# MEASURE INFORMATION FORM

## *Project Title:*

Dialysis Facility Compare – Standardized Transfusion Ratio

## *Project Overview:*

The Centers for Medicare & Medicaid Services (CMS) has contracted with the University of Michigan Kidney Epidemiology and Cost Center (UM-KECC) to calculate and report quality measures for public reporting on Dialysis Facility Compare. The contract name is ESRD Quality Measure Development, Maintenance, and Support. The contract number is HHSM-500-2013-13017I.

## *Date:*

Information included is current beginning with the measures reported in the Quarterly Dialysis Facility Compare Preview Period for October 2016 Report.

## *Measure Name*

Anemia of chronic kidney disease: Dialysis facility standardized transfusion ratio (STrR)

## *Descriptive Information*

**Measure Name (Measure Title De.2.)**
Anemia of chronic kidney disease: Dialysis facility standardized transfusion ratio (STrR)

**Measure Type De.1.**
Outcome

**Brief Description of Measure De.3.**
The risk adjusted facility level transfusion ratio "STrR" is specified for all adult dialysis patients. It is a ratio of number of eligible red blood cell transfusion events observed in patients dialyzing at a facility, to the number of eligible transfusions that would be expected under a national norm, after accounting for the patient characteristics within each facility. Eligible transfusions are those that do not have any claims pertaining to the comorbidities identified for exclusion, in the one year look back period prior to each observation window.

**If Paired or Grouped De.4.**
N/A

**Subject/Topic Areas De.5.**
Renal, Renal : End Stage Renal Disease (ESRD)

**Crosscutting Areas De 6.**
N/A

## *Measure Specifications*

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

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

**Data Dictionary, Code Table, or Value Sets S.2b.**
N/A

**For Endorsement Maintenance S.3.**
N/A

**Numerator Statement S.4.**
Number of eligible observed red blood cell transfusion events. Events are defined as transfer of one or more units of blood or blood products into recipient's blood stream (code set is provided in the

numerator details) among patients dialyzing at the facility during the inclusion episodes of the reporting period. Inclusion episodes are those that do not have any claims pertaining to the comorbidities identified for exclusion, in the one year look back period prior to each observation window.

**Time Period for Data S.5.**
One year

**Numerator Details S.6.**
Red blood cell transfusions are identified by in-patient records with revenue center codes in (0380, 0381, 0382, 0389, 0390, 0391, 0392, 0399) or value code = 37 or procedure code in (9903, 9904, 30230H1, 30233H1, 30240H1, 30243H1, 30250H1, 30253H1, 30260H1, 30263H1, 30230N1, 30230P1, 30233N1, 30233P1, 30240N1, 30240P1, 30243N1, 30243P1, 30250N1, 30250P1, 30253N1, 30253P1, 30260N1, 30260P1, 30263N1, and 30263P1) and with out-patient records with revenue center codes in (0380, 0381, 0382, 0389, 0390, 0391, 0392, 0399) and HCPCS code in (P9010, P9011, P9016, P9021, P9022, P9038, P9039, P9040, P9051, P9054, P9056, P9057, P9058, 36430).

The numerator is calculated using Medicare Claims data. Transfusion events are identified by using the above mentioned codes and then the patient is attributed to a dialysis facility using the rules discussed in the denominator details (S.9). The numerator is the count of all such eligible transfusion events over the inclusion periods as defined below in section S.11, for a given facility.
Our method for counting transfusion events relies on a conservative counting algorithm and, because of the way transfusion information is reported in Medicare claims, we use different rules for counting transfusion events, depending on whether or not the event occurs in the inpatient setting, or an outpatient setting. The most common way events are reported on claims is by reporting a revenue center or value code (inpatient claims) or for outpatient claims, reporting HCPCS codes for a revenue center date.

One “transfusion event” is counted per inpatient claim if one or more transfusion-related revenue center or value codes are present. This is the way most inpatient transfusion events are reported on claims (i.e., using revenue center or value codes, not procedure codes). We only count a single transfusion event for an inpatient claim regardless of the number of transfusion revenue center and value codes reported so that the number of discrete events counted is the same whether the claim indicates 1 unit of blood or multiple units of blood. This results in a very conservative estimate of blood transfusions from inpatient claims. A small fraction of inpatient transfusion events are identified using specific procedure codes. For these cases, we are able to identify multiple transfusion events for some hospitalizations and count a unique “transfusion event” for each transfusion procedure code listed on an inpatient claim. CMS allows the transfusion procedure to be billed only once per day per visit.

Transfusion events are not common in outpatient settings, but similar rules apply. Multiple HCPCS codes reported for the same revenue center date are counted as a single transfusion event regardless of the number of units of blood recorded. In other words, 3 pints of blood reported with the same revenue center date would be counted as a single transfusion event.

**Denominator Statement S.7.**
Number of eligible red blood cell transfusion events (as defined in the numerator statement) that would be expected among patients at a facility during the reporting period, given the patient mix at the facility.

Inclusion episodes are those that do not have any claims pertaining to the comorbidities identified for exclusion, in the one year look back period prior to each observation window.

### Target Population Category S.8.
Populations at Risk

### Denominator Details S.9.
Starting with day 91 after onset of ESRD, a patient is attributed to a facility once the patient has been treated there for the past 60 days and for the following 60 days after transfer to another dialysis facility.

Based on a risk adjustment model for the overall national transfusion rates, we compute the expected number of red blood cell transfusion events for each patient attributed to a given facility. The sum of all such expectations over patients in a facility yields the overall expected number of transfusions for a given facility given the specific patient mix. This forms the denominator of the measure. This measure is based on Medicare administrative claims and databases and is applied to patients covered by Medicare.

### Denominator Exclusions (NQF Includes "Exceptions" in the "Exclusion" Field) S.10.
All transfusions associated with transplant hospitalization are excluded. Patients are excluded if they have a Medicare claim for hemolytic and aplastic anemia, solid organ cancer (breast, prostate, lung, digestive tract and others), lymphoma, carcinoma in situ, coagulation disorders, multiple myeloma, myelodysplastic syndrome and myelofibrosis, leukemia, head and neck cancer, other cancers (connective tissue, skin, and others), metastatic cancer, and sickle cell anemia within one year of their patient at risk time. Since these comorbidities are associated with higher risk of transfusion and require different anemia management practices that the measure is not intended to address, every patient's risk window is modified to have at least 1 year free of claims that contain diagnoses on the exclusion list.

### Denominator Exclusion Details (NQF Includes "Exceptions" in the "Exclusion" Field) S.11.
All transfusions associated with transplant hospitalization are excluded. Patients are excluded if they have a Medicare claim for hemolytic and aplastic anemia, solid organ cancer (breast, prostate, lung, digestive tract and others), lymphoma, carcinoma in situ, coagulation disorders, multiple myeloma, myelodysplastic syndrome and myelofibrosis, leukemia, head and neck cancer, other cancers (connective tissue, skin, and others), metastatic cancer, and sickle cell anemia within one year of their patient at risk time. Since these comorbidities are associated with higher risk of transfusion and require different anemia management practices that the measure is not intended to address, every patient's risk window is modified to have at least 1 year free of claims that contain diagnoses on the exclusion list.

We performed multivariate logistic regression demonstrating that a 1-year look back period for the above mentioned comorbidities was more predictive of transfusion events compared to longer look back periods.

### Stratification Details/Variables S.12.
N/A

### Risk Adjustment Type S.13.
Statistical risk model

## Statistical Risk Model and Variables S.14.

The denominator of the "STrR" uses expected transfusions calculated from a Cox model (Cox, 1972) as extended to handle repeated events (Lawless and Nadeau, 1995; Lin et al., 2000; Kalbfleisch and Prentice, 2002). For computational purposes, we adopt a model with piecewise constant baseline rates (e.g. Cook and Lawless, 2007) and computational methodology as developed in Liu, Schaubel and Kalbfleisch (2010). A stage 1 model is first fitted to the national data with piecewise-constant baseline rates stratified by facility; transfusion rates are adjusted for patient age, diabetes, duration of ESRD, nursing home status, BMI at incidence, comorbidities at incidence, and calendar year. This model allows the baseline transfusion 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 linear predictor for each patient based on the regression coefficients in the stage 1 model is used to compute a risk adjustment factor that is then used as an offset in the stage 2 model.

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

- Age: We determine each patient's age for the birth date provided in the SIMS and REMIS databases and group patients into the following categories: 0-17 years old, 18-24 years old, 25-44 years old, 45-59 years old, 60-74 years old, or 75+ years old.
- Diabetes as cause of ESRD: We determine each patient's primary cause of ESRD from his/her CMS-2728.
- Duration of ESRD: We determine each patient's length of time on dialysis using the first service date from his/her CMS-2728, claims history (all claim types), the SIMS database and the SRTR database and categorize as 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.
- 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 and duration and cause of ESRD are also included:

- Diabetes as cause of ESRD*Duration of ESRD

- Diabetes as cause of ESRD*Age

References:
Cox, D.R. (1972) Regression Models and Life Tables (with Discussion). J. Royal statistical Society, Series B, 34, 187-220.
Cook, R. and Lawless, J. The Statistical Analysis of Recurrent Events. New York: Springer. 2007.
Cook, R. and Lawless, J. Marginal analysis of recurrent events and a terminal event. Statistics in Medicine 1997; 16: 911-924.
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Lawless, J. F. and Nadeau, C. Some simple and robust methods for the analysis of recurrent events, Technometrics, 37 1995, 355-364.
Lin, D.Y., Wei, L.J., Yang, I. and Ying, Z. Semi parametric regression for the mean and rate functions of recurrent events, Journal of the Royal Statistical Society Series B, 62, 2000, 771-730
Liu, D., Schaubel, D.E. and Kalbfleisch, J.D. Computationally efficient marginal models for clustered recurrent event data, University of Michigan Department of Biostatistics Technical Reports, 2010.

## Detailed Risk Model Specifications S.15.

The denominator of the STrR 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:

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

where $X_{ik}$ is the vector of covariates for the $(i,k)$th patient and $\beta$ is the vector of regression coefficients. The baseline rate function $r_{0k}(t)$ is assumed specific to the $k^{th}$ facility, which 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 transfusion 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.

The patient characteristics $X_{ik}$ included in the stage I model are age (18-24 years old, 25-44 years old, 45-59 years old, 60-74 years old, or 75+ years old), cause of ESRD (diabetes or other), nursing home status, BMI at incidence, individual comorbidities at incidence reported on the Medical Evidence Form (CMS-2728), calendar year, and two-way interaction terms of age * cause of ESRD and duration of ESRD * cause of ESRD. Duration of ESRD is categorized 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 is identified as in or not in a nursing home in the previous calendar year. BMI is included as a log-linear term. Categorical indicator variables are included as covariates in the stage I model to flag records missing values for cause of ESRD, and BMI. These variables have a value of 1 if the patient is missing the corresponding piece of information and a value of 0 otherwise. Another two categorical indicator variables are included to flag

records with having no comorbidities and having at least one comorbidity at incidence reported on the Medical Evidence Form. These variables have a value of 1 if the patient is having no comorbidities or having at least one comorbidity and a value of 0 otherwise.

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 transfusions, $r_0(t)$, across all facilities by considering the model

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

where $R_{ik} = \exp(\beta' X_{ik})$ is the estimated relative risk for patient i in facility k estimated from the stage I. In our computation, we assume the baseline to be a step function with 6 unknown parameters, $\alpha_1, \ldots, \alpha_6$, to estimate. These estimates are used to compute the expected number of transfusions 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 $s^{th}$ time interval with estimated rate $\alpha_s$. The corresponding expected number of transfusions in the sth 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 sth time interval. Summing the $E_{iks}$ over all 6 intervals and all $N_k$ patients in a given facility, k, gives

$$\mathbf{Exp} = \sum_{i=1}^{N} \sum_{s=1}^{6} E_{iks} = \sum_{i=1}^{N} \sum_{s=1}^{6} \alpha_s\, t_{iks}\, R_{ik}$$

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

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

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

**Type of Score S.16.**
Ratio

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

**Calculation Algorithm/Measure Logic S.18.**
See denominator details and risk adjustment instructions

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

**Sampling S.20.**
N/A

**Survey/Patient-Reported Data S.21.**
N/A

**Missing Data S.22.**
N/A

**Data Source S.23.**
Administrative claims, Electronic Clinical Data

**Data Source or Collection Instrument S.24.**
These data are part of an extensive and comprehensive national ESRD patient database, derived from the Consolidated Renal Operations in a Web-enabled Network (CROWN) data system, Medicare claims, and the Social Security Death Master File. The CROWN data system is made up of the Renal Management Information System (REMIS) and CROWNWeb and is updated regularly using the Medicare Enrollment Database (EDB), ESRD Medical Evidence Report forms (CMS 2728), ESRD Death Notification forms (CMS 2746), and the Organ Procurement and Transplantation Network (OPTN) transplant database.

**Data Source or Collection Instrument (Reference) S.25.**
No data collection instrument provided

**Level of Analysis S.26.**
Facility

**Care Setting S.27.**
Dialysis Facility

**Composite Performance Measure S.28.**
N/A