Atherosclerosis of native arteries of extremities with intermittent claudication, unspecified extremity |
| 44022 | Atherosclerosis of native arteries of the extremities with rest pain | I70229 | I70229  Atherosclerosis of native arteries of extremities with rest pain, unspecified extremity |
| 44023 | Atherosclerosis of native arteries of the extremities with ulceration | 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 lower extremities, other | I80209 | I80209  Phlebitis and thrombophlebitis of unspecified deep vessels of unspecified lower extremity |
| 4532 | Other venous embolism and thrombosis of inferior vena cava | I82220 | I82220  Acute embolism and thrombosis of inferior vena cava |
| 4532 | Other venous embolism and thrombosis of inferior vena cava | I82221 | I82221  Chronic embolism and thrombosis of inferior vena cava |
| 45341 | Acute venous embolism and thrombosis of deep vessels of proximal lower extremity | I82419 | I82419  Acute embolism and thrombosis of unspecified femoral vein |
| 45341 | Acute venous embolism and thrombosis of deep vessels of proximal lower extremity | I82429 | I82429  Acute embolism and thrombosis of unspecified iliac vein |
| 45341 | Acute venous embolism and thrombosis of deep vessels of proximal lower extremity | I82439 | I82439  Acute embolism and thrombosis of unspecified popliteal vein |
| 45341 | Acute venous embolism and thrombosis of deep vessels of proximal lower extremity | I824Y9 | I824Y9  Acute embolism and thrombosis of unspecified deep veins of unspecified proximal lower extremity |
| 45350 | Chronic venous embolism and thrombosis of unspecified deep | I82509 | I82509  Chronic embolism and thrombosis of unspecified deep veins of |

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| | vessels of lower extremity | | unspecified lower extremity |
| 45350 | Chronic venous embolism and thrombosis of unspecified deep vessels of lower extremity | I82599 | I82599  Chronic embolism and thrombosis of other specified deep vein of unspecified lower extremity |
| 45351 | Chronic venous embolism and thrombosis of deep vessels of proximal lower extremity | I82519 | I82519  Chronic embolism and thrombosis of unspecified femoral vein |
| 45351 | Chronic venous embolism and thrombosis of deep vessels of proximal lower extremity | I82529 | I82529  Chronic embolism and thrombosis of unspecified iliac vein |
| 45351 | Chronic venous embolism and thrombosis of deep vessels of proximal lower extremity | I82539 | I82539  Chronic embolism and thrombosis of unspecified popliteal vein |
| 45351 | Chronic venous embolism and thrombosis of deep vessels of proximal lower extremity | I825Y9 | I825Y9  Chronic embolism and thrombosis of unspecified deep veins of unspecified proximal lower extremity |
| 45375 | Chronic venous embolism and thrombosis of subclavian veins | I82B29 | I82B29  Chronic embolism and thrombosis of unspecified subclavian vein |
| 45382 | Acute venous embolism and thrombosis of deep veins of upper extremity | I82629 | I82629  Acute embolism and thrombosis of deep veins of unspecified upper extremity |
| 45384 | Acute venous embolism and thrombosis of axillary veins | I82A19 | I82A19  Acute embolism and thrombosis of unspecified axillary vein |
| 45386 | Acute venous embolism and thrombosis of internal jugular veins | I82C19 | I82C19  Acute embolism and thrombosis of unspecified internal jugular vein |
| 45387 | Acute venous embolism and thrombosis of other thoracic veins | I82290 | I82290  Acute embolism and thrombosis of other thoracic veins |
| 45621 | Esophageal varices in diseases classified elsewhere, without mention of bleeding | I8510 | I8510   Secondary esophageal varices without bleeding |
| 49121 | Obstructive chronic bronchitis with (acute) exacerbation | 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) exacerbation | 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 elsewhere | J99 | J99      Respiratory disorders in diseases classified elsewhere |
| 51851 | Acute respiratory failure following trauma and surgery | J95821 | J95821  Acute postprocedural respiratory failure |
| 51851 | Acute respiratory failure following trauma and surgery | J9600 | J9600   Acute respiratory failure, unspecified whether with hypoxia or hypercapnia |
| 51852 | Other pulmonary insufficiency, not elsewhere classified, | J951 | J951   Acute pulmonary insufficiency following thoracic surgery |

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| | following trauma and surgery | | |
| 51852 | Other pulmonary insufficiency, not elsewhere classified, following trauma and surgery | J952 | J952  Acute pulmonary insufficiency following nonthoracic surgery |
| 51852 | Other pulmonary insufficiency, not elsewhere classified, following trauma and surgery | J953 | J953  Chronic pulmonary insufficiency following surgery |
| 51882 | Other pulmonary insufficiency, not elsewhere classified | 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 |

| ICD9DX | ICD9::ICD9DX_desc | ICD10CM | ICD10::ICD10CM_desc |
|---|---|---|---|
| 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 fracture |

| ICD9DX | ICD9::ICD9DX_desc | ICD10CM | ICD10::ICD10CM_desc |
|---|---|---|---|
| 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), unilateral, below knee, without mention of complication | S88119A | S88119A Complete traumatic amputation at level between knee and ankle, unspecified lower leg, initial encounter |
| 8970 | Traumatic amputation of leg(s) (complete) (partial), unilateral, below knee, without mention of complication | S88129A | S88129A Partial traumatic amputation at level between knee and ankle, unspecified lower leg, initial encounter |
| 8971 | Traumatic amputation of leg(s) (complete) (partial), unilateral, below knee, complicated | S88119A | S88119A Complete traumatic amputation at level between knee and ankle, unspecified lower leg, initial encounter |
| 8971 | Traumatic amputation of leg(s) (complete) (partial), unilateral, below knee, complicated | S88129A | S88129A Partial traumatic amputation at level between knee and ankle, unspecified lower leg, initial encounter |
| 8972 | Traumatic amputation of leg(s) (complete) (partial), unilateral, at or above knee, without mention of complication | S78019A | S78019A Complete traumatic amputation at unspecified hip joint, initial encounter |
| 8972 | Traumatic amputation of leg(s) (complete) (partial), unilateral, at or above knee, without mention of complication | S78029A | S78029A Partial traumatic amputation at unspecified hip joint, initial encounter |
| 8972 | Traumatic amputation of leg(s) (complete) (partial), unilateral, at or above knee, without mention of complication | S78119A | S78119A Complete traumatic amputation at level between unspecified hip and knee, initial encounter |
| 8972 | Traumatic amputation of leg(s) (complete) (partial), unilateral, at or above knee, without mention of complication | S78129A | S78129A Partial traumatic amputation at level between unspecified hip and knee, initial encounter |

| ICD9DX | ICD9::ICD9DX_desc | ICD10CM | ICD10::ICD10CM_desc |
|---|---|---|---|
| 8972 | Traumatic amputation of leg(s) (complete) (partial), unilateral, at or above knee, without mention of complication | S78919A | S78919A Complete traumatic amputation of unspecified hip and thigh, level unspecified, initial encounter |
| 8972 | Traumatic amputation of leg(s) (complete) (partial), unilateral, at or above knee, without mention of complication | S78929A | S78929A Partial traumatic amputation of unspecified hip and thigh, level unspecified, initial encounter |
| 8972 | Traumatic amputation of leg(s) (complete) (partial), unilateral, at or above knee, without mention of complication | S88019A | S88019A Complete traumatic amputation at knee level, unspecified lower leg, initial encounter |
| 8972 | Traumatic amputation of leg(s) (complete) (partial), unilateral, at or above knee, without mention of complication | S88029A | S88029A Partial traumatic amputation at knee level, unspecified lower leg, initial encounter |
| 8974 | Traumatic amputation of leg(s) (complete) (partial), unilateral, level not specified, without mention of complication | S78919A | S78919A Complete traumatic amputation of unspecified hip and thigh, level unspecified, initial encounter |
| 8974 | Traumatic amputation of leg(s) (complete) (partial), unilateral, level not specified, without mention of complication | S78929A | S78929A Partial traumatic amputation of unspecified hip and thigh, level unspecified, initial encounter |
| 8974 | Traumatic amputation of leg(s) (complete) (partial), unilateral, level not specified, without mention of complication | S88919A | S88919A Complete traumatic amputation of unspecified lower leg, level unspecified, initial encounter |
| 8974 | Traumatic amputation of leg(s) (complete) (partial), unilateral, level not specified, without mention of complication | S88929A | S88929A Partial traumatic amputation of unspecified lower leg, level unspecified, initial encounter |
| 99664 | Infection and inflammatory reaction due to indwelling urinary catheter | 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] infection status | 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 |