

DRAFT

Standardized Readmission Ratio (SRR) for dialysis facilities

3b Measure Justification

Importance

- **High Impact Aspect of Health Care**
 - **Demonstrated high impact aspect**

1a1.1 Select from the following all that apply:

- *Affects large numbers*
- *A leading cause of morbidity/mortality*
- *Frequently performed procedure*
- *High resource use*
- *Patient/societal consequences of poor quality*

The Standardized Readmission Ratio (SRR) is a facility-level measure that applies to large numbers of dialysis patients. At the end of 2010 there were 593,086 patients being dialyzed, of whom 116,946 were new (incident) ESRD patients.¹ The SRR measures potentially poor or incomplete quality of care among the dialysis population, reflecting an aspect of care that is especially resource intensive. In 2010, the total Medicare cost for the ESRD program tallies \$33 billion, an 8% increase from 2009.¹ In particular, hospitalization costs for ESRD patients are high, with Medicare costs of more than \$12 billion in 2010. Throughout this document, “hospitalizations” refers to inpatient services, and “hospitals” refers to acute care hospitals.

- **Summary of evidence of high impact**

1a3. Provide epidemiological or resource use data

Hospitalization and readmission rates are two important indicators of dialysis patient morbidity and quality of life. In 2010, dialysis patients were admitted to the hospital twice on average and spent an average of 12 days in the hospital, accounting for approximately 38% of Medicare expenditures for ESRD patients.¹ Furthermore, a significant percentage (30%)² of ESRD patients discharged from the hospital have an unplanned readmission within 30 days. In the non-ESRD population, clinical studies have demonstrated that improved care coordination and discharge planning may reduce readmission rates. Some studies³ also confirm that a sizable portion of unplanned readmissions are preventable. Hence, a systematic measure on unplanned readmissions is essential for controlling escalating medical costs in that it can identify potential problems and help facilities to provide cost-effective health care. Hospitalization measures have been in use in the Dialysis Facility Reports (DFRs) since 1995, whereas a measure of 30-day readmission was added to the same report in 2011. Dialysis facilities and ESRD Networks use the DFRs for quality improvement, and ESRD state surveyors use the reports for monitoring and surveillance of dialysis facilities.

- **Citation**

1a.4. Provide citations for the evidence described above

1. U S Renal Data System, USRDS 2012 Annual Data Report: Atlas of Chronic Kidney Disease and End-Stage Renal Disease in the United States, National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, MD, 2012.
2. Arbor Research Collaborative for Health & the University of Michigan Kidney Epidemiology and Cost Center. Unpublished analyses of 2009 Medicare claims.
3. Goldfield NI, McCullough EC, Hughes JS, et al. Identifying potentially preventable readmissions. *Health Care Financ Rev.* 2008;30:75–91.

- **Opportunity for Improvement**

- **Briefly explain the benefits envisioned by use of this measure**

- 1b.1. *(Quality improvement anticipated)*

Readmission rates are an important indicator of dialysis patient morbidity and quality of life. In 2010, the average dialysis patient was admitted to the hospital twice a year with an average length of stay (LOS) of 12 days. Furthermore, a significant percentage of patients discharged from the hospital have an unplanned readmission within 30 days. As confirmed by some studies among the dialysis population, a sizable portion of hospital readmissions are preventable. This propels a new readmission measure, which will encourage facilities to review the readmission practices and identify potential problems. With the health care system moving toward a paradigm of shared accountability across providers from different care settings, a readmission measure that is particularly applicable to ESRD patients will not only encourage improvement in transition of care across various settings, but also serve as a strong motivation for facilities to coordinate treatment with the discharging hospital to reduce readmission rates.

- **Summary of data demonstrating performance gap**

- 1b.2. *(Variation or overall less than optimal performance across providers)*

The SRR to be defined below is a facility-level measure, comparing the observed number of unplanned readmissions at a facility with the number of unplanned readmissions that would be expected under a national norm, after accounting for the patient characteristics within each facility. In the 2009 cohort, the distribution of the SRR across all dialysis facilities is roughly normal, with a median of 1.00, a mean of 0.98 and a standard deviation of 0.27. The 25th percentile and 75th percentile of the distribution are 0.83 and 1.15, respectively, while the minimum and maximum values are 0 and 2.68, respectively.

- **Citations**

- 1b.3. *Provide citations for the evidence described above*

Arbor Research Collaborative for Health & the University of Michigan Kidney Epidemiology and Cost Center. Unpublished analyses of 2009 Medicare claims.

- **Summary of data on disparities by population group**

- 1b.4. *Summarize evidence found that demonstrates any disparities. Describe groups in which disparities exist.*

Investigations of the SRR by Hispanic ethnicity indicate relatively little variation and no substantial disparities; however, analyses do show some difference between black and non-black patients (SRR = 1.07 v. 1.01, respectively). Differences by sex were also small among the studied cohort. These results are similar to those reported by USRDS.¹ As discussed further below, we adjust for sex in the measure development but do not adjust for race, which is consistent with the NQF guidelines.²

- **Citations**

1b.5. Provide citations for the evidence described above

1. Gilbertson D, Collins A, Foley R. *Readmission Rates in the CKD Population*. PowerPoint presentation developed on behalf of the US Renal Data System from the 2011 Annual Data Report. 2012.
2. National Quality Forum. Measure Evaluation Criteria. Available at: http://www.qualityforum.org/docs/measure_evaluation_criteria.aspx. Accessed December 6, 2012.

- **Evidence to Support Measure Focus**

- **Structure-process-outcome relationship**

1c.1. Briefly state the measure focus (for example, health outcome, intermediate clinical outcome, process, structure) Then, identify the appropriate links (for example, structure-process-health outcome, process-health outcome, intermediate clinical outcome-health outcome)

CMS has a policy focusing on reducing unplanned readmissions, as unplanned readmissions reflects an outcome of poor care or uncoordinated care that leads to rising health care costs. CMS has several measures in place or under development that score care providers on readmissions. A readmission measure for dialysis facilities is consistent with the overall CMS goal of reducing hospital readmissions. Currently, there are a variety of processes of care in the dialysis facility and in the interactions of the dialysis facility with other care providers, all of which can influence hospital readmission rates, which serve as an outcome measure.

- **Type of evidence**

1c.2. Describe the type of evidence, selecting from the following list all that apply:

- *Clinical practice guideline*
- *Selected individual studies (rather than entire body of evidence)*
- *Systematic review of body of evidence (other than within guideline development)*
- *Other (state type of evidence)*

Selected individual studies.

- **Directness of evidence to the specified measure**

1c.4. State the central topic, population, and outcomes addressed in the body of evidence and identify any differences from the measure focus and measure target population.

A measure of unplanned readmissions is accepted as an important outcome of care. The studies providing evidence for the development of a readmissions measure for dialysis facilities have investigated the frequency of, variation in, and attributability of hospital readmissions to dialysis facilities.

The overall 30-day hospital readmission rate among patients treated in dialysis facilities is approximately twice that for the general Medicare population.¹ The 30-day hospital readmission rate for ESRD patients in 2009 was about 30 percent.² Nearly half of readmissions are for diagnoses classified by AHRQ as potentially preventable hospitalizations.³

There is substantial variability across facilities in the unadjusted hospital readmission rates. The interquartile range is approximately 22% to 35%.²

Preliminary analyses suggest that the total variance in readmission rates attributable to the dialysis facility is comparable to the variance attributable to the hospital.^{2,4} These analyses suggest a strong shared accountability between dialysis facility and the discharging hospital.

Based on expert clinical opinion, Plantinga⁵ described improvements in the process of care for dialysis patients that should be effective in preventing repeat hospitalizations. Some of these processes take place in the hospital, during the initial (or index) hospitalization, but many take place after discharge in the dialysis facility. These latter processes include: (1) monitoring Hb, ESA use, and IV iron use; (2) monitoring serum albumin, in consultation with dietetic expertise; (3) adjusting patient dry weight, as needed; (4) monitoring and continued treatment for infection; and (5) reconciling medication after hospital discharge.

One retrospective cohort study⁶ found that three dialysis facility-level process-of-care interventions (Hb testing and modification of EPO dose; MBD testing and modification of vitamin D; and modification of dry weight after discharge) done within the first seven days post-hospital discharge were associated with reduced risk of hospital readmission, adjusted for patient age, sex, race, Charlson comorbidity index, index hospitalization length of stay, time on dialysis, vascular access, diabetes, pre-hospital lab values and the 20 most prevalent causes of hospitalization. Furthermore, several studies in the non-ESRD population^{7–15} found that patients who underwent pre- or post-discharge interventions were at significantly reduced risk for hospital readmission.

- **Quantity of studies in the body of evidence**

- 1c.5. *Total number of studies, not articles*

- A representative study⁶ reveals the relation between dialysis process of care and hospital readmission rate.

- **Quality of body of evidence**

- 1c.6. *Summarize the certainty or confidence in the estimates of benefits and harms to patients across studies in the body of evidence resulting from study factors. Please address:*

- *Study design/flaws*
 - *Directness/indirectness of the evidence to this measure (for example, interventions, comparisons, outcomes assessed, population included in the evidence)*
 - *Imprecision/wide confidence intervals due to few patients or events)*

- The study cited⁶ was retrospective but, as noted, did control for a long list of patient characteristics, which were all highly significant in the risk-adjustment model for readmissions (all *p* values less than .0001).

- **Consistency of results across studies**

- 1c7. *Summarize the consistency of the magnitude and direction of the effect across studies*

- N/A. One study found.⁶

- **Net benefit**

- 1c8. *Provide estimates of effect for benefit/outcome, identify harms addressed and estimates of effect, and net benefit---benefit over harms across studies. Please include results of business/social/economic case for the measure.*

- N/A. The SRR is an outcome measure.

○ **Grading of strength/quality of the body of evidence**

1c9, 1c10, 1c11, 1c13, 1c14. Please address:

- Indicate if the body of evidence has been graded
- If the body of evidence was graded, identify the entity that graded the evidence including balance of representation and any disclosures regarding bias
- System used for grading the body of evidence
- Grade assigned to the body of evidence
- Summary of controversy/contradictory evidence

We did not grade the body of evidence, given that there is only one study examining hospital readmissions among ESRD patients (and thus there is also no contradictory evidence). Furthermore, the SRR is a measure of a health outcome, which the National Quality Forum (NQF) acknowledges as the central goal of healthcare and also the most preferred type of measure (versus process or structure measures). Because the goal of instituting measures is to improve health outcomes—with health outcomes representing the final stage of Donabedian's structure-process-outcome model—there is no need to establish a link between a structure or a process, given that these are less direct indicators of a patient's health.¹⁶

○ **Citation**

1c15. Provide citations for the evidence described above

1. Medicare Payment Advisory Commission (MedPAC). *Promoting Greater Efficiency in Medicare*. Report to Congress. MedPAC: Washington, DC. June 2007.
2. Turenne M, Hunter S, Wolfe RA, Shearon TH, Pearson J, Kalbfleisch J, Dahlerus C, Wheeler JRC, Messana JM, Hirth R. 30-Day Hospital Readmission among Dialysis Patients: Influence of Dialysis Facilities Versus Hospitals. Poster session presented at: 2010 ASN Kidney Week. Annual Conference of the American Society of Nephrology; 2010 November 17–20; Denver, CO.
3. Agency for Healthcare Research & Quality (AHRQ). "Prevention Quality Indicators (PQIs) Overview." Available at: http://www.qualityindicators.ahrq.gov/Modules/pqi_overview.aspx. Accessed December 6, 2012.
4. He K, Kalbfleisch JD, Li Y, Li Y. "Evaluating readmission rates in dialysis facilities with or without adjustment for hospital effects." Unpublished manuscript. 2012.
5. Plantinga LC, Jaar BG. Preventing repeat hospitalizations in dialysis patients: a call for action. *Kidney International* (2009) 76:249–251.
6. Chan KE, Lazarus JM, Wingard RL, et al. Association between repeat hospitalization and early intervention in dialysis patients following hospital discharge. *Kidney International*. 2009;76:331–341.
7. Ahmed A, Thornton P, Perry GJ, Allman RM, DeLong JF. Impact of atrial fibrillation on mortality and readmission in older adults hospitalized with heart failure. *Eur J Heart Fail*. 2004;6:421–426.
8. Anderson C, Deepak BV, Amoateng-Adjepong Y, Zarich S. [Benefits of comprehensive inpatient education and discharge planning combined with outpatient support in elderly patients with congestive heart failure](#). *Congest Heart Fail*. 2005;11(6):315–312.
9. Azevedo A, Pimenta J, Dias P, Bettencourt P, Ferreira A, Cerqueira-Gomes M. [Effect of a heart failure clinic on survival and hospital readmission in patients discharged from acute hospital care](#). *Eur J Heart Fail*. 2002;4(3):353–359.
10. Coleman EA, Smith JD, Frank JC, Min SJ, Parry C, Kramer AM. [Preparing patients and caregivers to participate in care delivered across settings: The Care Transitions Intervention](#). *J Am Geriatr Soc*. 2004;52(11):1817–1825.
11. Coleman E, Parry C, Chalmers S, et al. The care transitions intervention. *Arch Internal Med*. 2006;166:1822–1828.
12. [Creason H. Lippincotts Case Manag](#). *Congest Heart Fail*. 2001;6(4):146–156.
13. Jack B, Chetty V, Anthony D, et al. A reengineered hospital discharge program to decrease rehospitalization. *Ann Internal Med*. 2009;150:178–188.

14. [Koehler BE, Richter KM, Youngblood L](#), et al. Reduction of 30-day postdischarge hospital readmission or emergency department (ED) visit rates in high-risk elderly medical patients through delivery of a targeted care bundle. *J Hosp Med*. 2009;4(4):211–218.
15. Naylor M, Broton D, Jones R, Lavizzo-Mourey R, Mezey M, Pauly M. [Comprehensive discharge planning for the hospitalized elderly. A randomized clinical trial](#). *Ann Intern Med*. 1994;120(12):999–1006.
16. National Quality Forum (NQF) Evidence Task Force. “Guidance for Evaluating the Evidence Related to the Focus of Quality Measurement and Importance to Measure and Report.” January 2011. Available online at: https://www.qualityforum.org/Publications/2011/01/Evidence_Task_Force.aspx. Accessed March 6, 2013.

○ **Guideline recommendation**

1c16. Quote verbatim, the specific guideline recommendation (Including guideline number and/or page number)
See 1c9, 1c10, 1c11, 1c13, 1c14 above.

○ **Citation**

1c17. Provide citations for the clinical practice guideline quoted above
N/A

○ **URL**

1c18. National Guideline Clearinghouse or other URL
N/A

○ **Grading of strength of recommendation**

1c19 1c21, 1c23. Please address:

- Has the recommendation been graded?
- System used for grading the strength of guideline recommendation (USPSTF, GRADE, etc.) Grade assigned to the recommendation

N/A

○ **Rationale for using this guideline over others**

1c24. If multiple guidelines exist, describe why the guideline cited was chosen. Factors may include rigor of guideline development, widespread acceptance and use, etc.

N/A

○ **Overall assessment of the body of evidence**

1c25, 1c26, 1c27. Based on the NQF descriptions for rating the evidence, what was your assessment of the following attributes of the body of evidence?

- Quantity
- Quality
- Consistency

CMS accepts reducing hospital readmissions as an important aim, which justifies the development of readmission measures such as the SRR. Justifications for applying a hospital readmission measure to dialysis facilities rest on the fact that the likelihood of readmission is influenced by process of care at the dialysis facility. Expert clinical opinion supports that improved processes of care in the dialysis facility can reduce the risk of hospital readmission. There is at least one retrospective study using appropriate statistical methodology showing reduced risk of hospital readmission associated with three dialysis process-of-care measures.

Reliability and Validity – Scientific Acceptability of Measure Properties

- **Reliability Testing**

- **Data sample**

2a2.1. Describe the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included

We evaluated the draft SRR from data on all 2009 hospitalizations for ESRD patients. These data represent 483,548 discharges, 213,189 patients, 5,797 facilities and 4,668 hospitals. Although the measure applies to calendar year 2009 only, we used data from January 1, 2009 – January 31, 2010, to characterize whether each 2009 discharge resulted in an unplanned readmission. These data are part of an extensive and comprehensive national ESRD patient database, derived from Program Medical Management and Information System (PMMIS/REMIS), Medicare claims, the Standard Information Management System (SIMS) database maintained by the 18 ESRD Networks, the CMS Annual Facility Survey (CMS Form 2744), the CMS Medical Evidence Form (CMS Form 2728), the Death Notification Form (CMS Form 2746), and the Social Security Death Master File.

- **Analytic methods**

2a2.2. Describe method of validity testing and rationale; if face validity, describe systematic assessment

If the measure were a simple average across individuals in the facility, the NQF-recommended 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.¹ The inter-unit reliability (IUR) measures the proportion of the measure variability that is attributable to the between-facility variance. The SRR, 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. Refer to the appendix for a detailed description of this methodology.

Citation

1. Health Services Advisory Group. "A Blueprint for the CMS Measures Management System, Volume I." Centers for Medicare and Medicaid Services: Baltimore, MD. January 2012; 9.1:308.

- **Testing results**

2a2.3. Provide reliability statistics and assessment of adequacy in the context of norms for the test conducted

Overall, we found that IUR = .48, which indicates that about one half of the variation in the SRR can be attributed to the between facility differences and about half to within facility variation. This value of IUR indicates a moderate degree of reliability.

When stratified by facility size, we find that, as expected, larger facilities have greater IUR.

Facility Size	No. of Facilities	IUR	F-statistic
Small (<43 patients)	1759	.41	1.68
Medium (44-77 patients)	1681	.45	1.82
Large (>77 patients)	1720	.54	2.18

- **Validity Testing**

- **Data sample**

2b2.1. Describe the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included

We developed the draft SRR from data on all 2009 hospitalizations for ESRD patients. Refer to section 2a2.1 for the detailed data description.

We compared the SRR using data on hospitalizations and other quality measures among ESRD patients over a three-year period of 2008–2011. Specifically, as reported in section 2b2.3, we examined the measure's correlations with the other measures of quality among this population and reported significant correlation estimates.

- **Analytic method**

2b2.2 .Describe method of validity testing and rationale; if face validity, describe systematic assessment

We assessed the validity of the measure through various comparisons of this measure with other quality measures in use, and in May 2012, presented a preliminary version of the SRR to a CMS Technical Expert Panel (TEP) for clinical validity. As hospitalization is a major cost factor in the management of ESRD patients, there is a strong case for face validity of the SRR measure.

- **Testing results**

2b2.3. (Provide statistical results and assessment of adequacy in the context of norms for the test conducted; if face validity, describe results of systematic assessment)

The SRR is a measure of hospital use, comprising many causes of hospitalization. The TEP considered devising cause-specific SRRs but recommended the use of overall SRR measures due to various reasons, including the lack of clear consensus on which causes are modifiable by the dialysis facility and concerns about gaming the system if certain conditions are identified.

This face validity of the SRR measure is also supported by its association with other known quality measures, which include both dialysis facility outcomes and practices. The measure is positively correlated with the one-year Standardized Hospitalization Ratio for Admissions ($r = .51, p < .0001$), the one-year Standardized Mortality Ratio ($r = .18, p < .0001$), and catheter use ($r = .09, p < .0001$). This relationship indicates that higher values of SRR are associated with increased use of catheters and higher rates of hospitalization and mortality. The SRR is negatively correlated with the percentage of patients having a Urea Reduction Ratio (URR) of at least 65% ($r = -.05, p = .0003$) and using a fistula ($r = -.09, p < .0001$). That is, higher values of SRR are associated with lower rates of URR and fistula use.

- **Exclusions**

- **Data sample for analysis of exclusions**

2b3.1. Describe the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included

We developed the draft SRR from data on all 2009 hospitalizations for ESRD patients. Refer to section 2a2.1 for the detailed data description.

- **Analytic method**

2b3.2. Describe type of analysis and rationale for examining exclusions, including exclusion related to patient preference

CMS has a policy focusing on reducing unplanned readmissions, as unplanned readmissions reflects an outcome of poor care or uncoordinated care that leads to rising health care costs. In the process of developing the measure of 30-day unplanned readmissions in dialysis facilities, we exclude planned readmissions from the numerator ($n = 12,865$). For details on how we determined a readmission's status as planned, please see Appendix B from the corresponding Measure Information Form.

We further exclude the following hospital discharges from the denominator:

1. End in death ($n = 30,433$)
2. Result in a patient dying within 30 days with no readmission ($n = 21,284$)
3. Are against medical advice ($n = 8,198$)
4. Include a primary diagnosis for cancer, mental health or rehabilitation ($n = 16,678$)
5. Are from a PPS-exempt cancer hospital ($n = 171$)
6. Result in a transfer to another hospital on the same day ($n = 0$)
7. Occur after a patient's 12th readmission in the calendar year ($n = 2,226$)

The numerator exclusion and first six denominator exclusions are aligned with CMS' Hospital-Wide All-Cause readmission measure. We additionally excluded discharge records following a patient's 12th readmission in response to concerns from some members of the TEP held in May 2012 for this measure. Specifically, it was felt that frequently hospitalized patients would unfairly penalize smaller facilities by inflating their facility's SRR. However, this concern is relevant in the context of the measure's potential applications, which are to identify poor-performing facilities for quality improvement purposes.

We determined the cut point (cap) for readmissions by examining the distribution of the number of readmissions per patient. We compared SRRs with and without the readmission cap to determine the extent to which the measure changed with the exclusion.

- **Results**

2b3.3. Provide statistical results for analysis of exclusions (for example, frequency, variability, sensitivity analyses)

We conducted no analyses to justify the first six exclusions, as relevant statistical analyses were performed by the Hospital-Wide All-Cause Readmission measure steward. Regarding the readmission-cap exclusion, we found that 99.9% of patients had fewer than 12 readmissions in the year; 63.5% of patients did not have any readmissions during the year.

- **Risk Adjustment Strategy**

- **Data/sample**

2b4.1. Describe the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included. Delete row if measure is not risk adjusted.

We developed the draft SRR from data on all 2009 hospitalizations for ESRD patients. Refer to section 2a2.1 for the detailed data description.

○ **Analytic method**

2b4.2. Describe methods and rationale for development and testing of risk model or risk stratification including selection of factors/variables

The risk adjustment is based on a two-stage logistic model. The adjustment is made for patient age, sex, diabetes, duration of ESRD, BMI at incidence, prior-year comorbidities, length of hospital stay and presence of a high-risk diagnosis at discharge. In the first stage of this model, both dialysis facilities and hospitals are represented as random effects, and regression adjustments are made for the set of patient-level characteristics listed above. From this first stage, we obtain the estimated standard deviation of the random effects of hospitals.

The second stage of the model is a mixed-effects model, in which facilities are fixed effects and hospitals are modeled as random effects, with the standard deviation specified as equal to its estimate from the first stage. The expected number of readmissions for each facility is estimated as the summation of the probabilities of readmission for the discharges of all patients in this facility, assuming the national average or norm for facility effect. This model accounts for a given facility's case mix using the same set of patient-level characteristics as those in the first stage.

All covariates have face validity from a clinical perspective and are based on the list of covariates used in CMS' Hospital-Wide All-Cause Readmission Rate, which were statistically verified by the measure developer.¹

Relevant references are below^{2,3}; we conducted all analyses in R and SAS.

○ **Citation**

1. Horwitz L, Partovian C, Lin Z, et al. "Hospital-wide all-cause risk-standardized readmission measure: Measure methodology report." Technical paper submitted to the Centers for Medicare and Medicaid Services. September 27, 2011. Available at <http://www.naph.org/Unpublished-Documents/Hospital-Wide-All-Condition-30-Day-Risk-Standardized-Readmission-Measure.aspx>. Accessed December 6, 2012.
2. He K, Kalbfleisch JD, Li Y, Li Y. "Evaluating readmission rates in dialysis facilities with or without adjustment for hospital effects." Unpublished manuscript. 2012.
3. Diggle PJ, Heagerty P, Liang KY, Zeger SL. *Analysis of Longitudinal Data* (2nd ed). Oxford University Press; Oxford. 2002.

○ **Testing results**

2b4.3. Statistical risk model: Provide quantitative assessment of relative contribution of model risk factors; risk model performance metrics including cross-validation discrimination and calibration statistics, calibration curve and risk decile plot, and assessment of adequacy in the context of norms for risk models. Risk stratification: Provide quantitative assessment of relationship of risk factors to the outcome and differences in outcomes among the strata. Delete row if measure is not risk adjusted.

All risk factors included in the model have face validity, and all but one—being respirator-dependent at some point in the year leading up to hospitalization—are also significantly predictive of readmission (see Appendix Table 1). As the ROC curve demonstrates, the model's accuracy is fair (c-statistic = .65; see Appendix Figure 1).

The model's fit is demonstrated in Appendix Figure 2, which compares the observed rates with the model-based predictions. We bin all observations into 20 groups based on their model-based predicted values and compute the observed readmission proportion for each group. We then apply the logit transformation to each group's observed readmission proportion and plot it against the same group's average linear prediction; see

the dots for all 20 groups in the plot. The 45-degree line would represent a perfect match between the observed values and the model-based predictions. In general, the closer the observed values are to this line the better the model fit. As the figure shows, the observed values are spaced fairly equally and lie very close to the 45-degree line, indicating a good fit.

- **Rationale for no adjustment**

2b4.4. If outcome or resource use measure is not risk adjusted, provide rationale and analyses to justify lack of adjustment. The three rows above may be deleted if this field is used. Delete row if measure is risk adjusted or if this is a process measure.

N/A

- **Identification of Meaningful Differences in Performance**

- **Data/sample**

2b5.1 Describe the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included

We developed the draft SRR from data on all 2009 hospitalizations for ESRD patients. Refer to section 2a2.1 for the detailed data description.

- **Analytic method**

2b5.2. Describe methods and rationale to identify statistically significant and practically/meaningfully differences in performance

Measuring or assessing significance of a large SRR (i.e., an SRR much greater than 1) is based on the p-value. To calculate the p-value, we use an exact method that assesses the probability that the facility would experience a number of readmissions more extreme than that observed if the null hypothesis were true; this calculation accounts for each facility's patient mix. For instance, to test the hypothesis that the true SRR=1, we calculate the nominal p-value for each facility as the probability that the number of readmissions should be at least as extreme as that observed under the assumption that this facility has readmission rates corresponding to the average facility and given the patient characteristics or covariates.

- **Testing results**

2b5.3. Results-Provide measure performance results/scores (for example, distribution by quartile, mean, median, SD, etc.); identification of statistically significant and meaningfully differences in performance

In the 2009 cohort, the distribution of the SRR across all dialysis facilities is roughly normal, with a median of 1.00, a mean of 0.98 and a standard deviation of 0.27. The 25th percentile and 75th percentile of the distribution are 0.83 and 1.15, respectively, while the minimum and maximum values are 0 and 2.68, respectively.

- **Comparability of Multiple Data Sources/Methods**

- **Data/ sample**

2b6.1. Describe the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included

N/A

- **Analytic method**

2b6.2. Describe methods and rationale for testing comparability of scores produced by the different data sources specified in the measure

N/A

- **Testing results**

2b6.3. Provide statistical results (for example, correlation statistics, comparison of rankings) and assessment of adequacy in the context of norms for the test conducted

N/A

- **Disparities in Care**

- **Stratification**

2c.1. If measure is stratified for disparities, provide stratified results (scores by stratified categories/cohorts)

N/A

- **Rationale for no stratification**

2c.2. If disparities have been reported/identified, but measure is not specified to detect disparities, please explain.

To identify potential disparities related to race, we examined facilities' relationship between SRR and proportion of African American patients. We classified facilities into four groups based on the proportion of African American patients: 0%–10%, 10%–30% and 30%+.

Results show that the median SRR increases with the increasing proportion of African American patients. Because the SRR is not adjusted for race, these clearly reveal that our measures can detect racial differences in outcomes, representing true disparities that should not be adjusted out. Furthermore, given that there is no clinical rationale for an African American patient to have different readmission risk than a white patient based on race alone, we elected not to stratify the measure by race. Dialysis facilities should not be held to a different standard based on race.

Proportion of African American Patients at Facility (%)	N Facilities	SRR						
		Mean	SD	Minimum	Q1	Median	Q3	Maximum
0 – 10	1592	0.91	0.28	0	0.75	0.92	1.09	1.96
10 – 30	1157	1.00	0.25	0	0.86	1.01	1.15	2.39
30+	2366	1.03	0.25	0	0.88	1.04	1.19	2.57

- **Supplemental information**

2.1. Supplemental testing methodology information: If additional information if available, please indicate where this information can be found: appendix, attachment, or URL

N/A

Usability

- **Public Reporting**

- **Meaningful, understandable and useful**

3a.1. Use in public reporting---disclosure of performance results to the public at large (If used in a public reporting program, provide name of program(s), locations, Web page URL(s). If not publicly reported in a national or community program, state the reason and plans to achieve public reporting, potential reporting programs or commitments, and timeline, for example, within 3 years of endorsement)

3a.2. Provide a rationale for why the measure performance results are meaningful, understandable, and useful for public reporting. If usefulness was demonstrated (for example, focus, group, cognitive testing) describe the data, method and results.

CMS has scheduled the SRR to undergo public comment in early 2013, after which CMS will submit the measure for NQF approval. Once the measure has undergone the NQF review process, we plan to include the SRR in the publicly available Dialysis Facility Reports released in calendar year 2014.

A readmission measure has appeared in the Dialysis Facility Reports since 2011. 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. See <http://www.dialysisreports.org>.

- **Quality Improvement**

- **Meaningful, understandable and useful**

3b.1. Use in QI (If used in quality improvement program, provide name of program(s), locations, Web page URL(s))

3b.2. Provide a rationale for why the measure performance results are meaningful, understandable, and useful for quality improvement. If usefulness was demonstrated (for example, QI, initiative) describe the data, method and results

N/A

- **Other accountability uses**

3.2. Use for other accountability functions (payment, certification, accreditation) (If used in a public accountability program, provide name of program(s), locations, Web page URL(s)). This row may be deleted if not applicable.

N/A

Feasibility

- **How the data elements needed to compute measure score are generated**

4a.1. How are the data elements needed to compute measure scores generated? State all that apply. Data used in the measure are:

- Generated by and used by health care personnel during the provision of care (for example, blood pressure, lab value, medical condition)
- Coded by someone other than person obtaining original information (for example, DRG, ICD-9 codes on claims)
- Abstracted from a record by someone other than person obtaining original information (for example, chart abstraction for quality measure or registry)
- Other

Data used in the measure are:

- Generated by and used by health care personnel during the provision of care
- Coded by someone other than person obtaining original information

- **Electronic availability**

4b.1. Are the data elements needed for the measure as specified available electronically (elements that are needed to compute measure scores are in defined, computer-readable fields)?

- ALL data elements in electronic health records (EHRs)
- ALL data elements in electronic claims
- ALL data elements are in a combination of electronic sources (describe)
- Some data elements are in electronic sources (describe)
- No data elements are in electronic sources

The data elements needed for the measure as specified are all available electronically.

- **Susceptibility to inaccuracies, errors, or unintended consequences**

4c.1. Identify susceptibility to inaccuracies, errors, or unintended consequences of measurement identified during testing and/or operational use and strategies to prevent, minimize, or detect. If audited, provide results.

N/A

- **Data collection strategy**

4d.1. Describe what you have learned/modified as a result of testing and/or operational use of the measure regarding data collection, availability of data, missing data, timing and frequency of data collection, sampling, patient confidentiality, time and cost of data collection, other feasibility/implementation issues (for example fees for use of proprietary measures)

As data are derived from administrative databases, there is no additional data collection required and the questions about sampling, availability, cost, etc., are not applicable. There is a lag of approximately nine months needed to collect the hospital data through the CMS claims data files.

Related Measures

- **Harmonization**

5a.1. If this measure has EITHER the same measure focus OR the same target population as NQF-endorsed measure(s): Are the measure specifications completely harmonized? If so, describe.

The proposed SRR applies to the **same population**—Medicare-covered ESRD patients—as CMS’ Standardized Hospitalization Ratio for Admissions (NQF #1463) and Standardized Mortality Ratio (NQF #0369). Both measures adjust for a similar set of patient characteristics as the SRR and utilize fixed effects in their modeling approach. Harmonization with other measures that are specific to the ESRD population is important because the same stakeholders are interpreting and using the measures.

The proposed SRR has the **same measure focus**—unplanned 30-day readmissions—as CMS’ Hospital-Wide All-Cause Readmission Rate (NQF #1789). Differences between the SRR and the existing CMS measure are listed below:

- **Exclusions**

1. SRR does not exclude patients with incomplete claims history from the past year.
2. SRR excludes discharges that follow a patient’s 12th readmission in the year.
3. SRR excludes from the numerator readmissions that include a diagnosis of “fluid and electrolyte disorders” (CCS 55) and meet other criteria for planned readmissions (see Appendix B).

- **Risk Adjustment**

1. SRR does not adjust for comorbidities that are highly prevalent in the ESRD population, such as
 - Acute renal failure
 - Dialysis status
 - Kidney transplant

- Fluid/electrolyte disorders
- Iron deficiency
- 2. SRR additionally adjusts for
 - Diagnoses (grouped by the Clinical Classification Software [CCS] method) that are relatively rare but have a high risk of 30-day readmission in the ESRD population
 - Length of hospital stay
 - Diabetes as the primary cause of ESRD
 - Time on dialysis
 - Sex

- **Modeling**

Although both measures utilize mixed effects modeling, the SRR treats the unit of interest (i.e., the dialysis facility instead of the hospital) as a fixed effect rather than a random effect. A key distinguishing feature of dialysis facilities that is relevant to the use of fixed effects to characterize their impact on readmissions is the frequency of relatively small providers. As opposed to the hospital population that the Hospital-wide All-Cause-Specific measure applies to, there are many more “small” providers in the dialysis context. Consequently, the random effects model applied to the readmission measure for dialysis facilities would result in a more marked effect on the overall estimated standardized readmission rates than would be the case for hospitals. We note that the SRR measure is harmonized with two existing CMS measures, namely, the standardized hospitalization rate (SHR) and the standardized mortality rate (SMR), both of which are on the same ESRD population and both of which include facilities as fixed effects.

Furthermore, our SRR measure accounts for the discharging hospital as a random effect to allow for and adjust the facility measurement of the possible effects of hospital on readmission rates, which compensates for the influence of ‘secondary’ providers. This approach is especially relevant for the ESRD population, where there is a natural pairing between hospitals and dialysis facilities.

- **Similar measures**

5b.1. If this measure has both the same measure focus and the same target population as NQF-endorsed measure(s) or other measures in current use, describe why this measure is superior to existing measures (for example, a more valid or efficient way to measure quality); OR, provide a rationale for the additive value of developing and endorsing an additional measure. (Provide analyses when possible.)

N/A

APPENDIX

Figure 1. ROC Curve for SRR Model (c-statistic = 0.6506)

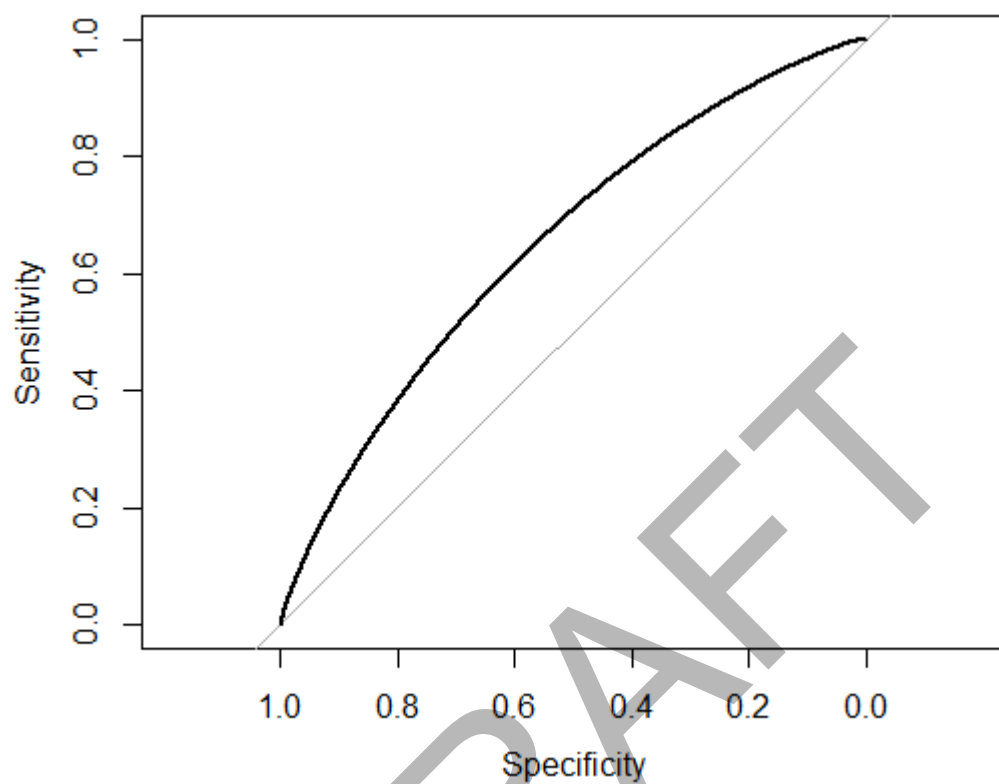
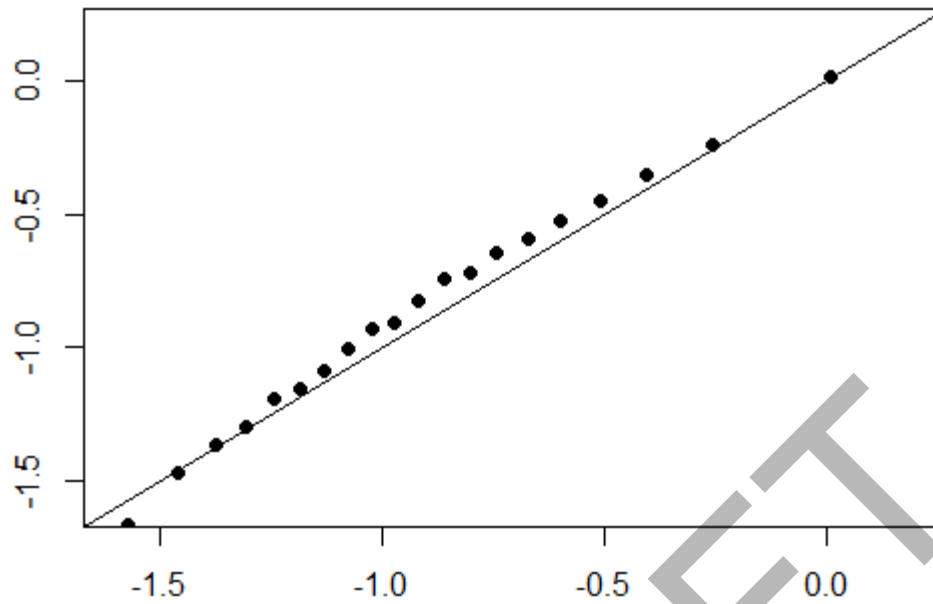


Figure 2. A plot of the logit of the observed proportion of admissions against the logit of model estimated probabilities to assess overall model fit.



Note. The 45-degree line represents the model-predicted values for the linear predictor, whereas the dots represent the observed values. Both values are shown as logit transformations of proportions. For interpretation purposes, the closer the observed values are to the predicted line, the better the model fit. In a perfectly predictive model, the observed values would fall along the 45-degree line.

Table 1. Coefficients and Standard Errors for Covariates in SRR Model

Risk Factor	Beta	SE	p
Age (y)			
<25	0.31	0.03	<.0001
25–45	0.14	0.01	<.0001
45–60 (ref)	—	—	—
60–75	-0.04	0.01	<.0001
>75	0.04	0.01	<.0001
BMI			
Underweight	0.09	0.01	<.0001
Normal Weight (ref)	—	—	—
Overweight	-0.04	0.01	<.0001
Obese	-0.12	0.01	<.0001
Cause of ESRD: Diabetes	0.06	0.01	<.0001
Comorbidity (past year)			
Amputation status	0.09	0.01	<.0001
COPD	0.24	0.01	<.0001
Cardiorespiratory failure/shock	0.24	0.01	<.0001
Coagulation defects & other specified hematological disorders	0.14	0.01	<.0001
Drug and alcohol disorders	0.30	0.01	<.0001
End-Stage Liver Disease	0.34	0.02	<.0001
Fibrosis of lung or other chronic lung disorders	0.06	0.02	<.0001
Hemiplegia, paraplegia, paralysis	0.12	0.01	<.0001
Hip fracture/dislocation	0.04	0.02	0.01
Major organ transplants (excl. kidney)	0.04	0.02	0.02
Metastatic cancer/acute leukemia	0.29	0.03	<.0001

Other hematological disorders	0.18	0.01	<.0001
Other infectious disease & pneumonias	0.16	0.01	<.0001
Other major cancers	0.05	0.01	<.0001
Pancreatic disease	0.23	0.01	<.0001
Psychiatric comorbidity	0.22	0.01	<.0001
Respirator dependence/tracheostomy status	0.01	0.03	0.19
Rheumatoid arthritis & inflammatory connective tissue disease	0.07	0.01	<.0001
Seizure disorders & convulsions	0.15	0.01	<.0001
Septicemia/shock	0.15	0.01	<.0001
Severe cancer	0.17	0.02	<.0001
Severe infection	0.10	0.01	<.0001
Ulcers	0.14	0.01	<.0001
Length of Index Hospitalization (days)			
Quartile 1 (ref)	—	—	—
Quartile 2	0.11	0.01	<.0001
Quartile 3	0.22	0.01	<.0001
Quartile 4	0.42	0.01	<.0001
Presence of high-risk diagnosis at index discharge	0.35	0.04	<.0001
Sex: Female	0.06	0.01	<.0001
Time on ESRD (y)			
<1 (ref)	—	—	—
1–2	-0.04	0.01	0.001
2–3	-0.03	0.01	0.01
3–6	-0.02	0.01	0.03
>6	-0.07	0.01	<.0001

Note. Discharge diagnoses that were relatively rare but led to a 30-day unplanned readmission in at least 40% of cases.

Method Description for Reliability Testing

Suppose that there are N facilities with at least 11 discharges in the year. Let T_1, \dots, T_N be the SRR for these facilities. Within each facility, select at random and with replacement $B = 200$ bootstrap samples. That is, if the i th facility has n_i subjects, randomly draw with replacement n_i subjects from those in the same facility, find their corresponding SRR_i and repeat the process 200 times. Thus, for the i th facility, we have bootstrapped SRRs of $T_{i1}^*, \dots, T_{i200}^*$. Let S_i^{*2} be the sample variance of this bootstrap sample. From this it can be seen that

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

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

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

where

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

is the weighted mean of the observed SRR and

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

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

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

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