Developer Responses: Readmissions SDS Trial Webinar #1

Measure: NQF #0505 Hospital 30-day all-cause risk-standardized readmission rate (RSRR) following acute myocardial infarction (AMI) hospitalization

QUESTION 1: Describe the conceptual relationship between your outcome measure and possible SDS risk factors. Specifically, provide support from the literature or other empirical data on whether a conceptual relationship exists between at least one (1) specific SDS risk factor and the outcome being measured. Describe the possible risk factor(s) that exhibits the strongest relationship to admissions/readmissions. Possible SDS risk factors for examination may include income, level of education, homelessness status, English language proficiency, health insurance status, occupation, employment status, literacy, health literacy, or neighborhood-level data that can be used as a proxy for individual data such as median neighborhood income, education, or local funding availability for safety net providers.

A variety of sociodemographic status (SDS) risk factors may influence readmission risk following a hospital visit for acute myocardial infarction (AMI). Although some recent literature evaluates the relationship between patient SDS and the readmission outcome, few studies directly address causal pathways or examine the role of the hospital in these pathways. With respect to AMI, several factors including race/ethnicity, income, marital status, and education status have been looked at, but the associations have been inconclusive [1]. Moreover, the current literature examines a wide range of conditions and risk variables with no clear consensus on which risk factors demonstrate the strongest relationship with readmission. The risk factors that have been examined in the SDS readmission literature can be categorized into three domains: (1) patient-level variables, (2) neighborhood/community-level variables, and (3) hospital- level variables. Patient-level variables describe characteristics of individual patients, and range from the race or ethnicity of the patient to the patient's income or education level [2, 3]. Neighborhood/community-level variables use information from sources such as the American Community Survey (ACS) as either a proxy for individual patient-level data or to measure environmental factors. Studies using these variables use one dimensional measures such as median household income or composite measures such as the Agency for Healthcare Research and Quality (AHRQ)- validated SES index score [4]. Hospital-level variables measure attributes of the hospital which may be related to patient risk. Examples of hospital-level variables used in studies are ZIP code characteristics aggregated to the hospital level or the proportion of Medicaid patient days [5, 6].

The conceptual relationship, or potential causal pathways by which these possible SDS risk factors influence the risk of return to the hospital following an acute illness or major surgery, like the factors themselves, are varied and complex. There are at least four potential pathways that are important to consider. We briefly describe them here and comment on their implications for the hospital readmission measures.

1. Relationship of SDS to health at admission. Sociodemographic disadvantage often leads to worse general health status and therefore patients who have lower income/education/literacy or unstable

housing may present for their hospitalization or procedure with a greater severity of underlying illness. These SDS risk factors, which are characterized by patient-level or neighborhood/community-level (as proxy for patient-level) variables, may also contribute to worse health status at admission due to patients failing to respond to early symptoms and presenting for treatment later in their disease progression. This causal pathway should be largely accounted for by current clinical risk- adjustment.

However, while studies have shown that variables such as race are associated with worse health status, race itself may not directly affect health status at hospital admission. Rather, the association of race with worse health is likely mediated through the association between race and other sociodemographic factors such as poverty or disparate access to high quality care.

2. Use of low-quality hospitals. SDS risk factors may be associated with access to quality healthcare providers because of the distribution of providers and prohibitive costs. In particular, SDS factors can influence the likelihood that patients access high quality care. Patients of lower income, lower education, or unstable housing may not have access to high quality facilities because such facilities are less likely to be found in lower SDS geographic areas. Poor and minority patients are more likely to be seen in lower quality hospitals, which can contribute to the likelihood of hospital readmission [7-9]. To the extent that the relationship between SDS and readmission is driven by clustering of low SDS patients within lower quality facilities, traditional patient-level risk adjustment for SDS would be inappropriate.

3. Differential care within a hospital. The third major pathway by which SDS factors may contribute to readmission risk is that patients may not receive equivalent care within a facility. For example, patients of low income or minority race may experience differential, lower quality, or discriminatory care within a given facility [10]. Alternatively, patients with SDS risk factors may require differentiated care – e.g. provision of lower literacy information – that they do not receive. That is to say, hospitals may provide the same care for all populations (e.g. the same discharge instructions) and this may represent substandard care for patients for whom the standard approach is not effective (e.g. due to low literacy). By failing to actively address the unique needs of patients with SDS risk factors, institutions may be providing lower quality care to these patients. Again, in such circumstances, patient-level risk adjustment for SDS is problematic as it would essentially adjust for a characteristic of the care provided rather than for a patient risk factor.

4. Influence of SDS on readmission risk outside of hospital quality and health status. Some SDS risk factors, such as income or wealth, may affect the likelihood of hospital readmission without directly affecting health status at admission or the quality of care received during the hospital stay. For instance, while a hospital may make appropriate care decisions and provide tailored care and

education, a lower-income patient may be less likely to follow prescribed care (e.g. refill a prescription or keep a follow-up visit with a primary care provider) because limited resources create competing priorities for the patient or their community may have a limited supply of primary care providers. These kinds of pathways present more complex questions about appropriate risk-adjustment decisions.

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QUESTION 2: Describe the relationship between the SDS risk factor(s) and the measured unit (hospital, SNF, etc.) to indicate the variation in the risk factor across the measured unit. Information from the literature is sufficient to indicate potential variation; however, empirical data for the measure as specified (e.g., via bivariate frequency distributions) would be needed to demonstrate that variation does not exist and therefore adjustment is not appropriate.

Since these measures have been developed and implemented using national-level data, there is substantial variation in SDS risk factors across hospitals. Two variables we have presented in our NQF applications provide empirical evidence that this variation exists. For the AMI Readmission measure, the percentage of patients who are black ranges from 0% to 96.0% across hospitals, with a median of 4.0% (interquartile range [IQR] 1.2%-11.1%). The percentage of patients who are Medicaid beneficiaries ranges from 0% to 76.1% across hospitals, with a median of 18.3% (IQR 13.4%- 22.8%). This information was based on the most current data for reporting.

QUESTION 3: What are the patient-level sociodemographic variables that are available in the datasets used to develop the measure?

The variables that are available within or that can be linked directly to Medicare administrative claims data used for these measures include the following:

1. Race (black, white, other). Data source: Medicare claims, enrollment database.
2. Medicaid dual-eligible status. Data source: Medicare claims, enrollment database.
3. Neighborhood SES factors as proxies for patient-level SES [1]. Data source: Enrollment database and Census data (American Community Survey).

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1. Creation of New Race-Ethnicity Codes and Socioeconomic Status (SES) Indicators for Medicare Beneficiaries: Final Report. August 2012. Agency for Healthcare Research and Quality, Rockville, MD. http://archive.ahrq.gov/research/findings/final-reports/medicareindicators/index.html

QUESTION 4: How well do the patient-level SDS variables that are available represent the underlying conceptual relationship identified?

SDS is a multifaceted phenomenon (more so than clinical factors) and therefore it is unlikely that a single SDS factor will fully and consistently capture the aspects of SDS which affect the risk of readmission through the causal pathways described above.

Dual-eligible status: For our readmission measures, which include Medicare fee-for-service (FFS) beneficiaries aged 65 years and older, dual-status is a good indicator of current assets and income and dual-eligibility criteria are consistent across most states (though cost of living varies) [1]. We think this is, therefore, a reasonable patient-level variable to assess the relationship between SDS and readmission in that it provides a reliably-obtained indication of patients with low income/assets. There are two important caveats: first, dual-eligible status is a dichotomous variable and thus provides less gradation of SDS; and second, for some patients dual-eligibility is the result of a "spending down" to obtain coverage for nursing care. For such patients, it is difficult to differentiate between those who may have faced a lifetime of low SDS and associated challenges versus those who have had more resources earlier in life and only recently became classified as low income.

Race: The particular case of race as a predictor of health outcomes illuminates the complexity of the role SDS variables play in assessing hospital performance. Racial identity itself confers no differential risk of mortality or readmission following hospitalization. The evidence suggests that a greater prevalence of risk factors in combination with the effects of bias and discrimination account for differential outcomes observed among certain racial groups. This is not to say that there are no meaningful biological variations among groups whose genetic ancestry can be traced to different geographic regions of the world. However, these variations are quite specific and narrowly defined and have not been shown confer broad health risks across groups absent specific genetic markers. Nevertheless, numerous studies have demonstrated greater disease burden, lack of access to health care services, and bias in application of medical intervention among racial minorities, particularly black patients seeking care for a variety of medical and surgical conditions.

In risk-adjusted statistical models of readmission following hospitalization, race is a marker for other SDS factors, such as poverty or social support; however, we often find that the association between race and readmission is greater and more robust or consistent than that of economic factors. The absence of any biologically defined causal pathway suggests that this stronger association may result from exposure to broad societal racial bias. We can determine the specific health outcome-related effects of exposure to societal racial bias through quality measurement, as the health outcome is relatively consistent across exposed individuals. Poverty may have more nuanced effects dependent on unmeasured factors such as the surrounding community, familial support, and others.

Whether we should we include a risk variable to adjust for the presence of this bias depends on whether or not the risk conferred through bias is attributable to factors within or beyond the hospitals' control. The evidence that blacks receive differential care across a variety of medical and surgical conditions suggests that, even as this bias exists broadly throughout the institutions of society, hospitals and providers also contribute to it [2]. If so, this contribution of the hospital – the effect of treatment bias – should not be included in risk adjusted models of hospital performance as to do so would, in effect, be giving hospitals credit for more disparate or discriminatory care.

ZIP Code-level SDS indicators: The American Community Survey (ACS) provides a number of SDS indicators that are available at the ZIP code level. We are in the process of developing an approach to linking these data to at the 9-digit ZIP code level, which will allow for a more granular perspective on local SDS. We propose to analyze an Agency for Healthcare Research and Quality (AHRQ)-validated composite index of SES which has been used and tested among Medicare beneficiaries [3]. This index is a composite of seven different variables found in the Census data which may capture SDS better than any single variable. The variables are: (1) median household income, (2) percentage of persons living below the federal poverty level, (3) percentage of persons who are aged >16 years and in the labor force but not employed, (4) median value of owner-occupied homes, (5) percentage of persons aged >25 years who completed at least a 12th grade education, (6) percentage of persons aged >25 years who completed at least four years of college, and (7) percentage of households that average one or more persons per room. This is a neighborhood-level variable, which we would use as a proxy for patient-level SDS factors.

References:

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Measure: NQF # 0695 Hospital 30-Day Risk-Standardized Readmission Rates following Percutaneous Coronary Intervention (PCI)

QUESTION 1: Describe the conceptual relationship between your outcome measure and possible SDS risk factors. Specifically, provide support from the literature or other empirical data on whether a conceptual relationship exists between at least one (1) specific SDS risk factor and the outcome being measured. Describe the possible risk factor(s) that exhibits the strongest relationship to admissions/readmissions. Possible SDS risk factors for examination may include income, level of education, homelessness status, English language proficiency, health insurance status, occupation, employment status, literacy, health literacy, or neighborhood-level data that can be used as a proxy for individual data such as median neighborhood income, education, or local funding availability for safety net providers.

[Repeating original response] Studies have suggested that across a number of conditions and procedures, patients' risk of readmission varies by sociodemographic status. However, there is limited scientific literature that links sociodemographic factors to hospital-level risk standardized readmission rates (RSRR).

This readmission post PCI measure is mapped to Medicare claims data, thus requiring the patient population evaluated be covered with CMS insurance. Our measure includes variables for gender and age. Race and ethnicity are captured within the registry dataset. Consistent with the previous recommendation to exclude socioeconomic status and race from statistical risk models, these variables were not included in the PCI readmission measure.

The preponderance of data suggests that hospital related factors, specifically detailed discharge planning and post discharge follow up, exert a stronger influence on readmission rates. A 2011 systematic review of 43 studies, 16 of which were randomized trials, found that the strategies employed in successful studies involved several simultaneous interventions, including patient-centered discharge instructions and a post discharge telephone call. A 2012 systematic review identified several interventions (including medication reconciliation, structured electronic discharge summaries, discharge planning, and facilitated communication between hospital and community providers) that favorably influenced readmission rates (Hesselink, 2012).

QUESTION 2: Describe the relationship between the SDS risk factor(s) and the measured unit (hospital, SNF, etc.) to indicate the variation in the risk factor across the measured unit. Information from the literature is sufficient to indicate potential variation; however, empirical data for the

measure as specified (e.g., via bivariate frequency distributions) would be needed to demonstrate that variation does not exist and therefore adjustment is not appropriate.

[Repeating original response] The socioeconomic status analyses included within the NQF application for this measures provides the strongest evidence suggesting that these SDS factors do not exert a strong impact on hospital RSRR.

We analyzed whether disparities in performance on this measure exist at the hospital level. To identify potential disparities, we examined the relationship between hospital-level RSRR and hospital proportion of African- American patients among all hospitals grouped by quintile of the proportion of African-American patients. We used the Medicare Provider Analysis and Review (MEDPAR) File for 2010 to calculate the proportion of African-American patients treated at each hospital, using all patients admitted to each hospital. There were 277,439 admissions to 1,195 hospitals.

Our analyses demonstrated that there were modest differences in the RSRRs by quintile. Specifically, the median RSRR for hospitals with the highest proportion of African-American patients was 12.4% compared with 11.2% for hospitals with the lowest proportion of African-American patients. In comparison to the registry average of 11.8%, hospitals with high proportions of African-American patients have modestly higher 30-day RSRRs. However, the distributions for the RSRRs overlapped across hospital quintiles, and many hospitals caring for the highest percentage of African-American patients performed well on the measures.

Similarly, to identify potential disparities related socoioeconomic status, we examined the relationship between RSRR and hospital proportion of dual eligible patients. We used the MEDPAR File for 2010 to calculate the percentage of patients 65 or older and eligible for both Medicare and Medicaid (dual eligible patients) treated at each hospital. There were 277,439 admissions to 1,195 hospitals. The proportion of dual eligible patients was used as a marker for determining the SES status of hospitals' patients because this is a low income and vulnerable population. Similar to the analysis above, we examined hospital-level RSRRs across quintiles of the proportion of dual eligible patients.

There were no differences in RSRRs across income quintile. Analyses demonstrated that the median RSRR for hospitals in the top quintile of dual eligible patients was 12.3% compared with 11.6% for hospitals in the bottom quintile of dual eligible patients. In comparison to the registry average of 11.8%, hospitals that treat a high percentage of dual eligible patients have moderately higher 30-day RSRRs. However, the distributions for the RSRRs overlapped, and many hospitals in the highest quintile of dual eligible patients performed well on the measure.

Aside from our own analysis, an exhaustive review of the literature found only one, single center study that identified a possible link between sociodemographic factors and readmissions post PCI. Khawaja and colleagues reported on a review of over 15,000 patients who underwent (both urgent and non-urgent) PCI between 1998 and 2008, the 30-day readmission rate was 9.4 percent (Khawaja, 2012). The author's intent was to identify factors associated with 30-day readmission rates. Demographic variables, including age and sex, were collected from the Mayo Clinic PCI registry.

Additional demographic variables were collected from Mayo Clinic administrative databases and merged with the PCI registry. These variables included marital status (single, married, divorced, separated, or widowed), education level (eighth grade or less, some high school, high school graduate or equivalent, some college, college graduate, postgraduate studies, or unknown), miles traveled to Mayo Clinic, and insurance type (Medicare, Medicaid, uninsured, or privately insured). Clinical variables were also evaluated. After their multivariable analysis, the following factors were found to be associated with an increased risk of readmission: female sex, Medicare insurance, having less than a high school education, unstable angina, cerebrovascular accident or transient ischemic attack, moderate to severe renal disease, chronic obstructive pulmonary disease, peptic ulcer disease, metastatic cancer, and a length of stay of more than three days (Khawaja, 2012).

While patient's level of education had a weak association, it is one isolated sociodemographic risk factor that has been identified to influence readmission rates throughout the literature. Wasfy et al. (2013), provided evidence from a 5573 patients during 2007 -2011 in a single center study, identifying that the largest proportion of readmissions after PCI is due to symptoms that prompt concern for angina. The overwhelming majority of which (90.0%) do not require repeat revascularization (Wasfy, 2013). Feasible suggestions to reduce readmission rates derived from this study suggested that hospitals may be able to minimize 30-day readmission rates after PCI substantially by postponing non-urgent, non- coronary procedures after PCI. Transferring the evaluation of low-risk chest pain to the outpatient setting or to emergency department observation units could dramatically reduce 30 day readmission rates after PCI (Wasfy, 2013). These suggestions to reduce the rate of readmission are actionable, feasible and do not add additional burden to the hospitals. Requiring hospitals to query each patient for their level of education, would increase data collection burden and demands on the hospitals for minimal gains.

The NQF Technical Report (2014, p. 40) clearly states that "data constraints may be the biggest barrier to adjustment for sociodemographicfactors and will require further initiatives to define standards and to implement datacollection". The National Committee on Vital and Health Statistics proposed that education (i.e., years of schooling) should be

considered a core health data element that should be standardized in healthcare and healthcare information fields (NCVHSR, 1996). Despite this recommendation nearly two decades ago, education is not widely collected in

healthcare. The NQF Technical Report references work by Kirst et al, (2013) to support the concept that "education may be easier to collect from patients with fewer refusals" than elements such as household income (NQF Technical Panel Report, p.41). In the original article Kirst explains what was required to attain a response rate of only 2.9%.

"… A public opinion and market research firm was employed to administer the survey… 72,216 calls were attempted.

…. After excluding, answering machines, calls with no answer, language barriers, ill or incapable respondents, and no eligible respondent being available, a total of 15,976 people were asked to participate in the survey. Of these .. 1,306 [qualified] as eligible and completed the interview. This represents a response rate of 2.9%, with 8.2% of persons asked to complete the survey doing so.

Willingness to participate in the survey was taken to imply consent, and no personal identifiers were collected. Surveys were conducted in English and French…" (Kirst, 2013).

While potentially feasible from a clinical trial with the ability to finance a public opinion and market research firm to capture the level of educate data, this is not feasible at a hospital level.

QUESTION 3: What are the patient-level sociodemographic variables that are available in the datasets used to develop the measure?

Datasets used to develop this measure include the CathPCI Registry and the Medicare Provider and Analysis Review (MEDPAR) file.

Patient-level sociodemographic variables available in the CathPCI Registry dataset include: gender, race, Hispanic ethnicity, age, zip code, and insurance status.

Patient-level sociodemographic variables available in the MEDPAR dataset includes: gender, race, Hispanic ethnicity, age and zip code.

QUESTION 4: How well do the patient-level SDS variables that are available represent the underlying conceptual relationship identified?

SDS Variable #1: African American Race

As described above, the empirical analyses conducted during measure development demonstrates that there were modest differences in the RSRRs by quintile. Specifically, the median RSRR for hospitals with

the highest proportion of African-American patients was 12.4% compared with 11.2% for hospitals with the lowest proportion of African-American patients. In comparison to the registry average of 11.8%, hospitals with high proportions of African-American patients have modestly higher 30-day RSRRs. However, the distributions for the RSRRs overlapped across hospital quintiles, and many hospitals caring for the highest percentage of African-American patients performed well on the measures.

SDS Variable #2: Income

There were no differences in RSRRs across income quintile. Analyses demonstrated that the median RSRR for hospitals in the top quintile of dual eligible patients was 12.3% compared with 11.6% for hospitals in the bottom quintile of dual eligible patients. In comparison to the registry average of 11.8%, hospitals that treat a high percentage of dual eligible patients have moderately higher 30-day RSRRs. However, the distributions for the RSRRs overlapped, and many hospitals in the highest quintile of dual eligible patients performed well on the measure.

In conclusion, empirical analysis for variables of African American race and income included within this measure suggest that SDS factors feasible for analysis do not exert a strong impact on hospital RSRR.

QUESTION 5: Appendix (includes literature review, reference list, etc.)

References:

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Measure: NQF #2375, PointRight® Pro 30™

QUESTION 1: Describe the conceptual relationship between your outcome measure and possible SDS risk factors. Specifically, provide support from the literature or other empirical data on whether a conceptual relationship exists between at least one (1) specific SDS risk factor and the outcome being measured. Describe the possible risk factor(s) that exhibits the strongest relationship to admissions/readmissions. Possible SDS risk factors for examination may include income, level of education, homelessness status, English language proficiency, health insurance status, occupation, employment status, literacy, health literacy, or neighborhood-level data that can be used as a proxy for individual data such as median neighborhood income, education, or local funding availability for safety net providers.

The literature on ethnic disparities in care in SNFs is scarce overall, with only two articles focusing on ethnic differences in rehospitalization rates. A Medline search of racial disparities in SNFs only yields 37 articles of which a fifth address issues related to ethnic disparities in access to SNF services. Of the remaining articles most address disparities in long term care but not for residents receiving short post-acute care services. Two articles focus on ethnic disparities related to hospitalizations (Li, 2011; Grunier, 2008). In the first study using national MDS data from 2008, the authors found that the 30 day rehospitalization rates were 14.3% for white patients (n = 865,993) and 18.6% for black patients (n = 94,651). Both patient and admitting facility characteristics accounted for a considerable portion of overall racial disparities, but disparities persisted after multivariable adjustments overall and in patient subgroups (Li, 2011). However, this study did not compare within-facility and between-facility disparities. Within-facility disparities are those where disparities exist between blacks and whites in the same facilities and between-facility disparities are those that exist between facilities with different racial composition (i.e. facilities with higher minority populations have poorer care quality than facilities with mostly white populations). Based on previous research related to racial disparities in SNFs, it is expected that disparities in rehospitalization would exist between facilities.

In the second article, hospitalization rates for long stay residents on Medicaid were examined (short stay residents were not included) (Grunier, 2008). In this study, using MDS data to look at long stay residents, 18.5% of white and 24.1% of black residents were hospitalized. Residents in nursing homes with high concentrations of blacks had 20% higher odds (95 percent confidence interval [CI]=1.15-1.25) of hospitalization than residents in nursing homes with no blacks. Ten- dollar increments in Medicaid rates reduced the odds of hospitalization by 4 percent (95% CI=0.93-1.00) for white residents and 22 percent (95% CI=0.69-0.87) for black residents.

Multiple studies in the past twenty years have examined racial disparities in the care of SNF residents and have consistently found poorer care in facilities with high minority populations (Fennell et al., 2000; Mor et al., 2004; Smith et al., 2007). Work on disparities in quality of care between elderly white and black residents within SNFs has shown clearly that nursing homes remain relatively segregated, and that nursing home care can be described as a tiered system in which blacks are concentrated in marginal-quality homes (Mor et al., 2004). Such homes tend to have serious deficiencies in staffing ratios, performance, and are more financially vulnerable (Smith et al, 2007; Chisholm et al., 2013). Based on a review of the SNF disparities literature, Konetzka and Werner (2009) concluded that disparities in care are likely related to racial and socioeconomic segregation as opposed to within-provider discrimination. This conclusion is supported, for example, by Grunier and colleagues who found that as the proportion of black residents in the nursing home increased the risk of hospitalization among all residents, regardless of race, also increased (Grunier et al., 2008). Rehospitalization risk likely also increases as the proportion of black residents increases, indicating that the best measure of racial disparities in rates of rehospitalization is one that measures rehospitalization at the facility level. Cai, S., Mukamel, D., & Temkin-Greener, H. (2010). Pressure ulcer prevalence among black and white nursing home residents in New York state: Evidence of racial disparity? Medical Care 48(3), 233-239.

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QUESTION 2: Describe the relationship between the SDS risk factor(s) and the measured unit (hospital, SNF, etc.) to indicate the variation in the risk factor across the measured unit. Information from the literature is sufficient to indicate potential variation; however, empirical data for the measure as specified (e.g., via bivariate frequency distributions) would be needed to demonstrate that variation does not exist and therefore adjustment is not appropriate.

To describe the relationship between the SDS risk factor(s) and the measured unit, we plan to analyze the quantitative effect of including or omitting the SDS characteristics (individually and collectively) on the risk adjustment model in terms of these four questions:

- What is the correlation between the SDS risk adjustor at each level of aggregation and the rehospitalization rate (controlling for the non-SDS risk adjustors) or rehospitalization indicator?
- What is the most appropriate level of aggregation at which to include each SDS risk adjustor? Should it be included at the facility-level, regional-level, or patient-level?
- Having chosen an appropriate set of SDS risk adjustors to include, and having decided the best level at which to include each of them into the model, what is the marginal improvement in the performance of the risk adjustment model when SDS adjustors are included? We will evaluate discrimination using C-statistics and R-squared statistics, and we will evaluate calibration using percentile plots percentile plots.

Disparity between the groups that are defined by the different levels of the SDS factor might be the result of differential care within a nursing home. This will be tested by exploring and adding into the model interaction terms of the SDS with other factors. Alternatively, it is possible that the disparity between the groups is rather due to differences resulting from the unequal quality of care across facilities. We will assess the effect of an SDS factor, avoiding confounding issues associated with quality of care, by fitting a model that further adjusts for the fixed effects of the nursing homes.

Correlation between the SDS risk adjustor and the rehospitalization rate/indicator. We will measure the correlation between the SDS characteristic at each level of aggregation, and the risk adjusted rehospitalization rate (regional and provider levels) or the rehospitalization indicator with the non-SDS risk adjustment model applied to it (patient level). It is important to do this net of the effects of the non-SDS risk adjustors already incorporated into the measure so that we do not focus on SDS characteristics that have already been accounted for by proxy, through the non-SDS clinical adjustors. By examining the correlations, we will understand the relative importance of each adjustor and can form a final shortlist for the SDS trial period project.

Levels of aggregation. We see three natural levels of analysis for including or omitting each SDS characteristic into the risk adjustment model: between-region variance in rehospitalization rates, within-region provider variance in rehospitalization rates, and within-facility patient variance in rehospitalization rates. Between-region variance reflects systematic differences in rehospitalization rates between one region and the next. Within-region provider variance reflects systematic differences in rehospitalization rates between the providers within a region. Within-provider variance reflects systematic differences in rehospitalization rates between the patients of a given provider.

We are still working to understand exactly how these different levels interact with the appropriateness of including or omitting SDS characteristics, but our preliminary understanding is that explaining variance at one level using an SDS characteristic may be desirable, where explaining variance at a different level for that characteristic may be undesirable. For example, adjusting for income differentials across regions, or between the providers of a region, may appropriately recognize that some providers serve poorer, higher-risk populations, but adjusting for differentials in income for patients within a provider may generate perverse patient selection incentives. We need to understand these contrasts in order to avoid causing perverse provider incentives.

Marginal improvement of revised risk adjustment model. For each expanded version of the risk adjustment model, we will re-test the performance of the risk adjustment model. This will parallel the same testing performed in the original NQF measure application. We will evaluate discrimination using C-statistics and R-squared statistics, and will evaluate calibration using percentile plots (actual rehospitalization rates grouped into quantiles vs mean expected rehospitalization rates).

QUESTION 3: What are the patient-level sociodemographic variables that are available in the datasets used to develop the measure?

Below are the patient-level sociodemographic variables that are available in the MDS.

Person characteristics:

- Race
- Age (already included in RA model)
- Sex (already included in RA model)
- Marital status (possibly crossed with age and sex)
- Language
- Gender
- Dual eligibility/state buy-in

Additionally, in the analysis phase we would like to explore the following variables as a proxy for individual level data.

- Facility characteristics:

- Percent of patients by race
- Percent of patients by age category
- Percent of patients by sex
- Percent of patients by gender
- Percent of patients by marital status
- Percent of patients by language
- Percent of patients by state buy-in indicator
- Percent of the facility's census that is receiving post-acute care (i.e., admitted from a hospital in the prior 30 days)
- Percent of the facility's census that is covered by Medicare FFS
- Percent of facility's residents with Medicaid benefits interacted with three levels of liberality of Medicaid eligibility, and three levels of liberality of per diem Medicaid SNF reimbursement
- The number of beds in the facility
- The ownership of the facility (nonprofit, for profit individual, for profit chain, public)

Regional characteristics (County or CBSA of SNF):

- Median household income
- Percent of households >= 133% of Federal poverty level
- Percent of adults eligible for Medicaid (according to state standards)
- Percent of persons >= 65 with private insurance
- Percent of persons >= 65 with Medicaid
- Percent of persons >= 65 with Medicare FFS
- Percent of persons >= 65 with Medicare Advantage
- Percent of persons in the labor force >= 25 who are unemployed
- Percent of persons >= 18 who are homeless
- Percent of persons aged >= 30 with a graduate degree; percent of persons aged >= 25 with a college degree
- Percent of persons >= 30 who live in rented dwellings
- Percent of people in the geographical region and the same demographic category who are poor

QUESTION 4: How well do the patient-level SDS variables that are available represent the underlying conceptual relationship identified?

The available patient-level SDS variables of race and language well represent the issue of racial disparity. As noted above, studies have found poorer care in facilities with high minority populations (Fennell et al., 2000; Mor et al., 2004; Smith et al., 2007).

QUESTION 5: Appendix (includes literature review, reference list, etc.)

None.

Measure: NQF #2380: Rehospitalization during the First 30 days of Home Health

Measure: NQF #2505: Emergency Department (ED) Use without Hospital Readmission during the First 30 Days of Home Health

QUESTION 1: Describe the conceptual relationship between your outcome measure and possible SDS risk factors. Specifically, provide support from the literature or other empirical data on whether a conceptual relationship exists between at least one (1) specific SDS risk factor and the outcome being measured. Describe the possible risk factor(s) that exhibits the strongest relationship to admissions/readmissions. Possible SDS risk factors for examination may include income, level of education, homelessness status, English language proficiency, health insurance status, occupation, employment status, literacy, health literacy, or neighborhood-level data that can be used as a proxy for individual data such as median neighborhood income, education, or local funding availability for safety net providers.

While a recent scoping review (Goodridge et al. 2012) found general agreement that persons of lower socioeconomic status are not disadvantaged in terms of HH care services, there is a well-documented socioeconomic gradient seen with primary and acute care services. Findings from the literature support a linkage between proposed SDS factors and ED use and hospital readmission. Individuals with lower social economic status (SES) are more likely to use EDs for primary health care services. In the home health setting, the 30-day period for re-hospitalization occurs while the patient is living in their own home, increasing the likelihood that non-medical factors, including geographic location and economic resources, will have an impact on acute care use. More specific findings regarding the documented relationship between socio-demographic factors, readmission and ED use are described below.

- A recent study of 30-day hospital readmission of elderly patients with initial discharge destination of HH care found race to be a significant predictor of readmission (Richmond, 2013).
- One study of 1375 patients examining differential use of EDs by various racial and ethnic groups found confounding impact by other SDS variables and concluded that programs to reduce inappropriate ED use must be sensitive to an array of complex socioeconomic issues and may necessitate a substantial paradigm shift in how acute care is provided in low SES communities. Research has also shown that ED wait time is also linked to factors related to race/ethnicity, with black patients having longer wait times than non-black patients (Hong et al. 2007).
- Even after adjustment for potential confounding factors, lower income is a positive predictor of readmission risk of patients for heart failure (Philbin et al. 2001).
- A study of community-dwelling elders with Medicare coverage discharged to home found that living alone and lower levels of education were significant predictors of readmission (Arbaje et al. 2008).
- Significant disparities have been found in visits to the ED for conditions sensitive to ambulatory care by race/ethnicity, insurance status, age group, and socioeconomic status (Johnson et al. 2012).

QUESTION 2: Describe the relationship between the SDS risk factor(s) and the measured unit (hospital, SNF, etc.) to indicate the variation in the risk factor across the measured unit. Information from the literature is sufficient to indicate potential variation; however, empirical data for the measure as specified (e.g., via bivariate frequency distributions) would be needed to demonstrate that variation does not exist and therefore adjustment is not appropriate.

Several socio-demographic factors were used to stratify the population level outcomes of rehospitalization and ED use in our original submission to NQF, using all HH stays beginning between July 1, 2010 and June 30, 2013. These results support the decision to include age, sex, and disability status in the existing risk adjustment model and also show that both race/ethnicity and Medicaid Status vary and are correlated with different outcome rates. In previous measure development work, our team also examined the impact of urban or rural location on Acute Care Hospitalization (NQF 0171) and ED Use without Hospitalization (NQF 0173) measured during the first 60 days of HH care. Rural beneficiaries with home health stays starting between July 2010 and June 2011 had higher rates of 60 day ED Use and Acute Care Hospitalization than did urban beneficiaries. This measure development work also found that both Rural location and Medicaid Status were significant predictors of hospitalization and ED visits even after controlling for age, sex, and clinical risk factors. Please refer to tables 1 and 2 provided in previous memo to NQF for empirical data.

QUESTION 3: What are the patient-level sociodemographic variables that are available in the datasets used to develop the measure?

The current risk adjustment model for NQF 2380 and 2505 relies on five categories of risk factors:

- Prior Care Setting including: acute care received in 30 days prior to HH, acute care received in 6 months prior to HH, and length of index hospitalization
- Age and sex interactions
- Health Status as measures by: Hierarchical Condition Categories (HCCs) based on past 6 months of Medicare claims, Diagnosis-Related Grouping (DRGs) on index hospitalization, and activities of daily living indicators, as captured on HH claims
- Medicare Enrollment Status, which identifies beneficiaries who are eligible for Medicare due to End-Stage Renal Disease (ESRD) or who were originally eligible due to disability
- Additional interactions between HHCs and Medicare Enrollment Status

The current model already includes demographic characteristics of age and sex. Additionally, the prior care setting risk factors likely account for some of the impact that additional SDS factors have on acute care utilization. Finally, both the age categories and the Medicare Enrollment Status indicators identify beneficiaries who are disabled and disability may act as both a clinical risk factor and a socio-demographic factor, due to correlation with income or employment.

Our team has identified several additional socio-demographic factors that can be reliably and feasibly captured using existing data sources. These include:

- Race/Ethnicity – included in Medicare Enrollment Database (EDB)
- Medicaid Status – included in EDB
- Rural location – determined from beneficiary address, as captured in EDB
- Neighborhood characteristics – determined from beneficiary address linked to survey data, such as the American Community Survey, and potentially including median income, employment rate, and crime rate

CMS is also proposing to pursue additional indicators of SDS for evaluation of use in the measures, such as the Area Deprivation Index.

QUESTION 4: How well do the patient-level SDS variables that are available represent the underlying conceptual relationship identified?

As previously mentioned, the results from our original submission to NQF support the decision to include age, sex, and disability status in the existing risk adjustment model and also show that both race/ethnicity and Medicaid Status vary and are correlated with different outcome rates. In addition, measure development work found that both Rural location and Medicaid Status were significant predictors of hospitalization and ED visits even after controlling for age, sex, and clinical risk factors.

QUESTION 5: Appendix (includes literature review, reference list, etc.)

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Measure: NQF #2393: Pediatric All-Condition Readmission Measure

Measure: NQF #2414: Pediatric Lower Respiratory Infection Readmission Measure

QUESTION 1: Describe the conceptual relationship between your outcome measure and possible SDS risk factors. Specifically, provide support from the literature or other empirical data on whether a conceptual relationship exists between at least one (1) specific SDS risk factor and the outcome being measured. Describe the possible risk factor(s) that exhibits the strongest relationship to admissions/readmissions. Possible SDS risk factors for examination may include income, level of education, homelessness status, English language proficiency, health insurance status, occupation, employment status, literacy, health literacy, or neighborhood-level data that can be used as a proxy for individual data such as median neighborhood income, education, or local funding availability for safety net providers.

Multiple factors within and outside of health systems contribute to a patient's health status after hospital discharge and thus influence the risk of readmission [1-3]. An important set of factors consists of patients' and families' social and economic conditions, which comprise both individual resources and community resources such as access to transportation and paid family leave [3-8]. Sociodemographic status (SDS) can affect health directly, as well as indirectly by having an impact on self-management, adherence to recommendations, and access to care [9–11]. Nearly 21% of children live in poverty—a rate almost double that for adults—making effects of SDS on health especially relevant to pediatrics [12].

To examine the impact of SDS on pediatric all-condition hospital readmissions, we evaluated the relationship between readmission risk and insurance status.

Evidence in the Literature

We chose to focus on insurance status because multiple studies in the literature have demonstrated that public insurance is associated with higher pediatric readmission rates [13-18]. For example, an analysis of community (non- children's) hospitals in the 2007 AHRQ Healthcare Cost and Utilization Project (HCUP) State Inpatient Databases for Arizona, Nebraska, and South Carolina found that the unadjusted 30-day all-condition readmission rate for pediatric Medicaid beneficiaries (ages 0 to 20 years old, including newborns but excluding obstetric patients) was 3.1%, compared with 2.0% for privately insured children ($p < 0.05$) [17]. Within the full sample of Medicaid-insured adult and pediatric patients, readmission rates were higher than for privately insured patients except for the subcategory of 13- to 20-year-old females admitted for obstetric care [17].

Readmissions at children's hospitals are likewise more frequent in publicly insured children than in patients with other insurance statuses. A study of recurrent all-condition readmissions at 37 freestanding children's hospitals found that as a patient's annual readmission frequency increased from 0 to ≥ 4 readmissions, the rate at which patients were publicly insured correspondingly increased from 40.9% (0 readmissions) to 56.3% (≥ 4 readmissions) ($p < .001$) [16]. Public (versus commercial) insurance remained significantly associated with readmission risk in multivariate analysis (odds ratio [OR] 1.36, 95% CI 1.33-1.40) [16]. Similarly, in an analysis of all-condition readmissions at 72 freestanding and non-freestanding children's hospitals, the unadjusted readmission rate was highest for publicly insured patients (6.9%), followed by those who had other insurance (6.2%), private insurance (5.9%), and no insurance (4.5%) ($p < .001$) [19]. Public (versus private) insurance was a significant risk factor for readmission in multivariate analysis (OR 1.12, 95% CI 1.09-1.15) [19].

Given their higher risk of readmission, publicly insured children are a vulnerable population for whom targeted interventions to reduce readmissions are critical. The percentage of pediatric hospitalizations for which Medicaid is the primary payer is substantial and increasing: Medicaid is the single largest payer for hospitalized children and accounted for 44% of pediatric admissions in 2007, up from 36% in 2000 [20, 21].

Interventions that reduce hospital readmissions by improving hospital discharge, transition, and post-discharge care, as well as disease management should be beneficial to all patients, including those insured by Medicaid. Interventions that specifically address the complex needs of Medicaid-insured patients, such as limited resources for healthcare and barriers to accessing care, may be particularly effective in reducing readmission rates in this group. Successful interventions to prevent readmissions in Medicaid-insured patients are described in the literature.

The Care Transitions Innovation (i.e., C-Train) is a low-cost, multi-component transitional care intervention that has decreased readmission rates in uninsured and Medicaid-insured adult populations [22]. The intervention helps remove financial barriers to care by providing inpatient pharmacy consultation, a 30-day supply of medications for use after discharge, payment for medical homes for uninsured patients who lack access to outpatient care, and access to a transitional care nurse to bridge care between the inpatient and outpatient settings. This low-cost intervention illustrates how investing a relatively small amount of resources upfront could potentially avert the much greater cost of hospital readmission.

North Carolina has demonstrated that interventions implemented via a Medicaid program can be highly effective in reducing readmissions. Its state-wide initiative focused on comprehensive transitional care for Medicaid beneficiaries of any age with complex chronic medical conditions, with the intensity of the intervention tailored to patients' readmission risk [23]. Patients who received the intervention were 20% less likely to experience a readmission during the subsequent year than clinically similar patients who received routine care. Additionally, patients who received the transitional care were less likely than routine-care patients to experience multiple readmissions. These findings suggest that transitional care interventions targeted to address the particular needs of Medicaid-insured patients can reduce hospital readmissions among this high-risk population. The Pediatric All-Condition Readmission Measure could be used to track the impact of similar interventions in Medicaid-insured children.

Empirical Data

We assessed disparities in readmission risk associated with insurance status using our Pediatric All-Condition Readmission Measure. We performed multivariate analysis for community and children's hospitals in 2005-2009 AHRQ HCUP State Inpatient Databases with Revisit Data for New York and Nebraska. We found that compared with

Medicaid-insured patients, the odds of readmission were significantly lower for those who had private insurance (AOR 0.76, 95% CI [0.75 - 0.78]), other types of insurance (such as Medicare or other government-sponsored insurance) (AOR 0.85, 95% CI [0.78-0.92]), or self-pay status (AOR 0.73, 95% CI [0.69-0.78]). Medicaid insurance was a risk factor independent of patient age, gender, and chronic conditions and of index admission hospital.

Using the same data, we also evaluated whether a given hospital's readmission performance tends to correlate among patients with different insurance statuses. We fitted the measure case-mix model, adding a random slope indicator variable for Medicaid, private insurance, and self-pay statuses (we were unable to include an indicator variable for other types of insurance because the model would not converge, perhaps due to low numbers of observations in this category at some hospitals). We found that the regression coefficients were highly correlated among different insurance statuses. Correlations were 0.84 for Medicaid and self-pay, 0.92 for Medicaid and private insurance, and 0.90 for private insurance and self-pay. This finding indicates that readmission rates tend to vary in parallel for all insurance categories, which suggests that a hospital's adjusted readmission rate is a valid measure of performance (relative to other hospitals) for children with all insurance statuses.

QUESTION 2: Describe the relationship between the SDS risk factor(s) and the measured unit (hospital, SNF, etc.) to indicate the variation in the risk factor across the measured unit. Information from the literature is sufficient to indicate potential variation; however, empirical data for the

measure as specified (e.g., via bivariate frequency distributions) would be needed to demonstrate that variation does not exist and therefore adjustment is not appropriate.

The percentage of admissions that are for Medicaid-insured patients varies across hospitals and is substantially greater in some hospitals than others [24]. We found in 2005-2009 AHRQ HCUP State Inpatient Databases with Revisit Data

for New York and Nebraska that the overall percentage of pediatric all-condition index hospitalizations at community and children's hospitals for which Medicaid was the primary payer was 47.7%. Because hospitals with very low pediatric volume might be outliers, we did not rely on observed sample hospital-level percentages to assess variation across hospitals. We instead estimated a random effects logistic regression to model the distribution of Medicaid rates at the hospital level. We found that the mean percentage of Medicaid hospitalizations was 41.8%; the percentage was 59.6% for hospitals 1 standard deviation above the mean and 26.0% for hospitals 1 standard deviation below the mean.

QUESTION 3: What are the patient-level sociodemographic variables that are available in the datasets used to develop the measure?

The only sociodemographic variable available in the datasets we used to develop this measure was insurance status in the 2009 AHRQ HCUP State Inpatient Databases with Revisit Data for New York and Nebraska. In addition, we plan to use the New York State 2013 Medicaid and all payer datasets that include the following variables: (1) individual-level insurance status and (2) census tract data to allow for determining neighborhood-level income and education.

QUESTION 4: How well do the patient-level SDS variables that are available represent the underlying conceptual relationship identified?

Insurance status, income, and education represent the underlying conceptual relationship identified. As stated above, SDS as measured by these variables can affect health directly, as well as indirectly by having an impact on self- management, adherence to recommendations, and access to care.

QUESTION 5: Appendix (includes literature review, reference list, etc.)

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Measure: NQF #2496 - Standardized Readmission Ratio (SRR) for dialysis facilities

QUESTION 1: Describe the conceptual relationship between your outcome measure and possible SDS risk factors. Specifically, provide support from the literature or other empirical data on whether a conceptual relationship exists between at least one (1) specific SDS risk factor and the outcome being measured. Describe the possible risk factor(s) that exhibits the strongest relationship to admissions/readmissions. Possible SDS risk factors for examination may include income, level of education, homelessness status, English language proficiency, health insurance status, occupation, employment status, literacy, health literacy, or neighborhood-level data that can be used as a proxy for individual data such as median neighborhood income, education, or local funding availability for safety net providers.

The Standardized Readmission Ratio, as a systematic measure of the rate of unplanned readmissions at dialysis facilities, can help to improve coordinated care and provide cost-effective health care for the end stage renal patients. There has been increasing interest in exploring the relation of hospital readmissions for dialysis patients with patient characteristics such as income, education, insurance status, race, and employment status. However, many existing studies of this set of relationships were conducted in other health care situations, such as in nursing homes, hospitals. Among the few studies on readmissions in the dialysis facility setting, patient level SDS factors are either not included in the analyses, or they are included as basic controls without any conceptual pathway describing the relationship between these factors and readmissions. For example, the focus of the analysis by Erikson et al (2014) is to examine frequency of physician visits, subsequent to a discharge, and the impact on preventing readmissions. While the analysis included race and sex in the descriptive statistics and models, these were considered as basic patient level controls. It may not be appropriate to extrapolate about the empirical relationship between these SDS patient-level factors and readmissions on the basis of this study.

In addition, much of the work on socio-demographic (SDS) factors and readmissions has been done at the geographic level, as opposed to the individual patient level. For example, Philbin et al. (2001) found substantially higher risks of readmission for persons residing in low income ZIP codes. These results held after controlling for comorbidities, location of care, and a fairly full set of other SDS characteristics, including age, sex, race and insurance, as measured at the ZIP code level. All SDS characteristics in the model were also associated with odds of readmission.

Foster et al. (2014) applied the Community Need Index (CNI) developed by Truven Health Analytics to analyze variation in all-cause hospital readmission, with and without adjustment for socioeconomic (SES) characteristics and race. The CNI is calculated at the ZIP code level and reflects potential barriers to

effective health care, including income, ethnicity, education, insurance and housing quality. The results show that standardizing for SES characteristics and race reduces the variation in readmission across hospitals, potentially resulting in a fairer comparison of readmission rates.

Singh has developed the Area Deprivation Index (ADI) with colleagues at the University of Wisconsin. Like the CNI, the ADI reflects a full set of SES and demographic characteristics, measured at the ZIP code level. Singh (2003) has applied the index in a variety of contexts, including analysis of county-level mortality rates. He found area differences in mortality associated with low SDS. Over the period studied, mortality differences widened because of slower mortality reductions in more deprived areas. Very recently, the ADI has been applied to the calculation of risk-adjusted rates of hospital readmission.

QUESTION 2: Describe the relationship between the SDS risk factor(s) and the measured unit (hospital, SNF, etc.) to indicate the variation in the risk factor across the measured unit. Information from the literature is sufficient to indicate potential variation; however, empirical data for the measure as specified (e.g., via bivariate frequency distributions) would be needed to demonstrate that variation does not exist and therefore adjustment is not appropriate.

The studies mentioned in our response to Question #2 have provided evidence that, at least at a conceptual level, patient SDS characteristics may affect the likelihood of hospital readmission among dialysis patients. To further explore this hypothesis, we conducted preliminary analyses of the relationships between select SDS characteristics and the Standardized Readmission Ratio (SRR) for dialysis facilities, using the 2012 national ESRD database, which comprises Medicare claims, CROWN data, CMS' ESRD Medical evidence form, CMS' Death Notification Form and UNOS transplant data, among other data sources. The database comprises more than 600,000 patients from 6,000+ facilities.

Relationship between patients' estimated income and SRR

As a proxy for patients' estimated income, we used the median income for each discharged patient's ZIP code of residence on the discharge date. In the model, income was categorized by quartiles. The estimated odds ratio of readmission was found to decrease slightly but steadily as the estimated income level increases. Compared with the first quartile (i.e., the lowest income level), the odds ratios were 0.995 ($p>0.05$), 0.975 ($p<0.01$) and 0.95 ($p<0.001$) for quartiles 2, 3 and 4, respectively. Thus, there is some indication that patients who reside in ZIP codes with higher median income have somewhat lower readmission rates than those living in ZIP codes with lower median income, although the effect is somewhat modest.

Using 2012 data, we compare the SRRs computed with and without adjustment for median income and examine the median SRR of facilities, by quintiles according to the facility average income of hospitalized patients in the facility. First, we note the non-SDS-adjusted and SDS-adjusted SRRs, respectively, are very

comparable (Q1: 1.00 vs 0.99; QUESTION 1: 0.99 vs 0.99; QUESTION 2: 0.98 vs 0.98; QUESTION 3: 1.00 vs 1.00; QUESTION 4: 1.01 vs 1.02). Second, the relative consistency of these values across quintiles suggests there is no systematic change of SRRs over the range of average incomes in the population. This suggests there is no clear evidence that patients with lower economic status would tend to be treated in facilities with poorer (or better) readmission rates.

Relationship between race and ethnicity and SRR

We first studied the within-facility effects of race and ethnicity on readmission by including race and ethnicity as risk- adjusters in a mixed effects logistic regression model for readmission. We found that, within the same facilities, black patients have an odds ratio of 0.9993 for readmission compared to the non-black patients. Similarly, within the facilities, Hispanic patients have an odds ratio of 0.98 for readmission compared to those who are identified as non-Hispanic.

Both results suggest that race and ethnicity do not have a strong effect on readmissions within the same facility.

We next studied how facility-level racial and ethnic composition would affect SRR. Specifically, we examined the median SRR by facilities grouped in quintiles by their percentage of black patients and also by their percentage of Hispanic patients. First, we saw no systematic differences between the SRRs for facilities with varying percentages of Hispanic patients—when comparing the ethnicity-adjusted SRR with the non-ethnicity-adjusted SRR, the median SRR was the same for each quintile except Q5, with an unadjusted median SRR of 1.00 and an adjusted median SRR of 1.01. On the other hand, there is an obvious upward trend in the SRR among facilities with increasing proportions of black patients (median SRRs for Q1: 0.92 [unadjusted] v. 0.93 [adjusted]; median SRRs for QUESTION 4: 1.04 [unadjusted] v. 1.03 [adjusted]). This indicates that, even having accounted for the within-facility differences in readmissions between black and non- black patients, facilities with higher proportions of black patients have higher readmission rates than those with lower proportion of black patients. We plan to explore these relationships of race and readmissions further.

QUESTION 3: What are the patient-level sociodemographic variables that are available in the datasets used to develop the measure?

We plan to examine four patient-level sociodemographic variables: Patient's unemployment status six months prior to onset of ESRD; whether the patient was dually eligible for Medicare and Medicaid at index discharge (indicator of lower income); whether the patient had Medicare as secondary insurance coverage at index discharge (indicator of higher income); and patient's race.

We recognize that one or more of these patient-level SDS factors are likely associated with one another particularly if they are collectively considered as constituent characteristics of area-level SDS factors. Based on studies and related literature cited here, there has been an observed interrelationship between area-level structural factors such as neighborhood-level poverty concentration, history of discrimination, crime levels, and racial segregation, that adversely impact access to care and health promoting resources (e.g., proximity to healthy foods, pharmacies, safe outside areas for activity) and in turn high comorbidity and poorer health outcomes such as higher readmissions for those populations living in high poverty or segregated areas. Often these populations are from historically disadvantaged racial and ethnic groups. Both patient- level and area-level variables are assumed to be independently and jointly associated with readmissions. For example, Kind et al found that "patients in the most disadvantaged neighborhoods were more likely to be black, on Medicaid, and had greater rates of comorbidities" (Kind et al Annals Int Med 2014, p769).

QUESTION 4: How well do the patient-level SDS variables that are available represent the underlying conceptual relationship identified?

Race, income, and relatedly unemployment and insurance status may be associated with readmissions. However it is important to recognize one or more of these patient-level SDS factors likely shares an association with one another, such as race and income. For example, an observed relationship of race and higher readmissions could also be reflecting in part the unmeasured influence of a higher portion of patients in a specific race or ethnic group with lower income, Medicaid/dual eligible status, or unemployment. Similarly, there is interplay between area level structural factors (neighborhood poverty; history of discrimination) that impact access to care, leading to poorer health for those populations living in high poverty areas, and who are from historically disadvantaged racial and ethnic groups, and in turn experience higher readmissions. For example, Kind et al found that "patients in the most disadvantaged neighborhoods were more likely to be black, on Medicaid, and had greater rates of comorbidities" (Kind et al Annals Int Med 2014, p769). With that said we describe the conceptual relationship between each patient-level SDS factor and readmissions.

Unemployment status six months prior to ESRD-onset: This could adversely impact patients' ability to have access to sufficient pre-ESRD care, and in turn increase their risk of an emergent dialysis start, and have higher or greater acuity of their comorbidity burden that may result in frequent re-hospitalizations due to their rapidly declining health. We also acknowledge unemployment status is likely associated with other SDS factors, such as income and insurance coverage.

Lower income status (dual Medicare/Medicaid eligibility status at index discharge): In the general population lower income patients tend to have higher readmission rates (MedPAC Chapter 4, June 2013). It is anticipated this would be more pronounced for the ESRD population given their typically

higher comorbidity burden. Lower income indicates lower available resources to obtain primary care or have access to other care, medications, and so forth that could help prevent readmissions after discharge.

Higher income status (Medicare as Secondary Payer at index discharge): Conversely, while lower income patients tend to have higher readmission rates, as a by-product of less access to care and limited resources, we expect that patients with Medicare secondary payer status are those who have private insurance (either as employees, or through a spouse or parent) and have necessary resources to receive adequate care subsequent to their hospital discharge. They likely have access to a primary care provider, medications, and other health care resources post-discharge that can reduce the risk of a subsequent readmission.

Patient Race: The impact of patient race (black race) on readmissions has been observed in the general population (e.g., Kind et al 2014). It is possible this may also reflect confounding related to other SDS factors, therefore race per se may not be the primary risk factor but could reflect the outcome of care in facilities with a higher percent of poor

patients that are black. Poorer patients likely have poorer health status and face access to care obstacles. After a discharge they may be more vulnerable to readmission in the absence of sufficient follow-up care and access or resources for medications, and other post-follow-up care. Race could also reflect a real disparity in care where historical or cultural and societal barriers reify the provision of care. For example, facilities may also be in impoverished and racially segregated areas that have been found to be associated with higher readmissions (Williams and Collins 2001).

We caveat that adjusting for the above patient-level SDS factors has the potential to lower the standard of care for patients based on race, (lower) income status, and unemployment status if care is not taken to disentangle factors modifiable (discrimination and disparate care delivery) and non-modifiable (higher comorbidity burden) by dialysis facilities.

Finally, the four variables listed in our response to Question #4 represent many of the broad SDS categories (e.g., income, insurance coverage, cultural barriers). In an effort to examine SDS categories not represented by these four available patient-level adjustors (e.g., education, housing barriers), we plan to examine ZIP code-level variables available from Census data.

QUESTION 5: Appendix (includes literature review, reference list, etc.)

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Measure: NQF #2510: Skilled Nursing Facility 30-Day All-Cause Readmission Measure (SNFRM)

QUESTION 1: Describe the conceptual relationship between your outcome measure and possible SDS risk factors. Specifically, provide support from the literature or other empirical data on whether a conceptual relationship exists between at least one (1) specific SDS risk factor and the outcome being measured. Describe the possible risk factor(s) that exhibits the strongest relationship to admissions/readmissions. Possible SDS risk factors for examination may include income, level of education, homelessness status, English language proficiency, health insurance status, occupation, employment status, literacy, health literacy, or

neighborhood-level data that can be used as a proxy for individual data such as median neighborhood income, education, or local funding availability for safety net providers.

The potential relationship between SDS risk factors and the outcome of hospital readmissions for Skilled Nursing Facility (SNF) patients is plausible; however, the literature on such relationships specific to this setting is not extensive. Research has found that racial and socio-demographic disparities exist both in the quality of nursing facilities as well as in hospital readmission rates. Any discussion of disparities in hospitalization or hospital readmission rates should acknowledge the potential influence of differences in preferences for intensity of intervention by patient subgroups.

Additionally, previous studies suggest that these disparities arise from vulnerable populations being admitted disproportionately into poorer quality homes, rather than patients or residents receiving care at different levels of quality by race within the same facility (Mor et al., 2004; Cai, Mukamel, Temkin-Greener 2010). Studies have suggested that a contributing factor to systematically poorer quality care among facilities providing services to disproportionately more low socio-demographic residents or patients is the lack of resources to dedicate to quality improvement (Mor et al., 2004).

Multiple studies have found that nursing facilities with higher proportions of minority and low socio-economic status residents tend to have poorer results on quality of care indicators, and that African-Americans have higher rates of hospital readmission (Howard et al., 2002; Mor et al., 2004; Grabowski 2004; Silverstein et al., 2008; Jencks, Williams, and Coleman 2009). Prior research has shown that racial disparities exist in care provided to nursing home residents with respect to occurrence of pressure sores (Li, Yue, et al., 2011a) and provision of influenza and pneumococcal vaccination (Li, Yue, Mukamel, 2010), and data indicate that these racial disparities persist for hospital readmissions. Using data from a large health maintenance organization and fee-for-service Medicare claims for patients with a stroke occurring in the 2-year period 1998-2000, African-American race was a significant predictor of experiencing at least one complicated transition defined as moving from a less to a more intense care

setting after hospital discharge. Patients who had had multiple complicated transitions were 38 percent more likely to be African-American (Kind et al., 2008).

Another study analyzing hospital readmission rates using Medicare claims data from 2003-2004 found that African- Americans had a nearly 6 percent higher risk of rehospitalization within 30 days of hospital discharge than those of other races (Jencks, Williams & Coleman, 2009).

Among studies specifically of hospital readmissions for patients in SNFs, one national study using MDS data found that the unadjusted 30-day readmission rate was 18.6 percent for African-American patients and 14.3 percent for White patients, resulting in an odds ratio of 1.37 (Li et al., 2011b). These differences were more marked when analyzing the 90-day readmission rate: the readmission rate for African-American patients was 29.5 percent compared to 22.1 percent for White patients, with an odds ratio of 1.48.

Recently published literature has focused on the potential relationship between unplanned readmissions and community or neighborhood-level socioeconomic characteristics that can serve as a proxy for individual-level factors. A small number of studies (Herrin et al, 2014; Kind et al, 2014; McHugh and Ma, 2013) have shown a relationship between county-level measures of low SDS (based on factors such as income, employment rate, education level, rate of home ownership and literacy) and increased rates of hospital readmission. This conceptual rationale—that neighborhood and community characteristics and general access to resources within the community influence the likelihood of readmission—will be used by the RTI team to identify potential county-level SDS factors for inclusion in the analysis.

The Medicare County Code variable specifies county of residence and has been shown to be a more reliable geographical identifier for Medicare beneficiaries than zipcode, and as such, we will focus on county-level measures of SDS for testing.

QUESTION 2: Describe the relationship between the SDS risk factor(s) and the measured unit (hospital, SNF, etc.) to indicate the variation in the risk factor across the measured unit. Information from the literature is sufficient to indicate potential variation; however, empirical data for the measure as specified (e.g., via bivariate frequency distributions) would be needed to demonstrate that variation does not exist and therefore adjustment is not appropriate.

The literature suggests that race and socio-economic status are possible patient-level risk factors that should be tested. Next, we summarize the results of our testing of these risk factors, as included in section 1b.4 of our Measure Submission Form. Our testing was limited by the availability of these

variables in our data sources (Medicare claims and administrative data). As such, we tested race (White, Black, and Other which includes the following codes: unknown, other, Asian, Hispanic, and North American native) and a proxy for low-income status (the dual eligibility indicator, a variable indicating that the patient is enrolled in both Medicare and Medicaid) in our readmission models. We conducted analyses to assess the potential impact on facilities based on their proportion of patients that were Non-White or had the dual eligibility indicator. Results of these analyses are summarized below and included in Appendix Tables 1-2 at the end of this memo.

Analyses of the distribution of patients by race shows that non-White populations are not evenly distributed across facilities. When the total number of SNFs is broken down by the percentage of patients who are non-White, there are a large proportion of facilities that have non-White populations smaller than the national average (16.5% of US population 60 and older). Under 30 percent (27.1%) of facilities have more than 16.5 percent of their patients who are non-White. 10 percent of facilities have over 40 percent non-White patients. Approximately7 percent of facilities have a majority non-White patients.

When examining whether facilities with higher percentages of non-White patients have systematically different performance scores for the SNFRM, the data suggest that the RSRR increases slightly as the percentage of non-White patients increases (see Appendix Table 1). This is consistent with prior literature showing that hospitals deemed as “minority serving” (defined as over 30% of patient served are minority) had higher readmission rates (25.5% readmitted within 30 days) than those that were “non-minority serving” (22.0% readmitted within 30 days) (Joynt 2011). Our data showed results that are less pronounced, with patients in facilities with over 30 percent non-White patients having readmission rates of 23.2 percent, versus facilities with less than 30 percent non-White patients having rates between 21.7-22.6 percent. The clustering of patients by race in facilities makes it difficult to argue for taking steps like reporting stratified measures because many facilities have very small minority populations. Prior literature examining other health outcomes has suggested that disparities in outcomes are due to differential access to quality care facilities, rather than differences in care being received by residents of different races in the same facility (Li, Yue, et al. 2011a; Li, Yue, Mukamel, 2010).

For dual eligible patients, the results were similar, in that the RSRR was higher for facilities with larger percentages of Medicaid enrollees. However, differences were small (ranging from 20.8% for facilities with the lowest percentage of dual eligible patients, to 21.6% for facilities with the highest percentage). The results are presented in Appendix Table 2.

QUESTION 3: What are the patient-level sociodemographic variables that are available in the datasets used to develop the measure?

The patient-level sociodemographic variables that are available in the Medicare claims data are Age, Sex, and the Race and the Dual Eligibility Indicator variables described in questions 1 and 2. The Dual Status Indicator is a categorical variable in the Master Beneficiary Summary File that indicates what category of dual eligibility the patient is classified

as, based on varying levels of income and assistance received . Also available is the Original Reason for Entitlement variable, which states the reason the beneficiary qualified for Medicare benefits and may allow us to adjust for beneficiaries that qualified for Medicare on the basis of disability. The MedPAR records also include a variable to note whether the patient receives Supplemental Security Income (SSI), which is an indicator of lower income. In addition, the Minimum Data Set (MDS), a standardized, primary screening and assessment tool of health status used in the SNF setting, contains a patient-level measure of marital status at time of admission and preferred language, which will also be considered for SDS adjustment.

As discussed in question 1, county-level sociodemographic variables that may be relevant to readmissions will be identified for testing. These regional variables will function as proxies for a patient's sociodemographic status and capture aspects of a patient's access to resources in his or her community. Some potential county-level variables that are available and could reflect a patient's SDS status include the median household income, employment rate, degree of urbanization, median education level and the availability of primary care providers; a panel of county-level variables will be tested for risk adjustment, both separately and as an aggregated index, during the trial period. These may be extracted from a variety of data sources, including the U.S. Census data, the Health Professional Shortage Area designation database, and other publicly available sources of county-level variables.

QUESTION 4: How well do the patient-level SDS variables that are available represent the underlying conceptual relationship identified?

As evidenced from the tables provided in the Appendix below, the patient-level SDS variables that were tested (Race and Medicaid Buy-In indicator) are indicative of a difference in readmission rate based on these factors. This suggests that these variables do capture the underlying conceptual relationship at the patient level reliably, and are likely candidates for inclusion in the SDS risk-adjustment for this measure during the trial period. Determining the degree to which disparities in care are responsible for the effect of race in particular must be investigated.

Empirical analyses have not been conducted for any county-level variables that are being considered for inclusion for SDS risk adjustment. As the trial period moves forward, RTI and CMS will identify and obtain data for the regional characteristics that represent the underlying conceptual relationship for inclusion in the risk adjustment model based on existing literature, NQF guidance and expert opinion, and we will conduct empirical analyses using these variables accordingly.

QUESTION 5: Appendix (includes literature review, reference list, etc.)

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Measure: NQF #2512 All-Cause Unplanned Readmission Measure for 30 Days Post Discharge from Long-Term Care Hospitals (LTCHs)

QUESTION 1: Describe the conceptual relationship between your outcome measure and possible SDS risk factors. Specifically, provide support from the literature or other empirical data on whether a conceptual relationship exists between at least one (1) specific SDS risk factor and the outcome being measured. Describe the possible risk factor(s) that exhibits the strongest relationship to admissions/readmissions. Possible SDS risk factors for examination may include income, level of education, homelessness status, English language proficiency, health insurance status, occupation, employment status, literacy, health literacy, or neighborhood-level data that can be used as a proxy for individual data such as median neighborhood income, education, or local funding availability for safety net providers.

The potential relationship between SDS risk factors and the outcome of readmissions post-discharge from Long-Term Care Hospitals (LTCHs) is plausible; however, there is a lack of literature on this topic specific to this setting. Evidence from readmission rates following acute-care discharge have shown disparities by race with Black beneficiaries having the highest 30-day readmission rates for acute myocardial infarction, heart failure, and pneumonia (Joynt, Orav, and Jha, 2011). Though this evidence is not specific to LTCHs, it suggests that race is one possible patient-level risk factor relevant to post-discharge readmissions that should be tested.

We included results of our testing of two SDS risk factors in section 1b.4 of our Measure Submission Form and summarize those results here. Our testing was limited by the availability of SDS variables in our data sources (Medicare claims and administrative data). As such, we tested race (White, Black, and Other which includes the following codes: unknown, other, Asian, Hispanic, and North American native) and a proxy for low-income status (Medicaid Buy-In) in our readmission models. The Buy-In variable is an indicator that a state is paying Part B premiums and/or cost sharing for beneficiaries because of low income. Buy-In policies vary by state, so although not perfect it is a reasonable measure for the effect of low-income.

Seventy-three percent of the LTCH sample was White, and the unadjusted, unplanned readmission rate was lowest for this group (22.6%) compared to the 20 percent of the sample in the Black race category which had the highest readmission rate (26.0%). Beneficiaries coded as Other for race—7.1 percent of the sample—had a higher readmission rate (24.6%) than White, but lower than Black beneficiaries. There is a high proportion of the LTCH sample with the Buy-In indicator code (41.1%), and the unadjusted, unplanned readmission rate was slightly higher than the national average.

Next, odds ratios were estimated from the logistic regression model including both race and Buy-In as risk-adjusters. In our risk-adjustment models, Black beneficiaries had about 6 percent higher odds of readmission relative to White beneficiaries, but there was no significant difference between beneficiaries in the Other race group compared to Whites. The odds of readmission for LTCH beneficiaries with the Buy-In indicator were 12 percent higher relative to those with no Buy-In indicator

for an unplanned readmission. Please refer to Appendix Tables 1-2 at the end of this memo for the results described above.

Recently published literature has focused on the potential relationship between unplanned readmissions and community or neighborhood-level socioeconomic characteristics that can serve as a proxy for individual-level factors. A small number of studies (Herrin et al, 2014; Kind et al, 2014; McHugh and Ma, 2013) have shown a relationship between county-level measures of low SDS (based on factors such as income, employment rate, education level, rate of home ownership and literacy) and increased rates of hospital readmission. This conceptual rationale—that neighborhood and community characteristics and general access to resources within the community influence the likelihood of readmission—will be used by the RTI team to identify potential county-level SDS factors for inclusion in the analysis.

The Medicare County Code variable specifies county of residence and has been shown to be a more reliable geographical identifier for Medicare beneficiaries than zipcode, and as such, we will focus on county-level measures of SDS for testing.

QUESTION 2: Describe the relationship between the SDS risk factor(s) and the measured unit (hospital, SNF, etc.) to indicate the variation in the risk factor across the measured unit. Information from the literature is sufficient to indicate potential variation; however, empirical data for the measure as specified (e.g., via bivariate frequency distributions) would be needed to demonstrate that variation does not exist and therefore adjustment is not appropriate.

In addition to analyzing the effect of including race and SES in the readmission models at the patient level, we also conducted analyses to assess the potential impact on LTCHs' readmissions rates based on their percentage of patients that were Non-White or had the Buy-In indicator. Results of these analyses are summarized below and included in Appendix Tables 3-4 at the end of this memo, as reported in section 1.b.4 of our Measure Submission Form.

Analyses of the distribution of LTCH patients by race show that Non-White populations are not evenly distributed across facilities. There were small differences in comparing LTCHs' performance on the RSRR based on facility percentages of Non-White patients. For example, LTCHs with 0 to 12 percent Non-White patients had a mean RSRR of 23.5 percent and a median of 23.5 percent compared to LTCHs with 35 percent or more Non-White patients in which the mean and median RSRRs were higher, 25.2 and 24.8 percent, respectively. These results suggest that facilities' RSRRs increase slightly as the percentage of Non-White LTCH patients increases.

For LTCH patients with the Buy-In indicator, the results were similar. There were slight increases in the RSRRs as the percentage of LTCH patients with Buy-In increased within LTCHs. For example, based on models that did not adjust for race or Buy-In, LTCHs with 0 to 30 percent Buy-In patients had a mean RSRR of 23.4 percent and a median of 23.3 percent compared to LTCHs with 47 percent or more Buy-In

patients in which the mean and median RSRRs were higher, 25.1 and 24.9 percent, respectively. In both cases it is not clear whether quality of care is a factor or some underlying factor not measured.

QUESTION 3: What are the patient-level sociodemographic variables that are available in the datasets used to develop the measure?

The patient-level sociodemographic variables that are available in the Medicare claims data are Age, Sex, and the Race and Dual Eligibility Indicator variables described in questions 1 and 2. The Dual Status Indicator is a categorical variable in the Master Beneficiary Summary File that indicates what category of dual eligibility the patient is classified as, based on varying levels of income and assistance received . Also available is the Original Reason for Entitlement variable, which states the reason the beneficiary qualified for Medicare benefits and may allow us to adjust for beneficiaries that qualified for Medicare on the basis of disability. In addition, the Long-Term Care Hospital (LTCH) Continuity Assessment Record & Evaluation (CARE) Data Set, a standardized, primary assessment tool of health status used in the LTCH setting, contains a patient-level measure of marital status at time of admission and preferred language, which will also be considered for SDS adjustment.

As discussed in question 1, county-level sociodemographic variables that may be relevant to readmissions will be identified for testing. These regional variables will function as proxies for a patient's sociodemographic status and capture aspects of a patient's access to resources in his or her community. Some potential county-level variables that are available and could reflect a patient's SDS status include the median household income, employment rate, degree of urbanization, median education level and the availability of primary care providers; a panel of county-level variables will be tested for risk adjustment, both separately and as an aggregated index, during the trial period. These may be extracted from a variety of data sources, including the U.S. Census data, the Health Professional Shortage Area designation database, and other publicly available sources of county-level variables.

QUESTION 4: How well do the patient-level SDS variables that are available represent the underlying conceptual relationship identified?

As evidenced from the tables provided in the Appendix below, the patient-level SDS variables that were tested (Race and Medicaid Buy-In indicator) are indicative of a difference in readmission rate based on these factors. This suggests that these variables do capture the underlying conceptual relationship at the patient level reliably, and are likely candidates for inclusion in the SDS risk-adjustment for this measure during the trial period. Determining the degree to which disparities in care are responsible for the effect of race in particular must be investigated.

Empirical analyses have not been conducted for any county-level variables that are being considered for inclusion for SDS risk adjustment. As the trial period moves forward, RTI and CMS will identify and obtain data for the regional characteristics that represent the underlying conceptual relationship for

inclusion in the risk adjustment model based on existing literature, NQF guidance and expert opinion, and we will conduct empirical analyses using these variables accordingly.

QUESTION 5: Appendix (includes literature review, reference list, etc.)

Herrin, J., St. Andre, J., Kenward, K., Joshi, M. S., Audet, A.-M. J. and Hines, S. C. (2015), Community Factors and Hospital Readmission Rates. Health Services Research, 50: 20–39.

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Appendix Tables Table A-1

Sample Descriptives for Race and SES Risk-Adjusters LTCH Post Discharge 2010/2011 Readmission Model (n=212,018)
Risk-Adjuster % sample with covariate % with unplanned readmission White 72.9 22.6
Black 20.0 26.0
Other 7.1 24.6
Medicaid Buy-In 41.1 25.6
Source: RTI International analysis of Medicare claims data, 2007-2012. (RTI program reference: lc35)

Table A-2

Odds Ratios for Race and SES Risk-Adjusters
LTCH Post-Discharge 2010/2011 Readmission Model Risk-Adjuster Odds Ratio 95% Confidence Interval
White REF REF
Black 1.06 1.03-1.09
Other 0.98 0.94-1.02
Medicaid Buy-In Indicator 1.12 1.09-1.14 Note: Full set of risk-adjusters not shown.
Source: RTI International analysis of Medicare claims data, 2007-2012. (RTI program reference: lc35)

Table A-3
Race: Distribution of Risk-Standardized Readmission Rate (%) by Facility Proportion Non-White Patients, 2010/2011
% of Facility Patients that are Non-White N Obs (LTCHs) Mean Minimum 25th Pctl Median 75th

Pctl Maximum
0 to <12% 116 23.5 18.1 21.8 23.5 25.1 30.6
12 to <22% 105 24.2 18.9 23.0 24.1 25.4 29.0
22 to <35% 115 24.3 17.9 23.0 24.3 25.8 28.5
35% or more 111 25.2 20.2 23.6 24.8 26.8 30.8
Total LTCHs 447 24.3 17.9 22.9 24.2 25.8 30.8
Note: The Risk-Standardized Readmission Rates reported are based on models that do not include race or Buy-In. LTCH=Long-Term Care Hospital; Obs=Observations; Pctl=Percentile.

Source: RTI analysis of Medicare claims data, 2007-2012. (RTI program references: lc38)

Table A-4

SES: Distribution of Risk-Standardized Readmission Rate (%) by Facility Proportion of Patients with Buy-In, 2010/2011
% of Facility Patients with State Buy-In during 2010/2011 N Obs (LTCHs) Mean Minimum 25th Pctl Median 75th
Pctl Maximum
0 to <30% 106 23.4 17.9 21.6 23.3 24.9 29.9
30 to <38% 121 24.3 19.5 23.0 24.1 25.4 30.1
38 to <47% 110 24.4 18.4 23.0 24.1 25.7 30.6
47% or more 110 25.1 21.2 23.9 24.9 26.4 30.8
Total LTCHs 447 24.3 17.9 22.9 24.2 25.8 30.8
Note: The Risk-Standardized Readmission Rates reported are based on models that do not include race or Buy-In. LTCH=Long-Term Care Hospital; Obs=Observations; Pctl=Percentile.

Source: RTI analysis of Medicare claims data, 2007-2012. (RTI program references: lc38)

Measure: NQF #2502 All-Cause Unplanned Readmission Measure for 30 Days Post Discharge from Inpatient Rehabilitation Facilities (IRFs)

QUESTION 1: Describe the conceptual relationship between your outcome measure and possible SDS risk factors. Specifically, provide support from the literature or other empirical data on whether a conceptual relationship exists between at least one (1) specific SDS risk factor and the outcome being measured. Describe the possible risk factor(s) that exhibits the strongest relationship to admissions/readmissions. Possible SDS risk factors for examination may include income, level of education, homelessness status, English language proficiency, health insurance status, occupation, employment status, literacy, health literacy, or neighborhood-level data that can be used as a proxy for individual data such as median neighborhood income, education, or local funding availability for safety net providers.

The potential relationship between SDS risk factors and the outcome of readmissions post-discharge from Inpatient Rehabilitation Facilities (IRFs) is plausible; however, the literature on such relationships specific to this setting is limited.

Readmission rates among patients recovering specifically from stroke were most frequently examined, and the evidence on disparities was mixed. Some studies showed no differences. For example, separately developed hierarchical models have shown that neither sex nor race is a significant predictor for either three-month (Ottenbacher et al., 2012) or six-month (Dossa, Glickman, & Berlowitz, 2011) acute rehospitalization from inpatient rehabilitation facilities. However, the former study, Ottenbacher et al. (2012), found that an interaction term between minority and depressive symptoms was significant in predicting hospital readmissions. One study of readmissions among stroke patients found differences by ethnicity suggesting certain ethnic patient populations had better readmission outcomes. In developing classification models assessing 80-180 day risk of hospital readmission post-IRF discharge for stroke patients, Hispanic men and Asian men had the lowest risk of rehospitalization compared to non-Hispanic white and African-American men (Ottenbacher et al., 2001). This finding was also identified in a study looking at 6-month hospital readmissions among older adults receiving inpatient rehabilitation after hip fracture (Ottenbacher et al., 2003). This hip fracture study found that 18.1 percent of non-Hispanic white males and 16.8 percent of African American males were rehospitalized compared to 10.1 percent of Hispanic males (Ottenbacher, et al., 2003).

Finally, a national study analyzing Medicare claims data from 2006-2011 for post-acute patients discharged from IRFs to the community for selected impairment categories found that readmission rates were highest among men and non-Hispanic blacks (Ottenbacher et al., 2014). This study also found higher readmission rates for dual eligible beneficiaries, suggesting a disparity by socio-economic status.

The literature suggests that race and socio-economic status are possible patient-level risk factors that should be tested.

Next, we summarize the results of our testing of these risk factors, as included in section 1b.4 of our Measure Submission Form. Our testing was limited by the availability of these variables in our data sources (Medicare claims and administrative data). As such, we tested race (White, Black, Other which includes the following codes: unknown, other, Asian, Hispanic, and North American native) and a proxy for low-income status (Medicaid Buy-In) in our readmission models.

About 10 percent of our sample was Black and we found that the unadjusted, unplanned readmission rate for this group was highest (15.5%). Eighty-five percent of the IRF sample included in the 2010/2011 model was White, and the unadjusted, unplanned readmission rate for this group was 13.4 percent. The remaining five percent of the sample included beneficiaries with race included in the Other category; the unadjusted, unplanned readmission rate for Other was similar to that of Whites (13.7%). Less than 19 percent of the IRF sample had the indicator for state (Medicaid) Buy-In of Medicare Part B, though the unadjusted, unplanned readmission rate was slightly higher among that group (16.0%).

In our risk-adjustment models, however, the odds of readmission for Black beneficiaries did not differ from White beneficiaries; however, there were reduced odds of readmissions for the Other race category relative to White beneficiaries. There was a significant increase in odds of readmission among beneficiaries with the Buy-In indicator— about 14 percent higher—relative to beneficiaries with no Buy-In indicator. Please refer to Appendix Tables 1-2 at the end of this memo for the results described above.

Recently published literature has focused on the potential relationship between unplanned readmissions and community or neighborhood-level socioeconomic characteristics that can serve as a proxy for individual-level factors. A small number of studies (Herrin et al, 2014; Kind et al, 2014; McHugh and Ma, 2013) have shown a relationship between county-level measures of low SDS (based on factors such as income, employment rate, education level, rate of home ownership and literacy) and increased rates of hospital readmission. This conceptual rationale—that neighborhood and community characteristics and general access to resources within the community influence the likelihood of readmission—will be used by the RTI team to identify potential county-level SDS factors for inclusion in the analysis.

The Medicare County Code variable specifies county of residence and has been shown to be a more reliable geographical identifier for Medicare beneficiaries than zipcode, and as such, we will focus on county-level measures of SDS for testing.

QUESTION 2: Describe the relationship between the SDS risk factor(s) and the measured unit (hospital, SNF, etc.) to indicate the variation in the risk factor across the measured unit. Information from the literature is sufficient to indicate potential variation; however, empirical data for the measure as specified (e.g., via bivariate frequency distributions) would be needed to demonstrate that variation does not exist and therefore adjustment is not appropriate.

In addition to analyzing the effect of including race and SES in the readmission models at the patient level, we also conducted analyses to assess the potential impact on facilities' scores based on the proportion of patients that were Non-White or had the Buy-In indicator. Results of these analyses are summarized below and included in Appendix Tables 3-4 at the end of this memo, as reported in section 1.b.4 of our Measure Submission Form. Analyses of the distribution of IRF patients by race shows that Non-White populations are not evenly distributed across facilities.

However, there were no differences in comparing IRFs' RSRRs based on facility percentages of Non-White patients. The mean RSRRs were similar, and there were only very small differences in the median RSRRs as IRFs' percentages of Non-White patients increased. Next, for IRF patients with the Buy-In indicator, a proxy for low-income status or SES, the results were similar. There were no differences in the RSRRs for facilities based on the proportion of patients with Buy-In. Note the RSRRs estimated for these analyses are based on risk-adjustment models that did not include either race or Buy-In. In both cases it is not clear whether quality of care is a factor or some underlying factor not measured.

QUESTION 3: What are the patient-level sociodemographic variables that are available in the datasets used to develop the measure?

The patient-level sociodemographic variables that are available in the Medicare claims data are Age, Sex, and the Race and Dual Eligibility Indicator variables described in questions 1 and 2. The Dual Status Indicator is a categorical variable in the Master Beneficiary Summary File that indicates what category of dual eligibility the patient is classified as, based on varying levels of income and assistance received . Also available is the Original Reason for Entitlement variable, which states the reason the beneficiary qualified for Medicare benefits and may allow us to adjust for beneficiaries that qualified for Medicare on the basis of disability. In addition, the IRF Patient Assessment Instrument (IRF-PAI), a standardized assessment tool of physical, cognitive, functional, and psychosocial status of patients, contains a patient-level measure of marital status at time of admission, which will also be considered for SDS adjustment.

As discussed in question 1, county-level sociodemographic variables that may be relevant to readmissions will be identified for testing. These regional variables will function as proxies for a patient's sociodemographic status and capture aspects of a patient's access to resources in his or her community.

Some potential county-level variables that are available and could reflect a patient's SDS status include the median household income, employment rate, degree of urbanization, median education level and the availability of primary care providers; a panel of county-level variables will be tested for risk adjustment, both separately and as an aggregated index, during the trial period. These may be extracted from a variety of data sources, including the U.S. Census data, the Health Professional Shortage Area designation database, and other publicly available sources of county-level variables.

QUESTION 4: How well do the patient-level SDS variables that are available represent the underlying conceptual relationship identified?

As evidenced from the tables provided in the Appendix below, the patient-level SDS variables that were tested (Race and Medicaid Buy-In indicator) are indicative of a difference in readmission rate based on these factors. This suggests that these variables do capture the underlying conceptual relationship at the patient level reliably, and are likely candidates for inclusion in the SDS risk-adjustment for this measure during the trial period. Determining the degree to which disparities in care are responsible for the effect of race in particular must be investigated.

Empirical analyses have not been conducted for any county-level variables that are being considered for inclusion for SDS risk adjustment. As the trial period moves forward, RTI and CMS will identify and obtain data for the regional characteristics that represent the underlying conceptual relationship for inclusion in the risk adjustment model based on existing literature, NQF guidance and expert opinion, and we will conduct empirical analyses using these variables accordingly.

QUESTION 5: Appendix (includes literature review, reference list, etc.)

References:

Dossa A, Glickman ME, Berlowitz D. Association between mental health conditions and rehospitalization, mortality, and functional outcomes in patients with stroke following inpatient rehabilitation. BMC Health Serv Res 11:311, 2011.

Herrin, J., St. Andre, J., Kenward, K., Joshi, M. S., Audet, A.-M. J. and Hines, S. C. (2015), Community Factors and Hospital Readmission Rates. Health Services Research, 50: 20–39.

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Appendix Tables Table A-1

Sample Descriptives for Race and SES Risk-Adjusters
IRF Post-Discharge 2010/2011 Readmission Model Sample Unadjusted Rates
(n=590,120)
Risk-Adjuster % sample with covariate % with unplanned readmission White 85.2 13.4
Black 10.2 15.5
Other 4.6 13.7
Medicaid Buy-In 18.7 16.0
SOURCE: RTI International analysis of Medicare claims data, 2007-2012. (RTI program reference: lc35)

Table A-2
Odds Ratios for Race and SES Risk-Adjusters
IRF Post-Discharge 2010/2011 Readmission Model Risk-Adjuster Odds Ratio 95% Confidence Interval
White REF REF
Black 0.99 0.96-1.01
Other 0.91 0.88-0.95
Medicaid Buy-In Indicator 1.14 1.11-1.16 NOTE: Full set of risk-adjusters not shown.
SOURCE: RTI International analysis of Medicare claims data, 2007-2012. (RTI program reference: lc35)

Table A-3
Race: Distribution of Risk-Standardized Readmission Rate (%) by Facility Proportion Non-White Patients, 2010/2011
% of Facility Patients that are Non-White N Obs (IRFs) Mean Minimum 25th Pctl Median 75th Pctl Maximum
0 to <5% 313 13.4 11.7 13.0 13.4 13.9 16.1
5 to <10% 271 13.4 11.2 13.0 13.4 13.8 15.5
10 to <20% 285 13.6 11.1 13.1 13.5 14.1 15.7
20% or more 302 13.5 11.8 13.1 13.6 13.9 15.6

Total IRFs 1,171 13.5 11.1 13.0 13.5 13.9 16.1
NOTE: The Risk-Standardized Readmission Rates reported are based on models that do not include race or Buy-In. IRF=Inpatient rehabilitation facility; Obs=Observations; Pctl=Percentile.
SOURCE: RTI analysis of Medicare claims data, 2007-2012. (RTI program references: lc38) Table A-4
SES: Distribution of Risk-Standardized Readmission Rate (%) by Facility Proportion of Patients with Buy-In, 2010/2011

% of Facility Patients with State Buy-In during 2010/2011 N Obs (IRFs) Mean Minimum 25th Pctl Median 75th Pctl Maximum
0 to <12% 288 13.4 11.5 13.0 13.4 13.8 15.5
12 to <17% 305 13.4 11.2 12.9 13.3 13.8 15.7
17 to <24% 291 13.5 11.1 13.1 13.5 14.0 16.1
24% or more 287 13.6 11.8 13.2 13.6 14.0 15.5
Total IRFs 1,171 13.5 11.1 13.0 13.5 13.9 16.1
NOTE: The Risk-Standardized Readmission Rates reported are based on models that do not include race or Buy-In. IRF=Inpatient rehabilitation facility; Obs=Observations; Pctl=Percentile.

SOURCE: RTI analysis of Medicare claims data, 2007-2012. (RTI program references: lc38)

Measure: NQF#2503 Hospitalizations per 1000 Medicare fee-for-service (FFS) Beneficiaries

Measure: NQF#2504: 30-day Rehospitalizations per 1000 Medicare fee-for-service (FFS) Beneficiaries

QUESTION 1: Describe the conceptual relationship between your outcome measure and possible SDS risk factors. Specifically, provide support from the literature or other empirical data on whether a conceptual relationship exists between at least one (1) specific SDS risk factor and the outcome being measured. Describe the possible risk factor(s) that exhibits the strongest relationship to admissions/readmissions. Possible SDS risk factors for examination may include income, level of education, homelessness status, English language proficiency, health insurance status, occupation, employment status, literacy, health literacy, or neighborhood-level data that can be used as a proxy for individual data such as median neighborhood income, education, or local funding availability for safety net providers.

The readmissions/1000 measure describes the readmission experience of a population of fee-for-service (FFS) Medicare beneficiaries; members of the population are defined by the geography of where they live. The measure is intended to track change in readmissions over time for a geographic region, and the SDS composition of a region's population are unlikely to change quickly, therefore we are using this measure without adjusting for the SDS of individual members. The readmissions/1000 measure probably reflects the influence of neighborhood contextual factors however, many of which are likely to be strongly correlated with socio-demographic (SD) determinants, or with personal SD factors that are often grouped into neighborhoods. What is unclear, and should be tested further, is whether or not neighborhoods of concentrated deprivation have more or less capacity to change, as many improvement initiatives focus efforts on such neighborhoods.

Published research has associated neighborhood of residence with health behaviors,1 access to food2,3 and safety,4 and outcomes such as mortality,1,5,6,7,8,9 birthweight10 and rehospitalization risk for heart failure.11 In addition, there is evidence that health indicators improve with moving persons to areas of less concentrated poverty.12,13 Previous studies of child health and mental health outcomes have established that neighborhood disadvantage is a separate risk factor beyond individual personal disadvantage, with worse health and social outcomes for persons who live in both poor families and poor neighborhoods than for persons living in poor families in less poor neighborhoods.12,14

We have recently demonstrated that a composite measure of neighborhood deprivation, based on 2000 Census data, was associated with 30-day readmission risk after hospitalizations from 2004 - 2009 for heart failure, myocardial infarction or pneumonia, and remained so after adjustment for usual patient-level socioeconomic (SE) variables such as income and dual eligibility.15

We calculated the deprivation index from 17 US Census variables using methods developed by Gopal Singh, PhD, MS, MSc.[16] Census variables used to calculate the ADI include:

- Percent of the population aged 25 and older with less than 9 years of education
- Percent of the population aged 25 and older with at least a high school diploma
- Percent employed persons aged 16 and older in white-collar occupations
- Median family income in US dollars
- Income disparity
- Median home value in US dollars
- Median gross rent in US dollars
- Median monthly mortgage in US dollars
- Percent of owner-occupied housing units
- Percent of civilian labor force population aged 16 years and older who are unemployed
- Percent of families below federal poverty level
- Percent of the population below 150% of the federal poverty threshold
- Percent of single-parent households with children less than 18 years of age
- Percent of households without a motor vehicle
- Percent of households without a telephone
- Percent of occupied housing units without complete plumbing
- Percent of households with more than 1 person per room

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1 Lantz PM, House JS, Lepkowski JM, Williams DR, Mero RP, Chen J. Socioeconomic factors, health behaviors, and mortality: results from a nationally representative prospective study of U.S. adults. JAMA. 1998;279:1703-8. [PMID: 9624022]

2 Moore LV, Diez Roux AV. Associations of neighborhood characteristics with the location and type of food stores. Am J Public Health. 2006;96:325-31. [PMID: 16380567]

3 Franco M, Diez Roux AV, Glass TA, Caballero B, Brancati FL. Neighborhood characteristics and availability of healthy foods in Baltimore. Am J Prev Med. 2008;35:561-7. [PMID: 18842389] doi:10.1016/j.amepre.2008.07.003

4 Hsieh CC, Pugh MD. Poverty, income inequality, and violent crime: a meta-analysis of recent aggregate data studies. Criminal Justice Review. 1993;18: 182-202.

5 Robert SA. Socioeconomic position and health: the independent contribution of community socioeconomic context. Annual Review of Sociology. 1999: 489-516.

6 House JS, Lepkowski JM, Kinney AM, Mero RP, Kessler RC, Herzog AR. The social stratification of aging and health. J Health Soc Behav. 1994;35:21334. [PMID: 7983335]

7 Joynt KE, Orav EJ, Jha AK. Thirty-day readmission rates for Medicare beneficiaries by race and site of care. JAMA. 2011;305:675-81. [PMID: 21325183] doi:10.1001/jama.2011.123

8 Joynt KE, Jha AK. Characteristics of hospitals receiving penalties under the Hospital Readmissions Reduction Program. JAMA. 2013;309:342-3. [PMID: 23340629] doi:10.1001/jama.2012.94856

9 Rau J. Hospitals treating the poor hardest hit by readmissions penalties. Kaiser Health News. 13 August 2012. Accessed at www.kaiserhealthnews.org /stories/2012/august/13/hospitals-treating-poor-hardest-hit-readmissions -penalties.aspx on 2 October 2014.
10 Blumenshine P, Egerter S, Barclay CJ, Cubbin C, Braveman PA. Socioeconomic disparities in adverse birth outcomes: a systematic review. Am J Prev Med. 2010;39:263-72. [PMID: 20709259] doi:10.1016/j.amepre.2010.05.012
11 Foraker RE, Rose KM, Suchindran CM, Chang PP, McNeill AM, Rosamond WD. Socioeconomic status, Medicaid coverage, clinical comorbidity, and rehospitalization or death after an incident heart failure hospitalization: Atherosclerosis Risk in Communities cohort (1987 to 2004). Circ Heart Fail. 2011;4: 308-16. [PMID: 21430286]doi:10.1161/ CIRCHEARTFAILURE.110.959031
12 Ludwig J, Duncan GJ, Gennetian LA, Katz LF, Kessler RC, Kling JR, et al. Neighborhoodeffectsonthelong-termwell-beingoflow-incomeadults.Science. 2012;337:1505-10. [PMID: 22997331]
13 Ludwig J, Sanbonmatsu L, Gennetian L, Adam E, Duncan GJ, Katz LF, et al. Neighborhoods, obesity, and diabetes—a randomized social experiment. N Engl J Med. 2011;365:1509-19. [PMID: 22010917] doi:10.1056 /NEJMsa1103216

Although neighborhood deprivation may be partially a proxy for personal SDS, we believe that it is an easier and therefore more practical approach to adjusting a regional population's readmission experience, without compromising validity.

Risk factors derived from Census data are unassociated with the effects of healthcare providers or the characteristics of the care provided. They measure slowly changing characteristics of the communities in which Medicare beneficiaries live and are present and stable from the beginning of a treatment episode and throughout that episode. They are also available in the public domain, freeing providers from having to capture these data themselves, and allowing them to fully engage in initiatives designed to address patterns of readmissions in their service areas.

QUESTION 2: Describe the relationship between the SDS risk factor(s) and the measured unit (hospital, SNF, etc.) to indicate the variation in the risk factor across the measured unit. Information from the literature is sufficient to indicate potential variation; however, empirical data for the measure as specified (e.g., via bivariate frequency distributions) would be needed to demonstrate that variation does not exist and therefore adjustment is not appropriate.

The geographic units at which both the outcome measure and the SDS adjustment factor are calculated can be set to any desired regional division. The US Census aggregates the variables used to calculate the ADI at the census tract level, and readmissions/1000 rates could be similarly assigned census tracts. Alternatively, ZIP+4 codes are the easiest method for aggregating admissions and readmissions rates, based on information from the Medicare enrollment file, and there are a number of publicly available

software packages designed to translate ZIP+4 into census tracts which could be used to match census-derived ADI scores to ZIP+4 defined readmission rates.

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14 Acevedo-Garcia D, Osypuk TL, McArdle N, Williams DR. Toward a policy-relevant analysis of geographic and racial/ethnic disparities in child health. Health Aff (Millwood). 2008;27:321-33. [PMID: 18332486] doi:10.1377 /hlthaff.27.2.321
15 Kind AJ, Jencks S, Brock J, Yu M, Bartels C, Ehlenbach W, et al. Neighborhood Socioeconomic Disadvantage and 30-Day Rehospitalization: A Retrospective Cohort Study. Ann Intern Med. 2014;161:765-774. doi:10.7326/M13-2946
16 Singh GK. Area deprivation and widening inequalities in U.S. mortality, 1969-1998. Am J Public Health. 2003;93:1137-43. [PMID: 12835199]

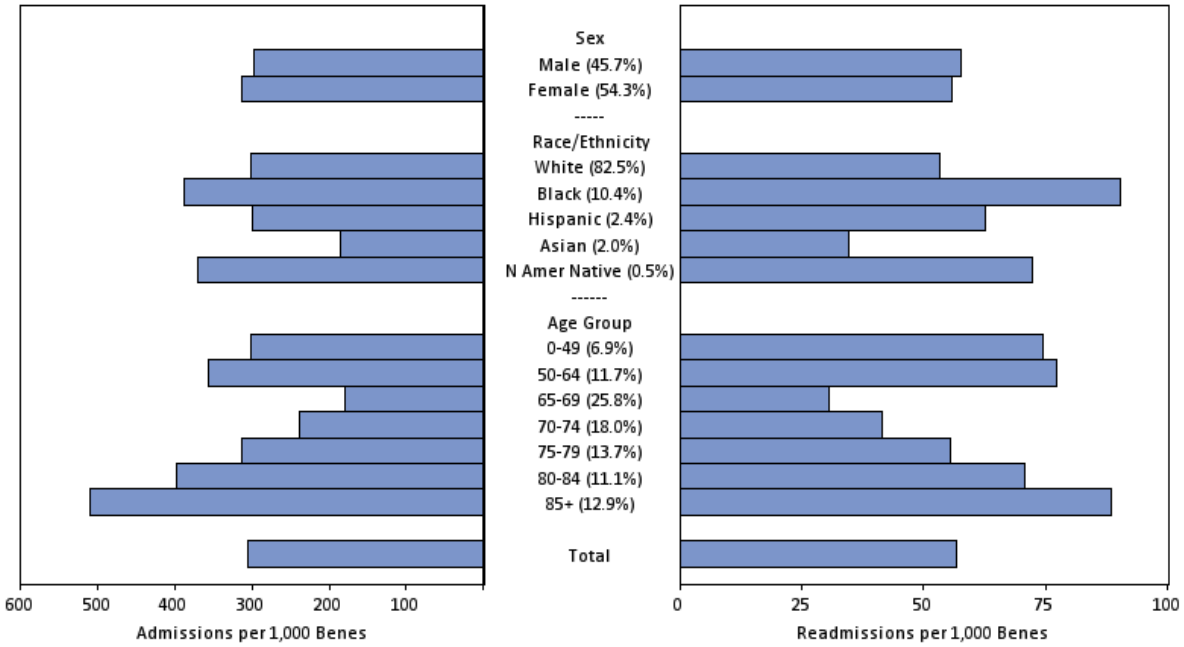
The variation in readmissions/discharges among patients hospitalized with heart failure, myocardial infarction and pneumonia varied from 21% to 27% in the published paper, with a sharp increase, or threshold, starting with the 15th percentile of most deprived neighborhoods. Geographically defined measures of readmission could be adjusted by the ADI metric as a binomial variable (significant neighborhood deprivation vs. no significant deprivation).

QUESTION 3: What are the patient-level sociodemographic variables that are available in the datasets used to develop the measure?

- Sex
- Race/ethnicity (not viewed as reliable enough)
- Age Group

QUESTION 4: How well do the patient-level SDS variables that are available represent the underlying conceptual relationship identified?

Please see the graph below that represents admissions and readmission by demographic characteristics for Calendar Year 2011 for underlying conceptual relationship with the outcomes. However, while we do not believe race/ethnicity and/or sex distributions change over time, the age distribution may. We will be exploring if the age distribution changes over time during this trial period.


Sex
Male (45.7%)
Female (54.3%)

Race/Ethnicity
White (82.5%)
Black (10.4%)
Hispanic (2.4%)
Asian (2.0%)
N Amer Native (0.5%)

Age Group
0-49 (6.9%)
50-64 (11.7%)
65-69 (25.8%)
70-74 (18.0%)
75-79 (13.7%)
80-84 (11.1%)
85+ (12.9%)
Total
600
500
400
300
200
100
Admissions per 1,000 Benes
0
25
50
75
100
Readmissions per 1,000 Benes

Measure: NQF #2514: Risk-Adjusted Coronary Artery Bypass Graft (CABG) Readmission Rate

QUESTION 1: Describe the conceptual relationship between your outcome measure and possible SDS risk factors. Specifically, provide support from the literature or other empirical data on whether a conceptual relationship exists between at least one (1) specific SDS risk factor and the outcome being measured. Describe the possible risk factor(s) that exhibits the strongest relationship to admissions/readmissions. Possible SDS risk factors for examination may include income, level of education, homelessness status, English language proficiency, health insurance status, occupation, employment status, literacy, health literacy, or neighborhood-level data that can be used as a proxy for individual data such as median neighborhood income, education, or local funding availability for safety net providers.

Current NQF policy suggests that the conditions for inclusion of SDS factors exist under the following circumstances [1]:

"Recommendation 1: When there is a conceptual relationship (i.e., logical rationale or theory) between sociodemographic factors and outcomes or processes of care and empirical evidence (e.g., statistical analysis) that sociodemographic factors affect an outcome or process of care reflected in a performance measure…those sociodemographic factors should be included in risk adjustment of the performance score (using accepted guidelines for selecting risk factors) unless there are conceptual reasons or empirical evidence indicating that adjustment is unnecessary or inappropriate…"

In the context of this NQF recommended policy, we believe that there is sufficient evidence regarding the association of SDS factors and readmission to justify the study of these factors in our Risk-Adjusted Coronary Artery Bypass Graft (CABG) Readmission Rate (NQF# #2514) measure. The following brief summary reviews the arguments and evidence.

Readmission and SES factors—Arguments pro and con[1-10]

Risk of mortality and other short-term clinical outcomes is mostly influenced by clinical factors present on admission, such as cardiogenic shock. By convention, given the plausible causal pathways leading to these outcomes, risk models used for mortality profiling have generally excluded non-clinical patient factors or local environmental factors, as their inclusion might theoretically adjust out important inequities in care.

Historically, the same general approaches have been used for readmission models. However, compared with the risk of early clinical events such as mortality, readmission risk is associated with a broader and more complex range of predisposing factors, which vary in the degree to which they are under the control of the index hospital. There is broad consensus in the literature that non-clinical patient factors (e.g., race, ethnicity, socioeconomic status) and local environmental factors (e.g., availability and quality of post-discharge healthcare services) are associated with readmissions and probably to a greater extent than they are with early clinical outcomes such as mortality (See Appendix—Literature Review). Although these factors may all confound the apparent association between quality of care and readmission, by convention, they have not been included in profiling risk models, although they are perfectly acceptable and even desirable for use by hospitals in identifying patients for targeted interventions to reduce readmissions.

Recently, because of the disproportionate impact of such non-clinical variables on the risk of readmission compared with mortality, and because certain hospitals care for much higher proportions of vulnerable populations, many have questioned whether this policy should be reconsidered for readmission models. Under the Hospital Readmissions Reduction Program, hospitals are penalized for readmission rates that are higher than expected, and these rates are currently adjusted only for patient clinical comorbidities. This has resulted in disproportionate penalties to hospitals serving disadvantaged populations. Joynt and Jha [7] note that the proportion of hospitals receiving penalties and the magnitude of penalties are directly related to the percentage of their patients receiving Supplemental Security Income. Lipstein and Dunagan [4] report that in the St. Louis area, the four hospitals with the highest poverty index also had the highest readmission rates and in some cases the highest penalties, potentially jeopardizing their financial survival.

Hospitals caring for the most vulnerable populations argue for SDS adjustment in order to avoid penalties for excess readmissions which they believe are inevitable given their patient populations. If readmissions are thought to be strongly associated with non-clinical factors in the external environment (e.g., a lack of community resources, poor living environment), then it is a societal and health delivery system problem of a larger scale than could be addressed by most hospitals. Hospitals serving predominately vulnerable patients, those at highest risk for readmission, may simply not have the necessary resources to broadly implement readmission-mitigation interventions in a non-research setting.

While summary Hospital Compare Chartbook data [11] suggest that some hospitals serving higher proportions of Medicaid or African American populations have readmission rates comparable to those serving wealthier non-minority populations (i.e., substantial overlap), the distributions of readmission rates for hospitals serving more vulnerable populations show higher rates at every quantile examined [11-13]. It seems unlikely that all such hospitals will be able to institute the interventions necessary to

overcome major social and local environmental challenges. As pointed out by Lipstein and Dunagan [4], "Although some safety-net providers across the United States are able to keep readmission rates below national averages, policymakers should not assume that all safety-net providers are equally resourced at the local level so that the playing field is, indeed, level. It is not. Some of these hospitals receive substantial economic support from local taxing jurisdictions; others receive no local funding. The former may well have the necessary patient care infrastructure to manage discharged patients in an outpatient or home setting; the latter probably do not."

Reimbursement penalties for excess readmissions may thus "make the poor poorer", a potential unintended negative consequence. If some hospitals caring for the most disadvantaged populations are financially unable to positively impact the local outpatient environment, perhaps the most important determinant of readmission for many conditions, then penalizing them will further reduce their effectiveness, and disparity gaps will widen. Such hospitals may also be increasingly reluctant to care for the neediest patients because they are the most likely to require readmission, a form of risk aversion that will reduce access to care for these patients.

On the other hand, some experts are concerned that inclusion of SDS adjustment to readmission measures would make poor outcomes in disadvantaged patients "expected", in the same way we expect worse outcomes in patients who have multiple comorbidities, and that this would essentially adjust away disparities in care (importantly, as pointed out in the NQF policy report [1], "expected" in this sense does not refer to ethical or moral acceptability but rather to the statistical output of a risk algorithm). These experts argue that if such patients were appropriately identified by hospitals before discharge, targeted interventions (e.g., more intensive follow-up phone calls) might reduce the subsequent need for readmission. Those holding this view argue that knowledge of the external environment and home living situation of patients is within the purview of hospitals, which then have a responsibility to focus additional post-discharge resources on patients from such environments.

Strategies for dealing with the effect of SDS factors

The preceding considerations have stimulated debate regarding ways in which the legitimate goal of reducing readmissions may be incentivized, while at the same time limiting the potential for unintended negative consequences. Many alternative or adjunctive strategies have been recommended [1-10]. These include the investigation of readmission profiling models with and without SDS variables, and comparison with stratified results (as in the NQF recommendation); comparison of safety-net hospitals' readmission performance with that of other similar hospitals rather than those serving less vulnerable populations; assessing improvements in readmissions rates over time rather

than absolute values only; slower phasing in of readmission penalties; incentives for reducing disparities in care; and the use of process measures that incentivize effective transitions and care coordination. Additional funding might also be considered for hospitals serving vulnerable populations to assist them in developing and implementing programs to reduce readmissions (the opposite of current plans to penalize such hospitals).

Summary

We believe the preponderance of evidence suggests an association between SDS factors and readmission rates, and this has profound implications for the health care system if not addressed.

Notwithstanding many excellent suggestions and strongly held beliefs, the best way to deal with this issue has yet to be determined. There is very little information regarding this topic in the CABG population. Therefore, with the permission of NQF, and contingent upon our ability to secure funding support, STS requests that our CABG readmission measure enter the NQF trial period.

We appreciate the opportunity to share our thoughts and recommendation with the NQF All-Cause Admissions and Readmissions Standing Committee. Thank you for your thoughtful consideration.

QUESTION 2: Describe the relationship between the SDS risk factor(s) and the measured unit (hospital, SNF, etc.) to indicate the variation in the risk factor across the measured unit. Information from the literature is sufficient to indicate potential variation; however, empirical data for the measure as specified (e.g., via bivariate frequency distributions) would be needed to demonstrate that variation does not exist and therefore adjustment is not appropriate.

Please refer to response in #2 above.

QUESTION 3: What are the patient-level sociodemographic variables that are available in the datasets used to develop the measure?

Payor/insurance variables are available in the STS Adult Cardiac Surgery Database, and STS plans to use dual-eligible beneficiary status (i.e., those qualifying for both Medicare and Medicaid benefits) as its SDS risk factor. As described below, dual-eligible beneficiary status is a suitable surrogate for SDS.

STS considered geocoding patients' addresses as a proxy for SDS; however, the rate of missing data for this field was too high in the STS Adult Cardiac Surgery Database. STS will explore the possibility of

obtaining patients' addresses from CMS data, which STS representatives will be prepared to discuss during the webinar on September 14.

QUESTION 4: How well do the patient-level SDS variables that are available represent the underlying conceptual relationship identified?

STS believes that there is sufficient evidence to support the fact that dual-eligible beneficiary status well represents the underlying conceptual relationship between SDS factors and readmission.

Prior research indicates a relationship between dual-eligible beneficiary status and the outcome of readmission. Bennett and Probst[1] studied readmission rates of dual-eligible vs. Medicare-only beneficiaries. While dual-eligible beneficiaries represented 19% of Medicare and 14% of Medicaid enrollment in 2009, they generated 34% of expenditures in both programs. In the analysis reported by Bennett and Probst, of Medicare discharges among dually eligible beneficiaries, 21.5% resulted in a 30-day rehospitalization. Meanwhile, of Medicare discharges among Medicare-only beneficiaries, 12.8% resulted in a 30-day rehospitalization.

Similarly, a recent study by Inovalon [2] reported that dual-eligible beneficiaries were at higher risk for readmission in comparison with non-dual-eligible beneficiaries.

In addition to the prior research that indicates a relationship between dual-eligible beneficiary status as a surrogate for SDS and the outcome of readmission, it is clear that a logical relationship and theory exists about the relationship between SDS and the outcome. Dual-eligible beneficiary status is associated with patients who have fewer resources available to them to support their healthcare and prevent readmission.

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QUESTION 5: Appendix (includes literature review, reference list, etc.)

Appendix: Readmission and SDS factors—Focused Literature Review

In a study of nearly 12,000 patients in Massachusetts hospitals, Weissman and colleagues [15] found that patients were more likely to be readmitted within 60 days if they were poor (adjusted OR = 1.25, $p < .05$), worked in unskilled or semiskilled occupations (adjusted OR = 1.25, $p < .05$), or rented their homes (adjusted OR = 1.23, $p < .01$). Philbin and colleagues [16] studied readmission risk among 41,776 New York heart failure patients in 1995. Patients living in lower income neighborhoods were more often women or African-Americans, they had more comorbid illnesses, more frequently used Medicaid insurance, and were more often admitted to rural hospitals. The crude frequency of readmission decreased from the lowest quartile of income (23.2%) to the highest (20.0%, $p <0.0001$). Even after adjustment for baseline differences and care processes, income was still a significant predictor, with an increased readmission risk for lower levels of income (adjusted odds ratio for comparing quartile 1 to quartile 4, 1.18; 95% CI 1.10- 1.26, $p <0.0001$).

Amarasingham and colleagues [17] developed a real-time predictive model to identify hospitalized heart failure patients at high risk for readmission or death, using data from a major urban medical center collected in 2007-2008. As in virtually all other studies, this readmission model had inferior predictive performance compared with mortality risk models. However, discrimination of their electronic readmission model (c-index 0.72) was superior to that of most other readmission algorithms, including the CMS model. Variables for social instability and lower socioeconomic status were largely responsible for the improved performance of the readmission model, as demonstrated by c-indices with and without these variables (0.72 vs. 0.61, $p < 0.05$). The authors conclude that the addition of complex social factors may significantly enhance performance of readmission models. This view is further supported by the work of Rathore and colleagues [18] who found that low SES heart failure patients had a higher risk of readmission (RR 1.08, 95% 1.03– 1.12).

Joynt and colleagues [19] studied Medicare fee-for-service patients who had readmissions for heart failure, MI, and pneumonia between 2006 and 2008. Black patients had higher readmission rates than white patients (24.8% vs 22.6%, OR 1.13; 95% CI, 1.11-1.14), and patients from minority-serving hospitals had higher readmission rates than those from non-minority-serving hospitals (25.5% vs 22.0%, OR 1.23; 95% CI, 1.20-1.27). Compared with white patients from non- minority serving hospitals, black MI patients from minority-serving hospitals had the highest readmission rate (26.4% vs. 20.9%; OR 1.35; 95% CI 1.28-1.42), while white patients from minority-serving hospitals had a 24.6% readmission rate (OR, 1.23; 95% CI, 1.18-1.29). Black patients from non-minority-serving hospitals had a 23.3% readmission rate (OR 1.20; 95% CI 1.16-1.23). Patterns were similar for CHF and pneumonia, and the results suggest that site of care may be at least as important a predictor of readmission risk as race. This

may reflect the financial inability of hospitals serving predominately minority populations to plan and execute coordinated post-discharge care. Commenting on these findings, Hernandez and Curtis [20] conclude that hospitals serving large minority populations may be penalized to a proportionately greater extent by impending reimbursement changes tied to higher than average readmission rates.

Many of these factors are a failure of the health care and societal support systems rather than a particular hospital [21]. The authors argue that if inferior care is being provided to patients solely because of race, then this should not be included in risk models as it masks disparate care. On the other hand, if black race is a proxy for socioeconomic or other markers of vulnerable populations that are unrelated to in-hospital care and outside the control of hospitals, then failure to include this in risk models may result in widening of disparities. It may be unreasonable for hospitals serving low income areas to be held responsible for assuring effective care transitions and outpatient care if the local community environment does not have the necessary resources. The authors conclude that current plans to penalize hospitals based on readmission rates, at least as currently calculated, have the potential of harming the hospitals most in need of support, and that the result may be a progressive widening of disparities.

Kansagara and colleagues [22] conducted a comprehensive review of risk prediction models for hospital readmission. Thirty studies of 26 unique risk models met their search criteria. Fourteen models were derived from retrospective administrative data and were thought to be potentially useful for comparative hospital profiling. Nine of these were tested in large US studies and demonstrated predictive discrimination (c-index 0.55 - 0.65) that was poor compared with most mortality prediction models, including the three current CMS models [23] for AMI [24], heart failure [25], and pneumonia [26] which have c-indices of 0.61-0.63. Three studies used real-time administrative data collected during the hospitalization to identify patients at high risk of readmission for targeted interventions. Because they were not being used for hospital profiling, these models included a broad range of social factors such as number of address changes, census tract socioeconomic status, cocaine use, marital status, in addition to comorbidities and prior use of medical services. The discrimination of these models (0.69-0.72) was superior to that of profiling models with more limited range of variables, which suggests that social factors play an important role in the risk of readmission.

Arbaje and colleagues [14] found that among Medicare beneficiaries, after adjusting for demographics and clinical status, the odds of early readmission were increased by living alone (odds ratio or OR = 1.50, 95% confidence interval or CI = 1.01-2.24), having unmet functional need (OR = 1.48, 95% CI = 1.04-2.10), lacking self-management skills (OR

= 1.44, 95% CI = 1.03-2.02), and having limited education (OR = 1.42, 95% CI = 1.01-2.02). Using the Singh census block area deprivation index (ADI) and a 5% Medicare sample from 2004 to 2009, Kind and

colleagues [28] found that within the most disadvantaged 15% of neighborhoods, rehospitalization rates increased from 22% to 27% with worsening ADI, even with full adjustment. The magnitude of this effect was comparable to that of chronic pulmonary disease and actually greater than that of uncomplicated diabetes. In a study of 30-day readmission rates for a variety of surgical procedures, using Medicare data from 2007 to 2010, Tsai and colleagues [27] found that "Black patients had higher readmission rates than white patients (14.8% vs 12.8%, odds ratio [OR] 1.19; 95% confidence interval [CI], 1.16– 1.22; P < 0.001). Patients undergoing major surgery at minority-serving hospitals also had higher readmission rates (14.3% vs 12.8%, OR 1.14, 95%CI 1.09–1.19; P < 0.001). In multivariate analyses, black patients at minority serving hospitals had the highest overall odds of readmissions (OR 1.34). White patients at minority-serving hospitals (OR 1.15) and black patients at non–minority-serving hospitals (OR 1.20) also had higher odds of readmission than the reference group of white patients at non–minority-serving hospitals. Racial disparities were mediated in part by poverty."

In a study of patients at Henry Ford Hospital, Hu and colleagues [8] found that patients living in high-poverty neighborhoods were 24 percent more likely than others to be readmitted, after adjustment for demographic characteristics and clinical conditions. Married patients were less likely to be readmitted, perhaps because they had more social support.

In their comprehensive review, Calvillo-King and colleagues [29] found that "Our systematic review identified 72 studies that had some information on the impact of social factors on risk of readmission or mortality in patients with CAP and HF… a broad spectrum of social factors were associated with worse outcomes in two common but different conditions: CAP, an acute infectious illness, and HF, a chronic disease with acute exacerbations. There were some themes across conditions and outcomes. Among Level 1 sociodemographic characteristics, older age was clearly the most consistent risk factor. Findings of disparities by race/ethnicity or gender were very mixed. Among Level 2 factors, various measures of low socioeconomic status (low income, education, Medicaid insurance) clearly increased risk. While few studies examined the same Level 3 variables, there was proof of concept evidence that social environment (housing stability, social support), behavioral (adherence, smoking, substance abuse), socio-cognitive (language proficiency), and neighborhood (rurality, distance to hospital) factors were independent predictors of poor posthospital outcomes."

Cardiac Surgery

There is little current information regarding the association of SES factors with readmission after cardiac surgery, and specifically CABG. However, in the excellent review of New York CABG readmissions by Hannan and colleagues [30], in multivariable analyses African American patients had an increased odds of 30-day readmission (1.16, 1.01-1.32, p = 0.03) and Medicaid patients had an increased odds ratio of 1.44 (1.22-1.70, p <0.0001).

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Measure: NQF #2513 Hospital 30-Day All-Cause Risk-Standardized Readmission Rate (RSRR) following Vascular Procedures

QUESTION 1: Describe the conceptual relationship between your outcome measure and possible SDS risk factors. Specifically, provide support from the literature or other empirical data on whether a conceptual relationship exists between at least one (1) specific SDS risk factor and the outcome being measured. Describe the possible risk factor(s) that exhibits the strongest relationship to admissions/readmissions. Possible SDS risk factors for examination may include income, level of education, homelessness status, English language proficiency, health insurance status, occupation, employment status, literacy, health literacy, or neighborhood-level data that can be used as a proxy for individual data such as median neighborhood income, education, or local funding availability for safety net providers.

A variety of sociodemographic status (SDS) risk factors may influence readmission risk following a hospital visit for a vascular procedure. Although some recent literature evaluates the relationship between patient SDS and the readmission outcome, few studies directly address causal pathways or examine the role of the hospital in these pathways. Moreover, the current literature examines a wide range of conditions and risk variables with no clear consensus on which risk factors demonstrate the strongest relationship with readmission. The risk factors that have been examined in the SDS readmission literature can be categorized into three domains: (1) patient-level variables, (2) neighborhood/community-level variables, and (3) hospital-level variables. Patient-level variables describe characteristics of individual patients, and range from the race or ethnicity of the patient to the patient's income or education level [1, 2]. Neighborhood/community-level variables use information from sources such as the American Community Survey (ACS) as either a proxy for individual patient-level data or to measure environmental factors. Studies using these variables use one dimensional measures such as median household income or composite measures such as the Agency for Healthcare Research and Quality (AHRQ)-validated SES index score [3]. Hospital-level variables measure attributes of the hospital which may be related to patient risk. Examples of hospital-level variables used in studies are ZIP code characteristics aggregated to the hospital level or the proportion of Medicaid patient days [4, 5].

The conceptual relationship, or potential causal pathways by which these possible SDS risk factors influence the risk of return to the hospital following an acute illness or major surgery, like the factors themselves, are varied and complex. There are at least four potential pathways that are important to consider. We briefly describe them here and comment on their implications for the hospital readmission measures.

1. Relationship of SDS to health at admission. Sociodemographic disadvantage often leads to worse general health status and therefore patients who have lower income/education/literacy or unstable

housing may present for their hospitalization or procedure with a greater severity of underlying illness. These SDS risk factors, which are characterized by patient-level or neighborhood/community-level (as proxy for patient-level) variables, may also contribute to worse health status at admission due to patients failing to respond to early symptoms and presenting for treatment later in their disease progression. This causal pathway should be largely accounted for by current clinical risk- adjustment.

However, while studies have shown that variables such as race are associated with worse health status, race itself may not directly affect health status at hospital admission. Rather, the association of race with worse health is likely mediated through the association between race and other sociodemographic factors such as poverty or disparate access to high quality care.

2. Use of low-quality hospitals. SDS risk factors may be associated with access to quality healthcare providers because of the distribution of providers and prohibitive costs. In particular, SDS factors can influence the likelihood that patients access high quality care. Patients of lower income, lower education, or unstable housing may not have access to high quality facilities because such facilities are less likely to be found in lower SDS geographic areas. Poor and minority patients are more likely to be seen in lower quality hospitals, which can contribute to the likelihood of hospital readmission [6-8]. To the extent that the relationship between SDS and readmission is driven by clustering of low SDS patients within lower quality facilities, traditional patient-level risk adjustment for SDS would be inappropriate.

3. Differential care within a hospital. The third major pathway by which SDS factors may contribute to readmission risk is that patients may not receive equivalent care within a facility. For example, patients of low income or minority race may experience differential, lower quality, or discriminatory care within a given facility [9]. Alternatively, patients with SDS risk factors may require differentiated care – e.g. provision of lower literacy information – that they do not receive. That is to say, hospitals may provide the same care for all populations (e.g. the same discharge instructions) and this may represent substandard care for patients for whom the standard approach is not effective (e.g. due to low literacy). By failing to actively address the unique needs of patients with SDS risk factors, institutions may be providing lower quality care to these patients. Again, in such circumstances, patient-level risk adjustment for SDS is problematic as it would essentially adjust for a characteristic of the care provided rather than for a patient risk factor.

4. Influence of SDS on readmission risk outside of hospital quality and health status. Some SDS risk factors, such as income or wealth, may affect the likelihood of hospital readmission without directly

affecting health status at admission or the quality of care received during the hospital stay. For instance, while a hospital may make appropriate care decisions and provide tailored care and education, a lower-income patient may be less likely to follow prescribed care (e.g. refill a prescription or keep a follow-up visit with a primary care provider) because limited resources create competing priorities for the patient or their community may have a limited supply of primary care providers. These kinds of pathways present more complex questions about appropriate risk-adjustment decisions.

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QUESTION 2: Describe the relationship between the SDS risk factor(s) and the measured unit (hospital, SNF, etc.) to indicate the variation in the risk factor across the measured unit. Information from the literature is sufficient to indicate potential variation; however, empirical data for the measure as specified (e.g., via bivariate frequency distributions) would be needed to demonstrate that variation does not exist and therefore adjustment is not appropriate.

Since these measures have been developed and implemented using national-level data, there is substantial variation in SDS risk factors across hospitals. Two variables we have presented in our NQF

applications provide empirical evidence that this variation exists. For the Vascular Readmission measure, the percentage of patients who are black ranges from 0% to 93.0% across hospitals, with a median of 4.3% (interquartile range [IQR] 1.4%-10.7%). The percentage of patients who are Medicaid beneficiaries ranges from 0% to 73.9%, with a median of 17.4% (IQR 11.8%- 21.9%). This information was based on 2009 data used for development.

QUESTION 3: What are the patient-level sociodemographic variables that are available in the datasets used to develop the measure?

The variables that are available within or that can be linked directly to Medicare administrative claims data used for these measures include the following:

1. Race (black, white, other). Data source: Medicare claims, enrollment database
2. Medicaid dual-eligible status. Data source: Medicare claims, enrollment database.
3. Neighborhood SES factors as proxies for patient-level SES [1]. Data source: Enrollment database and Census data (American Community Survey).

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QUESTION 4: How well do the patient-level SDS variables that are available represent the underlying conceptual relationship identified?

SDS is a multifaceted phenomenon (more so than clinical factors) and therefore it is unlikely that a single SDS factor will fully and consistently capture the aspects of SDS which affect the risk of readmission through the causal pathways described above.

Dual-eligible status: For our readmission measures, which include Medicare fee-for-service (FFS) beneficiaries aged 65 years and older, dual-status is a good indicator of current assets and income and dual-eligibility criteria are consistent across most states (though cost of living varies) [1]. We think this is, therefore, a reasonable patient-level variable to assess the relationship between SDS and readmission in

that it provides a reliably-obtained indication of patients with low income/assets. There are two important caveats: first, dual-eligible status is a dichotomous variable and thus provides less gradation of SDS; and second, for some patients dual-eligibility is the result of a “spending down” to obtain coverage for nursing care. For such patients, it is difficult to differentiate between those who may have faced a lifetime of low SDS and associated challenges versus those who have had more resources earlier in life and only recently became classified as low income.

Race: The particular case of race as a predictor of health outcomes illuminates the complexity of the role SDS variables play in assessing hospital performance. Racial identity itself confers no differential risk of mortality or readmission following hospitalization. The evidence suggests that a greater prevalence of risk factors in combination with the effects of bias and discrimination account for differential outcomes observed among certain racial groups. This is not to say that there are no meaningful biological variations among groups whose genetic ancestry can be traced to different geographic regions of the world. However, these variations are quite specific and narrowly defined and have not been shown confer broad health risks across groups absent specific genetic markers. Nevertheless, numerous studies have demonstrated greater disease burden, lack of access to health care services, and bias in application of medical intervention among racial minorities, particularly black patients seeking care for a variety of medical and surgical conditions.

In risk-adjusted statistical models of readmission following hospitalization, race is a marker for other SDS factors, such as poverty or social support; however, we often find that the association between race and readmission is greater and more robust or consistent than that of economic factors. The absence of any biologically defined causal pathway suggests that this stronger association may result from exposure to broad societal racial bias. We can determine the specific health outcome-related effects of exposure to societal racial bias through quality measurement, as the health outcome is relatively consistent across exposed individuals. Poverty may have more nuanced effects dependent on unmeasured factors such as the surrounding community, familial support, and others.

Whether we should we include a risk variable to adjust for the presence of this bias depends on whether or not the risk conferred through bias is attributable to factors within or beyond the hospitals’ control. The evidence that blacks receive differential care across a variety of medical and surgical conditions suggests that, even as this bias exists broadly throughout the institutions of society, hospitals and providers also contribute to it [2]. If so, this contribution of the hospital – the effect of treatment bias – should not be included in risk adjusted models of hospital performance as to do so would, in effect, be giving hospitals credit for more disparate or discriminatory care.

ZIP Code-level SDS indicators: The American Community Survey (ACS) provides a number of SDS indicators that are available at the ZIP code level. We are in the process of developing an approach to linking these data to at the 9-digit ZIP code level, which will allow for a more granular perspective on local SDS. We propose to analyze an Agency for Healthcare Research and Quality (AHRQ)-validated composite index of SES which has been used and tested among Medicare beneficiaries [3]. This index is a composite of seven different variables found in the Census data which may capture SDS better than any single variable. The variables are: (1) median household income, (2) percentage of persons living below the federal poverty level, (3) percentage of persons who are aged >16 years and in the labor force but not employed, (4) median value of owner-occupied homes, (5) percentage of persons aged >25 years who completed at least a 12th grade education, (6) percentage of persons aged >25 years who completed at least four years of college, and (7) percentage of households that average one or more persons per room. This is a neighborhood-level variable, which we would use as a proxy for patient-level SDS factors.

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Measure: NQF #2515 Hospital 30-day, all-cause, unplanned, risk-standardized readmission rate (RSRR) following coronary artery bypass graft (CABG) surgery

QUESTION 1: Describe the conceptual relationship between your outcome measure and possible SDS risk factors. Specifically, provide support from the literature or other empirical data on whether a conceptual relationship exists between at least one (1) specific SDS risk factor and the outcome being measured. Describe the possible risk factor(s) that exhibits the strongest relationship to admissions/readmissions. Possible SDS risk factors for examination may include income, level of education, homelessness status, English language proficiency, health insurance status, occupation, employment status, literacy, health literacy, or neighborhood-level data that can be used as a proxy for individual data such as median neighborhood income, education, or local funding availability for safety net providers.

A variety of sociodemographic status (SDS) risk factors may influence readmission risk following a hospital visit for coronary artery bypass graft surgery (CABG). Although some recent literature evaluates the relationship between patient SDS and the readmission outcome, few studies directly address causal pathways or examine the role of the hospital in these pathways. Moreover, the current literature examines a wide range of conditions and risk variables with no clear consensus on which risk factors demonstrate the strongest relationship with readmission. The risk factors that have been examined in the SDS readmission literature can be categorized into three domains: (1) patient-level variables, (2) neighborhood/community-level variables, and (3) hospital-level variables. Patient-level variables describe characteristics of individual patients, and range from the race or ethnicity of the patient to the patient's income or education level [1, 2]. Neighborhood/community-level variables use information from sources such as the American Community Survey (ACS) as either a proxy for individual patient-level data or to measure environmental factors. Studies using these variables use one dimensional measures such as median household income or composite measures such as the Agency for Healthcare Research and Quality (AHRQ)-validated SES index score [3]. Hospital-level variables measure attributes of the hospital which may be related to patient risk. Examples of hospital-level variables used in studies are ZIP code characteristics aggregated to the hospital level or the proportion of Medicaid patient days [4, 5].

The conceptual relationship, or potential causal pathways by which these possible SDS risk factors influence the risk of return to the hospital following an acute illness or major surgery, like the factors themselves, are varied and complex. There are at least four potential pathways that are important to consider. We briefly describe them here and comment on their implications for the hospital readmission measures.

1. Relationship of SDS to health at admission. Sociodemographic disadvantage often leads to worse general health status and therefore patients who have lower income/education/literacy or unstable housing may present for their hospitalization or procedure with a greater severity of underlying illness. These SDS risk factors, which are characterized by patient-level or neighborhood/community-level (as proxy for patient-level) variables, may also contribute to worse health status at admission due to patients failing to respond to early symptoms and presenting for treatment later in their disease progression. This causal pathway should be largely accounted for by current clinical risk- adjustment.

However, while studies have shown that variables such as race are associated with worse health status, race itself may not directly affect health status at hospital admission. Rather, the association of race with worse health is likely mediated through the association between race and other sociodemographic factors such as poverty or disparate access to high quality care.

2. Use of low-quality hospitals. SDS risk factors may be associated with access to quality healthcare providers because of the distribution of providers and prohibitive costs. In particular, SDS factors can influence the likelihood that patients access high quality care. Patients of lower income, lower education, or unstable housing may not have access to high quality facilities because such facilities are less likely to be found in lower SDS geographic areas. Poor and minority patients are more likely to be seen in lower quality hospitals, which can contribute to the likelihood of hospital readmission [6-8]. To the extent that the relationship between SDS and readmission is driven by clustering of low SDS patients within lower quality facilities, traditional patient-level risk adjustment for SDS would be inappropriate.

3. Differential care within a hospital. The third major pathway by which SDS factors may contribute to readmission risk is that patients may not receive equivalent care within a facility. For example, patients of low income or minority race may experience differential, lower quality, or discriminatory care within a given facility [9]. Alternatively, patients with SDS risk factors may require differentiated care – e.g. provision of lower literacy information – that they do not receive. That is to say, hospitals may provide the same care for all populations (e.g. the same discharge instructions) and this may represent substandard care for patients for whom the standard approach is not effective (e.g. due to low literacy). By failing to actively address the unique needs of patients with SDS risk factors, institutions may be providing lower quality care to these patients. Again, in such circumstances, patient-level risk adjustment for SDS is problematic as it would essentially adjust for a characteristic of the care provided rather than for a patient risk factor.

4. Influence of SDS on readmission risk outside of hospital quality and health status. Some SDS risk factors, such as income or wealth, may affect the likelihood of hospital readmission without directly

affecting health status at admission or the quality of care received during the hospital stay. For instance, while a hospital may make appropriate care decisions and provide tailored care and education, a lower-income patient may be less likely to follow prescribed care (e.g. refill a prescription or keep a follow-up visit with a primary care provider) because limited resources create competing priorities for the patient or their community may have a limited supply of primary care providers. These kinds of pathways present more complex questions about appropriate risk-adjustment decisions.

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QUESTION 2: Describe the relationship between the SDS risk factor(s) and the measured unit (hospital, SNF, etc.) to indicate the variation in the risk factor across the measured unit. Information from the literature is sufficient to indicate potential variation; however, empirical data for the measure as specified (e.g., via bivariate frequency distributions) would be needed to demonstrate that variation does not exist and therefore adjustment is not appropriate.

Since these measures have been developed and implemented using national-level data, there is substantial variation in SDS risk factors across hospitals. Two variables we have presented in our NQF

applications provide empirical evidence that this variation exists. For the CABG Readmission measure, the percentage of patients who are black ranges from 0% to 93.5% across hospitals, with a median of 4.8% (interquartile range [IQR] 1.7%-11.0%). The percentage of patients who are Medicaid beneficiaries ranges from 0% to 58.5% across hospitals, with a median of 18.3% (IQR 13.0%-22.6%) This information was based on the most current data for reporting.

QUESTION 3: What are the patient-level sociodemographic variables that are available in the datasets used to develop the measure?

The variables that are available within or that can be linked directly to Medicare administrative claims data used for these measures include the following:

1. Race (black, white, other). Data source: Medicare claims, enrollment database
2. Medicaid dual-eligible status. Data source: Medicare claims, enrollment database.
3. Neighborhood SES factors as proxies for patient-level SES [1]. Data source: Enrollment database and Census data (American Community Survey).

References:

1. Creation of New Race-Ethnicity Codes and Socioeconomic Status (SES) Indicators for Medicare Beneficiaries: Final Report. August 2012. Agency for Healthcare Research and Quality, Rockville, MD. http://archive.ahrq.gov/research/findings/final-reports/medicareindicators/index.html

QUESTION 4: How well do the patient-level SDS variables that are available represent the underlying conceptual relationship identified?

SDS is a multifaceted phenomenon (more so than clinical factors) and therefore it is unlikely that a single SDS factor will fully and consistently capture the aspects of SDS which affect the risk of readmission through the causal pathways described above.

Dual-eligible status: For our readmission measures, which include Medicare fee-for-service (FFS) beneficiaries aged 65 years and older, dual-status is a good indicator of current assets and income and dual-eligibility criteria are consistent across most states (though cost of living varies) [1]. We think this is, therefore, a reasonable patient-level variable to assess the relationship between SDS and readmission in

that it provides a reliably-obtained indication of patients with low income/assets. There are two important caveats: first, dual-eligible status is a dichotomous variable and thus provides less gradation of SDS; and second, for some patients dual-eligibility is the result of a “spending down” to obtain coverage for nursing care. For such patients, it is difficult to differentiate between those who may have faced a lifetime of low SDS and associated challenges versus those who have had more resources earlier in life and only recently became classified as low income.

Race: The particular case of race as a predictor of health outcomes illuminates the complexity of the role SDS variables play in assessing hospital performance. Racial identity itself confers no differential risk of mortality or readmission following hospitalization. The evidence suggests that a greater prevalence of risk factors in combination with the effects of bias and discrimination account for differential outcomes observed among certain racial groups. This is not to say that there are no meaningful biological variations among groups whose genetic ancestry can be traced to different geographic regions of the world. However, these variations are quite specific and narrowly defined and have not been shown confer broad health risks across groups absent specific genetic markers. Nevertheless, numerous studies have demonstrated greater disease burden, lack of access to health care services, and bias in application of medical intervention among racial minorities, particularly black patients seeking care for a variety of medical and surgical conditions.

In risk-adjusted statistical models of readmission following hospitalization, race is a marker for other SDS factors, such as poverty or social support; however, we often find that the association between race and readmission is greater and more robust or consistent than that of economic factors. The absence of any biologically defined causal pathway suggests that this stronger association may result from exposure to broad societal racial bias. We can determine the specific health outcome-related effects of exposure to societal racial bias through quality measurement, as the health outcome is relatively consistent across exposed individuals. Poverty may have more nuanced effects dependent on unmeasured factors such as the surrounding community, familial support, and others.

Whether we should we include a risk variable to adjust for the presence of this bias depends on whether or not the risk conferred through bias is attributable to factors within or beyond the hospitals’ control. The evidence that blacks receive differential care across a variety of medical and surgical conditions suggests that, even as this bias exists broadly throughout the institutions of society, hospitals and providers also contribute to it [2]. If so, this contribution of the hospital – the effect of treatment bias – should not be included in risk adjusted models of hospital performance as to do so would, in effect, be giving hospitals credit for more disparate or discriminatory care.

ZIP Code-level SDS indicators: The American Community Survey (ACS) provides a number of SDS indicators that are available at the ZIP code level. We are in the process of developing an approach to linking these data to at the 9-digit ZIP code level, which will allow for a more granular perspective on local SDS. We propose to analyze an Agency for Healthcare Research and Quality (AHRQ)-validated composite index of SES which has been used and tested among Medicare beneficiaries [3]. This index is a composite of seven different variables found in the Census data which may capture SDS better than any single variable. The variables are: (1) median household income, (2) percentage of persons living below the federal poverty level, (3) percentage of persons who are aged >16 years and in the labor force but not employed, (4) median value of owner-occupied homes, (5) percentage of persons aged >25 years who completed at least a 12th grade education, (6) percentage of persons aged >25 years who completed at least four years of college, and (7) percentage of households that average one or more persons per room. This is a neighborhood-level variable, which we would use as a proxy for patient-level SDS factors.

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