

M E M O R A N D U M

To: NQF Admissions & Readmissions Standing Committee

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Date: April 27th, 2016

Subject: Response to NQF SDS Trial Period analyses for NQF #2375,
the PointRight® Pro 30™ short stay SNF rehospitalization
measure

In August 2015, AHCA and PointRight submitted an analysis plan for our participation in NQF's Socio-Demographic Status (SDS) Trial Period project. Since then, we have conducted the work laid out in the plan, incorporating feedback NQF gave to us on the analysis plan. This memo presents the results of our work, organized into the eleven questions NQF had posed the SDS Trial Period participants.

Question 1. Enter measure # and title

Measure # 2375 PointRight ® Pro 30™

Question 2. What were the patient-level sociodemographic variables that were available and analyzed during measure development?

In our August 2015 analysis plan for the NQF SDS Trial Period, AHCA and PointRight proposed to analyze a wide array of sociodemographic factors targeting seven domains: age, sex, race, marital status, language, race and poverty. On reviewing our initial lengthy list of factors, NQF then recommended that we prune the list down to the most essential and meaningful of those variables, which we did as follows.

First, at the time of our analysis plan, the MDS requests for data that AHCA was making to calculate the measure did not include the patient's Medicaid identifier – which indicates Medicaid enrollment (a poverty measure when observed in the post-acute short stay population), and we did not expect to receive these data. To compensate, we proposed a long list of second-best proxy measures to use in lieu of a direct indicator that the patient was enrolled in Medicaid. Most of these were at the regional level (e.g., via

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census and other data). However, since then, CMS has approved inclusion of the patient's Medicaid identifier in AHCA's quarterly MDS data requests. This eliminated the need for all of the proxy measures, allowing us to focus on the first-best Medicaid enrollment identifier.

Second, we initially proposed analyzing variables at three levels of analysis: the patient level, facility level, and regional level. As we proceeded with the analysis design, we arrived at a methodology that, similarly, superseded this original framework. In particular, we adopted a methodology that adjusted for patient level variance in readmission rates *excluding the facility-level variance in readmission rates*. This approach controls for the portion of variance in the rates that are beyond a facility's control and which are orthogonal to the facility's quality of care.

Third, on consideration of age and sex, both of which were already included in the measure's risk model, we concluded that their main action was clinical rather than "sociodemographic", and thus left them out of further consideration in this project, but maintaining them as clinical adjustors in the risk model.

Fourth, when we considered the inclusion of language status ("needs an interpreter") in the risk model, our clinical experts raised serious doubts about the conceptual link between needing an interpreter and SNF rehospitalization rates. Additionally, only 3% of patients in the denominator needed an interpreter. We therefore dropped language status from further consideration in this project.

Fifth, marital status was grouped as married or single (i.e., widowed, separated, divorced, never married). Marital status is considered a proxy for support availability at home (Berkman & Mreslow, 1983).

Therefore, the final list of patient-level sociodemographic variables that we had available and analyzed were:

- Marital status (married or single)
- Race (black or non black)
- Medicaid enrollment (via the patient having a non-missing Medicaid identifier)

Next, our exploration of adding these variables into the measure's risk model employed a modified form of our original risk model. The risk model for our currently-endorsed measure's NQF application uses an ordinary logistic regression, predicting the probability of rehospitalization at the stay level. As mentioned above, particularly for race and Medicaid enrollment, which correlate with lower quality facilities (see our August analysis plan for the SDS trial period), it is important to decompose the effect of the SDS factors on rehospitalizations into the between-facility component and the within-facility component. The between-facility part of the effect is the main correlate with actual facility quality, and should not be controlled for in the measure; the within-facility part of the effect, however, may represent differences outside the facility's control. To model this, we used a two-stage logistic model. First, we fit a logistic regression including all clinical adjustors as well as race and Medicaid enrollment, with facility fixed effects (to remove the facility effects from

the coefficient estimates). Second, we fit a second logistic regression (this time without fixed effects) including all clinical adjusters plus marital status, and included race and Medicaid with the coefficients set as those in the first regression. For a detailed description of the methodology, see our third analysis in our response to Question 5. This was our best methodological approach for then evaluating the effect of adding the SDS factors to the model.

References

Berkman L, Breslow L. *Health and Ways of Living: the Alameda County Study*. New York: Oxford University Press, 1983.

Question 3. From the measure developer perspective, what is your recommendation for the Standing Committee to consider on whether SDS factors should be included in the measure's final risk adjustment model?

We performed a detailed examination of the potential value of including sociodemographic factors as risk adjusters in the Pro 30 post-acute rehospitalization measure. Specifically we addressed the question of whether adding sociodemographic adjustment would improve the validity of the measure as an indicator of the quality of post-acute care provided to SNFs. In our view, risk adjustment for patient-level sociodemographic factors of a facility-level performance measure should be done if the following conditions apply:

- 1) A risk adjustment model including the factors explains more variance in outcome than a model without such factors.
- 2) Differential outcomes for patients with different sociodemographic variables should be primarily due to otherwise-unmeasured differences in health status and not to disparities in the quality of healthcare provided to patients in particular sociodemographic groups. Risk adjustment should not “adjust away” disparities in care quality that should be the focus of quality improvement efforts.
- 3) The effects of sociodemographic factors in the risk adjustment model are compatible with research findings on the univariate effect of the factors and are not better explained by non-sociodemographic factors that are correlated with them.
- 4) Incorporating the sociodemographic factors in risk adjustment would significantly change the overall appraisal of clinical performance for a significant proportion of providers (in this case SNFs), so that including them would be necessary for the fair application of performance-based incentives and penalties.

Our response to Question 5 presents the detailed analyses to evaluate whether including SDS factors would accomplish this goal. By the end of those analyses, we had concluded that none of these four criteria were satisfied by the SDS factors, and therefore recommend that none of the sociodemographic independent variables should be added to the

PointRight® Pro 30™ risk adjustment model. In fact, adding these SDS variables could have the undesirable effect of adjusting for poor quality SNFs.

Question 4. What were the statistical results of the analyses used to select risk factors?

Noting that we recommend *not* adding any SDS factors to the PointRight® Pro 30™ risk model, here we present the approach used to select risk factors in the measure as currently endorsed by NQF, as summarized in our responses to Sections 2b4.3, 2b4.4 and 2b4.5 of the original NQF application.

High level strategy for electing and selecting risk factors, and conclusions

A clinical panel reviewed the entire MDS for skilled nursing facilities, identifying items that might be expected on clinical grounds to correlate with 30 day readmission risk, and that would be unlikely to change between the day of hospital discharge and the day of the first MDS assessment – which takes place by day 8 of the stay for all Medicare patients. Such items included demographics, chronic disease diagnoses, treatments begun in the hospital with orders to be continued in the SNF, and functional status items that change slowly when they change at all, such as the patient’s needing two-person assistance for transferring and/or bed mobility. These items were screened for significant univariate associations with the dependent variable (readmission to any acute care hospital directly from the SNF within 30 days of admission). This process yielded 39 candidate variables. A logistic regression formula was then estimated utilizing the 39 candidates; this was progressively refined into one that utilized 33 independent variables. The six dropped variables from the 39 – PTSD, transfusions, tuberculosis, continuing radiation therapy, continuing ventilator status, and continuing suction did not add explained variance if added to a model that already included the 33 actually used. With the exception of ventilator status and suction, the variables all had relatively low prevalence in the model-building sample. Ventilator status and suction were strongly associated with tracheostomy care, so it was not surprising that only one of the three variables was significant in the multivariate model that we ultimately selected for risk adjustment of readmission rates.

Approach for statistical testing

A bootstrap analysis as well as a stability analysis on the variables was conducted.

We performed a bootstrap analysis of the coefficients for PointRight® Pro 30™ in the following way: We began with a sample of 585,572 admissions to SNFs from acute care hospitals with admission dates in CY2011. Data were used if the SNF involved had a discharge assessment completion rate of 95% or higher. We calculated the coefficients of the PointRight® Pro 30™ logistic regression model on 1000 subsamples of 292,786 admissions. The distributions for each of the coefficients are displayed in the following table (Table 9) and compared with the coefficients used in the PointRight® Pro 30™ model, which was developed using a slightly different sample comprising 600,000 admissions to SNFs.

The PointRight® Pro 30™ model is based on the assumption that its independent variables rarely change between the day of admission and the assessment reference date of the first MDS assessment. While we cannot assess this directly we can look at the change from the first to the second PPS assessment of Medicare patients who remain in the facility long enough for two assessments. Typically this will be the change from day 7 to day 14 of a post-acute stay. This provides a rough estimate of variable stability. Table 2 shows the rates of change between assessments that were 7 days apart (N= 203,386). Note that only four variables show rates of change – usually in the direction of improvement – of greater than 10%. These variables are those for cognitive impairment, total bowel incontinence, two-person assist, and continued oxygen therapy. For these four variables the table shows the prevalence of 1s in the model building sample and the coefficient in the PointRight® Pro 30™ model. Considering all of the facts, it appears that facility-level estimates of expected readmission rates are unlikely to be affected greatly by variable instability. When the PointRight® Pro 30™ model is applied to data collected on the day of admission it will slightly overestimate the expected risk, because some patients with values of 1 on the least stable IVs will become zeroes by the day of the first MDS assessment.

Results from statistical testing

Bootstrap:

Table 1 shows the difference between the PointRight® Pro 30™ coefficients and the mean coefficients from the bootstrap analysis, expressed as actual values, standard deviation (S.D.) and percentage. It is evident that only a few variables have more than 10% variation from the bootstrap mean; for those variables the absolute value and/or the number of standard deviations is clinically acceptable.

Table 1. PointRight® Pro 30™ Coefficients Compared with Mean from Bootstrap Sampling

Variable Type	Independent Variable	PointRight® Pro 30™ Coefficient	Bootstrap Mean	S.D.	Difference	Difference in S.D.	Difference in %
Intercept	Intercept	-2.825	-2.819	0.019	-0.006	-0.32	0.2%
Type of Admission	Medicare	0.554	0.555	0.015	0.000	-0.03	-0.1%
	Re-entry	0.140	0.125	0.011	0.015	1.30	10.6%
Demographics	Male	0.162	0.158	0.010	0.005	0.48	2.9%
	Age Under 65	0.177	0.177	0.013	0.000	0.02	0.2%
Diagnoses	Anemia	0.092	0.092	0.010	0.000	0.02	0.2%
	Asthma	0.103	0.105	0.011	-0.002	-0.16	-1.7%
	Diabetes Mellitus	0.046	0.062	0.014	-0.016	-1.15	-34.6%

Diagnoses	Diabetic Foot Ulcer	0.146	0.139	0.044	0.007	0.17	5.0%
	Heart Failure	0.200	0.206	0.012	-0.006	-0.51	-3.0%
	Internal Bleeding	0.892	0.912	0.040	-0.020	-0.49	-2.2%
	Pressure Ulcer (Stage 2)	0.167	0.181	0.016	-0.014	-0.86	-8.2%
	Pressure Ulcer (Stage 3)	0.133	0.197	0.030	-0.063	-2.12	-47.5%
	Pressure Ulcer (Stage 4)	0.157	0.146	0.037	0.011	0.29	6.8%
	Pressure Ulcer (Unstageable)	0.181	0.163	0.020	0.018	0.92	10.2%
	Respiratory Failure	0.116	0.163	0.025	-0.047	-1.86	-40.6%
	Septicemia	0.089	0.121	0.029	-0.032	-1.09	-35.7%
	Vascular Ulcer	0.186	0.181	0.027	0.006	0.21	3.0%
	Viral Hepatitis	0.402	0.310	0.049	0.092	1.87	22.8%
Symptom	Daily Pain	0.061	0.054	0.017	0.007	0.40	11.1%
Functional Status	Bowel Incontinence (Total)	0.185	0.176	0.011	0.009	0.77	4.7%
	Cognition Not Intact	0.333	0.331	0.011	0.001	0.14	0.4%
	Eating Dependence	0.472	0.430	0.017	0.042	2.48	8.9%
	Two-Person Assist for Any ADL	0.239	0.226	0.011	0.013	1.21	5.3%
Treatments Continued from Hospital	Cancer Chemotherapy	0.600	0.595	0.050	0.005	0.10	0.8%
	Dialysis	0.604	0.606	0.021	-0.002	-0.09	-0.3%
	Insulin	0.178	0.159	0.015	0.018	1.21	10.3%
	IV Fluids or Meds	0.188	0.179	0.017	0.009	0.52	4.7%
	Ostomy Care	0.326	0.349	0.026	-0.023	-0.87	-6.9%
	Oxygen	0.340	0.346	0.012	-0.007	-0.56	-2.0%
	Radiation Therapy	0.611	0.489	0.069	0.122	1.77	19.9%
Treatments Continued from Hospital	Tracheostomy Care	0.134	0.170	0.040	-0.037	-0.91	-27.5%

Mitigating Factors	End-Stage Prognosis	-0.785	-0.729	0.056	-0.056	-1.00	7.1%
	Hospice Care	-1.509	-1.423	0.098	-0.086	-0.87	5.7%

Variable Stability:

Table 2. Variable Stability between Two Assessments Seven Days Apart

Variable	% Changing from 0 to 1	% Changing from 1 to 0	% Unchanged	Prevalence of 1s in Validation Sample	Coefficient in Model
Medicare	0%	0%	100%		
Re-entry	1%	1%	99%		
Male	0%	0%	100%		
Age Under 65	0%	0%	100%		
Anemia	2%	2%	98%		
Asthma	1%	2%	99%		
Diabetes Mellitus	1%	1%	99%		
Diabetic Foot Ulcer	0%	0%	100%		
Heart Failure	1%	1%	99%		
Internal Bleeding	0%	0%	100%		
Pressure Ulcer Stage 2	0%	2%	100%		
Pressure Ulcer Stage 3	0%	0%	100%		
Pressure Ulcer Stage 4	0%	0%	100%		
Pressure Ulcer Unstageable	0%	1%	100%		
Respiratory Failure	0%	1%	100%		
Septicemia	0%	1%	100%		
Vascular Ulcer	0%	0%	100%		
Viral Hepatitis	0%	0%	100%		
Daily Pain	2%	4%	98%		
Bowel Incontinence (Total)	7%	9%	93%	49%	0.185
Cognition Not Intact	4%	8%	96%	66%	0.333
Eating Dependence	1%	1%	99%		
Two-Person Assist	4%	14%	96%	57%	0.239
Chemotherapy	0%	1%	100%		
Dialysis	0%	3%	100%		

Insulin	1%	2%	99%		
IV Fluids or Medications	0%	6%	100%		
Ostomy Care	0%	0%	100%		
Oxygen	0%	18%	100%	22%	0.34
Radiation Therapy	0%	0%	100%		
Tracheostomy Care	0%	1%	100%		
End-Stage Prognosis	0%	0%	100%		
Hospice Care	0%	0%	100%		

Our original Pro 30 model was most recently refit using hospital admissions to the SNF in CY 2014. Our sample consisted of 2,760 SNFs that consistently submit MDS data to PointRight and had more than 30 admissions to the SNF from the hospital in the 12 month denominator window. The revised coefficients are presented in Table 3 below.

Table 3. Current Pro 30 Model (Ordinary Logistic Regression)

Category of Independent Variable	Independent Variable	Estimates (standard error)	P-Value
Constant	Intercept	-2.9658 (0.0114)	<.0001
Active Diagnoses	Anemia	0.1188 (0.0067)	<.0001
Active Diagnoses	Asthma, COPD or Chronic Lung Disease	0.1125 (0.0074)	<.0001
Active Diagnoses	Diabetes Mellitus	0.0711 (0.0087)	<.0001
Active Diagnoses	Diabetic Foot Ulcer(s)	0.1389 (0.0267)	<.0001
Active Diagnoses	End Stage Prognosis	-0.7109 (0.042)	<.0001
Active Diagnoses	Heart Failure	0.1934 (0.0073)	<.0001
Active Diagnoses	Internal Bleeding	1.0899 (0.026)	<.0001
Active Diagnoses	Respiratory Failure	0.1729 (0.0141)	<.0001
Active Diagnoses	Septicemia	0.0407 (0.0184)	0.0273
Active Diagnoses	Venous or Arterial Ulcer	0.183 (0.0177)	<.0001
Active Diagnoses	Viral Hepatitis	0.3793 (0.0292)	<.0001
Cognition	Cognition Not Completely Intact	0.3421 (0.007)	<.0001
Demographics	Age >= 65	0.0619 (0.0063)	<.0001
Demographics	Male	0.1465 (0.0063)	<.0001
Functional Status	Eating Dependency	0.5957 (0.0121)	<.0001
Functional Status	Two Person Physical Assist Needed for Any ADL	0.2364 (0.007)	<.0001
Hospice Status	Hospice Care	-1.4028 (0.0716)	<.0001
Incontinence	Total Bowel Incontinence	0.197 (0.007)	<.0001
Payer	Medicare Beneficiary	0.4894 (0.0089)	<.0001
Skin	Pressure Ulcer(s) Stage 2	0.1816 (0.0113)	<.0001
Skin	Pressure Ulcer(s) Stage 3	0.1558 (0.0196)	<.0001
Skin	Pressure Ulcer(s) Stage 4	0.0971 (0.0258)	0.0002
Skin	Pressure Ulcer(s) Unstageable	0.1907 (0.0124)	<.0001
Stay History	In this SNF Prior to the Acute Hospitalization	0.2443 (0.0077)	<.0001
Symptoms	Daily Pain	0.094 (0.0126)	<.0001
Treatments	Chemotherapy	0.5697 (0.0303)	<.0001
Treatments	Dialysis	0.6328 (0.0135)	<.0001
Treatments	IV Medications	0.1899 (0.011)	<.0001
Treatments	Ostomy Care	0.3993 (0.0166)	<.0001
Treatments	Oxygen Therapy	0.3394 (0.0078)	<.0001
Treatments	Radiation Therapy	0.5066 (0.0447)	<.0001
Treatments	Receiving Insulin	0.1772 (0.0095)	<.0001
Treatments	Tracheostomy Care	0.0697 (0.0271)	0.0101

Question 5. Describe the analyses and interpretation resulting in the decision to select SDS factors (e.g. prevalence of the factor across measured entities, empirical association with the outcome, contribution of unique variation in the outcome, assessment of between-unit effects and within-unit effects).

We undertook a detailed examination of the potential value of including sociodemographic factors as risk adjusters in the Pro 30 post-acute rehospitalization measure. Specifically we addressed the question of whether adding sociodemographic adjustment would improve

the validity of the measure as an indicator of the quality of post-acute care provided to SNFs.

Our exploratory data analyses used MDS data from 2,790 SNFs that consistently submitted data to PointRight and had more than 30 admissions from the hospital in 2014. All post-acute admissions to these facilities during CY2014 were included in the analyses, resulting in a total of 745,832 admissions from acute care hospitals. The 30-day rehospitalization rate for this patient group as a whole was 18.3%.

In our view, risk adjustment for patient-level sociodemographic factors of a facility-level performance measure should be done if the following conditions apply:

- 1) A risk adjustment model including the factors explains more variance in outcome than a model without such factors.
- 2) Differential outcomes for patients with different sociodemographic variables should be primarily due to otherwise-unmeasured differences in health status and not to disparities in the quality of healthcare provided to patients in particular sociodemographic groups. Risk adjustment should not “adjust away” disparities in care quality that should be the focus of quality improvement efforts.
- 3) The effects of sociodemographic factors in the risk adjustment model are compatible with research findings on the univariate effect of the factors and are not better explained by non-sociodemographic factors that are correlated with them.
- 4) Incorporating the sociodemographic factors in risk adjustment would significantly change the overall appraisal of clinical performance for a significant proportion of providers (in this case SNFs), so that including them would be necessary for the fair application of performance-based incentives and penalties.

The data analyses conducted on the CY2014 dataset showed that none of the four criteria are met for the three new sociodemographic factors considered here. In the following analyses we utilized the two-level fixed effects framework to apportion the impact of sociodemographic factors between the facility level and the individual patient level.

1. First, we tested the variation of the standardized risk ratios (SRRs) across facilities by a) the proportion of Medicaid patients, and b) the proportion of black patients. Table 4 presents the SRRs for SNFs with less than 15% Medicaid enrolled patients in the measure denominator, those with 15-40%, and those with 40% or more; and SNFs with less than 1% black patients in the denominator, those with 1-15%, and those with 15% or more. Therefore, at the facility level a higher proportion of black patients and/or a higher proportion of Medicaid patients are associated with higher risk-adjusted rehospitalization rates.

Table 4. Standardized Risk Ratios (SRRs) = Observed Rate/Expected Rate

Facility Population Characteristic ==>	Medicaid Proportion < 15%	Medicaid Proportion Between 15% and 40%	Medicaid Proportion >40%	Proportion Black <1%	Proportion Black Between 1% and 15%	Proportion Black Over 15%
Number of SNFs	718	1366	676	661	1353	746
Number of Admissions	289,786	342,317	113,729	126,518	418,580	200,734
Maximum	1.74	2.61	2.03	2.61	1.97	2.03
90th Percentile	1.24	1.29	1.34	1.18	1.29	1.39
75th Percentile	1.09	1.14	1.18	0.99	1.13	1.22
50th Percentile	0.94	0.96	0.99	0.84	0.96	1.06
25th Percentile	0.77	0.80	0.83	0.67	0.80	0.91
10th Percentile	0.64	0.62	0.63	0.53	0.65	0.76
Minimum	0.17	0.07	0.15	0.07	0.11	0.20

- Second, we examined the effect of adding sociodemographic factors on the variance explained by the ordinary logistic risk adjustment model. This is the same model form as currently used in the NQF-endorsed measure; Table 3 presents the regression results. Here we observed that all 3 of the added SES variables had significant terms, but there was no improvement in the model's c-statistic. The c-statistic of the current PointRight® Pro 30™ risk adjustment predictive model, an ordinary logistic regression with the MDS as the sole source of independent variables, is 0.676. The c-statistic of an ordinary logistic regression estimated after adding the three above candidate IVs was also 0.676. In other words, all of the variance in rehospitalization rates explainable by suitably reliable and stable MDS variables could be accounted for without the use of the three candidate sociodemographic IVs.

Table 5. Logistic Regression with Three Added SDS Variables

Category of Independent Variable	Independent Variable	Estimates (standard error)	P-Value
Constant	Intercept	-2.9793 (0.0117)	<.0001
Active Diagnoses	Anemia	0.1158 (0.0067)	<.0001
Active Diagnoses	Asthma, COPD or Chronic Lung Disease	0.1212 (0.0074)	<.0001
Active Diagnoses	Diabetes Mellitus	0.0669 (0.0087)	<.0001
Active Diagnoses	Diabetic Foot Ulcer(s)	0.1461 (0.0267)	<.0001
Active Diagnoses	End Stage Prognosis	-0.705 (0.042)	<.0001
Active Diagnoses	Heart Failure	0.1936 (0.0073)	<.0001
Active Diagnoses	Internal Bleeding	1.0901 (0.026)	<.0001
Active Diagnoses	Respiratory Failure	0.1758 (0.0141)	<.0001
Active Diagnoses	Septicemia	0.0437 (0.0184)	0.0179
Active Diagnoses	Venous or Arterial Ulcer	0.1822 (0.0177)	<.0001
Active Diagnoses	Viral Hepatitis	0.3765 (0.0293)	<.0001
Cognition	Cognition Not Completely Intact	0.3428 (0.007)	<.0001
Demographics	Age >= 65	0.0527 (0.0064)	<.0001
Demographics	Male	0.1339 (0.0065)	<.0001
Functional Status	Eating Dependency	0.5884 (0.0122)	<.0001
Functional Status	Two Person Physical Assist Needed for Any ADL	0.2367 (0.007)	<.0001
Hospice Status	Hospice Care	-1.3921 (0.0716)	<.0001
Incontinence	Total Bowel Incontinence	0.1934 (0.0071)	<.0001
Payer	Medicare Beneficiary	0.4907 (0.009)	<.0001
Skin	Pressure Ulcer(s) Stage 2	0.1773 (0.0113)	<.0001
Skin	Pressure Ulcer(s) Stage 3	0.1467 (0.0197)	<.0001
Skin	Pressure Ulcer(s) Stage 4	0.0868 (0.0258)	0.0008
Skin	Pressure Ulcer(s) Unstageable	0.188 (0.0124)	<.0001
Stay History	In this SNF Prior to the Acute Hospitalization	0.2614 (0.008)	<.0001
Symptoms	Daily Pain	0.1014 (0.0126)	<.0001
Treatments	Chemotherapy	0.5632 (0.0303)	<.0001
Treatments	Dialysis	0.6112 (0.0136)	<.0001
Treatments	IV Medications	0.1931 (0.011)	<.0001
Treatments	Ostomy Care	0.4042 (0.0166)	<.0001
Treatments	Oxygen Therapy	0.3434 (0.0078)	<.0001
Treatments	Radiation Therapy	0.5015 (0.0447)	<.0001
Treatments	Tracheostomy Care	0.0594 (0.0271)	0.0285
Treatments	Receiving Insulin	0.1763 (0.0095)	<.0001
Added Sociodemographic Variable	Married	0.0484 (0.0069)	<.0001
Added Sociodemographic Variable	Medicaid	-0.0691 (0.0078)	<.0001
Added Sociodemographic Variable	Black Race	0.1545 (0.0091)	<.0001

3. Third, to study the extent to which health care disparities between different socio-economic groups are the result of differential care within the nursing home or are due to differences resulting from unequal quality of care across nursing homes, we compared the Pro-30 model with a conditional fixed-effects logistic regression model, and then used the SDS factor coefficients as the first stage of a two-stage logistic regression approach.

Conditional fixed-effects models account for the heterogeneity of facilities. Including facility specific intercepts i.e. the fixed effects, removes any potential confounding in facility outcomes if one social group tended to be associated with facilities with better or poorer quality of care. If there are no across facility differences, the estimates of the coefficients of the standard logistic model (Pro 30) should be very close to the estimates of the conditional fixed effects model.

The difference in the estimates between these two models indicates the existence of heterogeneity across facilities (Cai et al. 2010, Grabowski et al., 2009).

In the first stage, we fit the conditional logistic regression model including all clinical adjustors as well as race and Medicaid enrollment, with facility fixed effects (to remove the facility effects from the coefficient estimates). Tables 5 and 6 present the results from the base and the conditional logistic regression models respectively. The coefficient of the variable “Black” declines from 0.1545 (p-value = 0.0091) in the base logistic model, to 0.0574 (p-value = 0.0105) in the conditional fixed effects model. That is, 63% of the variance related to race black was subsumed by the fixed effects, leaving just 37% of the total effect. The effect of race estimated by the conditional maximum likelihood estimate represents the within facility differences in the risk of re-hospitalization between Black and non-Black residents. The difference between the estimates of the two models is much higher, suggesting that the difference in the re-hospitalization risk detected in the base model, is primarily due to heterogeneity of facilities rather than to differential treatment between Black and non-Black residents within the same facility. This represented strong evidence against including black race in risk adjustment for Pro 30, which was then amplified repeatedly in our other analyses.

For Medicaid status, the coefficients changed less between the ordinary logistic model (-0.0691) and the model with facility fixed effects (-0.0814), however there is still a small between-facility effect beyond the within-facility effect. In particular, the between-facility effect of Medicaid status appears to be positive, and removing it causes the coefficient to become more negative (-0.0814) than the total effect (-0.0691). This suggests the between facility effect is about -15% of the within-facility effect.

Similarly, the coefficient for marital status changed less between the ordinary logistic regression model (0.0484) and the model with fixed effects (0.0560). Again this suggests the between facility effect is about 15% of the within-facility effect.

In the second stage, we fit an ordinary logistic regression (this time without fixed effects) including all clinical adjustors and marital status, and included race and Medicaid with the coefficients set as those in the first regression. This took the coefficients from the fixed effects model for Medicaid and race black and restricted these variables as we allowed the other covariates to be refit in a new logistic regression model. We consider the restricted coefficient of Medicare and race black to be the patient level effects excluding facility level effects. Furthermore, we decided to allow the marital status SDS variable coefficient to be refit as there was no conceptual reason to control away the between-facility effect of marital status, and less evidence to suggest that facility level effects

were confounded with the married/single effect. The estimates of the second stage are presented in Table 7.

This second stage model with the restricted coefficients from our first stage, fixed-effects model, is our version of the Pro 30 model that takes into account for SDS factors – that is, if we had chosen to include the factors, this is the model we would have proposed to adopt for the measure.

Table 6. Fixed Effects Logistic Regression with Three Added SDS Variables

Category of Independent Variable	Independent Variable	Estimate (Standard Error)	P-Value
Constant	Intercept	.	.
Active Diagnoses	Anemia	0.1362 (0.0069)	<.0001
Active Diagnoses	Asthma, COPD or Chronic Lung Disease	0.1175 (0.0075)	<.0001
Active Diagnoses	Diabetes Mellitus	0.0682 (0.0088)	<.0001
Active Diagnoses	Diabetic Foot Ulcer(s)	0.1521 (0.027)	<.0001
Active Diagnoses	End Stage Prognosis	-0.6639 (0.0425)	<.0001
Active Diagnoses	Heart Failure	0.1924 (0.0074)	<.0001
Active Diagnoses	Internal Bleeding	1.168 (0.0266)	<.0001
Active Diagnoses	Respiratory Failure	0.1822 (0.0145)	<.0001
Active Diagnoses	Septicemia	0.0771 (0.0188)	<.0001
Active Diagnoses	Venous and Arterial Ulcers	0.1885 (0.0179)	<.0001
Active Diagnoses	Viral Hepatitis	0.3644 (0.0298)	<.0001
Cognition	Cognition Not Completely Intact	0.3679 (0.0073)	<.0001
Demographics	Age >= 65	0.0526 (0.0065)	<.0001
Demographics	Male	0.1288 (0.0066)	<.0001
Functional Status	Eating Dependency	0.5765 (0.0125)	<.0001
Functional Status	Two Person Physical Assist Needed for Any ADL	0.2749 (0.0075)	<.0001
Hospice Status	Hospice Care	-1.4259 (0.0721)	<.0001
Incontinence	Total Bowel Incontinence	0.151 (0.0074)	<.0001
Payer	Medicare Beneficiary	0.5109 (0.0096)	<.0001
Skin	Pressure Ulcer(s) Stage 2	0.1832 (0.0115)	<.0001
Skin	Pressure Ulcer(s) Stage 3	0.121 (0.0199)	<.0001
Skin	Pressure Ulcer(s) Stage 4	0.0601 (0.0262)	0.0217
Skin	Pressure Ulcer(s) Unstageable	0.1788 (0.0127)	<.0001
Stay History	In this SNF Prior to the Acute Hospitalization	0.2083 (0.0082)	<.0001
Symptoms	Daily Pain	0.1292 (0.0132)	<.0001
Treatments	Chemotherapy	0.5829 (0.0306)	<.0001
Treatments	Dialysis	0.6111 (0.014)	<.0001
Treatments	IV Medications	0.2144 (0.0113)	<.0001
Treatments	Ostomy Care	0.418 (0.0168)	<.0001
Treatments	Oxygen Therapy	0.3959 (0.0082)	<.0001
Treatments	Radiation Therapy	0.4916 (0.0452)	<.0001
Treatments	Tracheostomy Care	0.0075 (0.0286)	0.7931
Treatments	Receiving Insulin	0.1644 (0.0096)	<.0001
Added Sociodemographic Variable	Married	0.056 (0.007)	<.0001
Added Sociodemographic Variable	Medicaid	-0.0814 (0.0084)	<.0001
Added Sociodemographic Variable	Black Race	0.0574 (0.0105)	<.0001

Table 7. Logistic Regression with Plugged in SDS Conditional Maximum Likelihood Coefficients

Category of Independent Variable	Parameter	Estimate (Standard Error)	P-Value
Constant	Intercept	-2.9637 (0.0115)	<.0001
Active Diagnoses	Anemia	0.1185 (0.0067)	<.0001
Active Diagnoses	Asthma, COPD or Chronic Lung Disease	0.12 (0.0074)	<.0001
Active Diagnoses	Diabetes Mellitus	0.0724 (0.0087)	<.0001
Active Diagnoses	Diabetic Foot Ulcer(s)	0.144 (0.0267)	<.0001
Active Diagnoses	End Stage Prognosis	-0.7084 (0.042)	<.0001
Active Diagnoses	Heart Failure	0.1935 (0.0073)	<.0001
Active Diagnoses	Internal Bleeding	1.0875 (0.026)	<.0001
Active Diagnoses	Respiratory Failure	0.1757 (0.0141)	<.0001
Active Diagnoses	Septicemia	0.0429 (0.0184)	0.02
Active Diagnoses	Venous and Arterial Ulcers	0.1834 (0.0177)	<.0001
Active Diagnoses	Viral Hepatitis	0.3926 (0.0292)	<.0001
Cognition	Cognition Not Completely Intact	0.3433 (0.007)	<.0001
Demographics	Age >= 65	0.0533 (0.0064)	<.0001
Demographics	Male	0.1347 (0.0065)	<.0001
Functional Status	Eating Dependency	0.5971 (0.0121)	<.0001
Functional Status	Two Person Physical Assist Needed for Any ADL	0.2348 (0.007)	<.0001
Hospice Status	Hospice Care	-1.3928 (0.0716)	<.0001
Incontinence	Total Bowel Incontinence	0.1984 (0.007)	<.0001
Payer	Medicare Beneficiary	0.486 (0.0089)	<.0001
Skin	Pressure Ulcer(s) Stage 2	0.1794 (0.0113)	<.0001
Skin	Pressure Ulcer(s) Stage 3	0.1533 (0.0196)	<.0001
Skin	Pressure Ulcer(s) Stage 4	0.0984 (0.0258)	0.0001
Skin	Pressure Ulcer(s) Unstageable	0.1885 (0.0124)	<.0001
Stay History	Reentry to SNF	0.2665 (0.0077)	<.0001
Symptoms	Daily Pain	0.0992 (0.0126)	<.0001
Treatments	Chemotherapy	0.5639 (0.0303)	<.0001
Treatments	Dialysis	0.6284 (0.0135)	<.0001
Treatments	IV Medications	0.1919 (0.011)	<.0001
Treatments	Ostomy Care	0.4008 (0.0166)	<.0001
Treatments	Oxygen Therapy	0.3387 (0.0078)	<.0001
Treatments	Radiation Therapy	0.5042 (0.0447)	<.0001
Treatments	Tracheostomy Care	0.0666 (0.0271)	0.014
Treatments	Receiving Insulin	0.1774 (0.0095)	<.0001
Added Sociodemographic Variable	Married	0.0406 (0.0068)	<.0001
Added Sociodemographic Variable	Medicaid	-0.0814*	N/A
Added Sociodemographic Variable	Race - Black	0.0574*	N/A

Coefficients labeled with (*) are plugged in from the fixed effects model.

- Fourth, we analyzed the structural causes of sociodemographic effects on the risk model. The association of married status with a higher readmission rate can be explained by the hypothesis that married patients are more likely to have resources for care at home than non-married patient, and therefore as a group married patients referred to SNFs rather than home-based care have a higher level of illness, functional impairment or need for specialized care than non-

married patients. This would warrant adding marital status to the risk adjustment model if it added to the explained variance in outcome, but it does not.

The association of Medicaid status with a lower rate of rehospitalization seems paradoxical, because lower-income individuals are known to have worse health than those with higher incomes (Hu, Gonsahn and Nerenz, 2014; Calvillo-King et al., 2013), and facilities with a high Medicaid census tend to deliver worse care than those funded primarily by Medicare, commercial insurance, and private payment. (In our sample facilities with a high proportion of Medicaid residents in fact had a higher risk-adjusted rehospitalization rate, whether or not the risk-adjustment included a facility effect). The effect of Medicaid beneficiary status on reducing the expected rehospitalization rate at the individual patient level is roughly the same size and direction in ordinary logistic regression and in the two-level fixed effects model.

The explanation for this paradox lies in the association between Medicaid beneficiary status and long-term SNF residence – the “spend-down” phenomenon. Many SNF residents are not poor when they are admitted to a SNF, but eventually exhaust their resources paying for residential care in the SNF and join the Medicaid rolls. Such residents would not be expected to show worse health than non-Medicaid beneficiaries. Moreover, the fact that a SNF patient was in the same facility six months earlier makes it more likely the patient does not have a terminal condition or one leading to prolonged hospitalizations, and the fact that a patient had a prior SNF stay of more than three months makes it less likely that the patient’s condition is one causing frequent hospitalizations. In fact, we found the effect of Medicaid status on rehospitalization risk became non-significant once variables were added to the risk-adjustment model that captured these aspects of a patient’s residential history. These were binary variables capturing (1) being present in the same facility six months earlier, and (2) having a length of stay greater than 90 days for the SNF stay prior to the hospitalization immediately before the post-acute admission.

Variables capturing patients’ prior residential history might be considered in future updates of the model, but due to the indirectness of the relationship between prior residential history and rehospitalization risk we would not advocate adding them unless they added significantly to the overall explained variance of the model – which they don’t do. .

5. Fifth, we measured the effect on classification of facility performance of applying our revised risk model with SDS factors. For both the current Pro 30 risk-adjustment model (an ordinary logistic regression) and a model including sociodemographic factors (a logistic regression in which the coefficients for black race and Medicaid status were determined by a fixed effects model and thus eliminated facility-level effects), we ranked facilities according to the

observed over expected (O/E) ratio, then classified the facility's performance by decile of O/E. We then examined the 10x10 matrix that relates each facility's original decile rank with its decile rank in the new model with sociodemographic adjustment. (See Table 8 in our response to Question 10.) In only one of 2760 cases did a facility's decile rank change by more than one between the old and the new risk adjustment method.

The coefficient for marital status in a model that incorporates race and Medicaid status as well as the original risk adjustment IVs is 0.04. The smallness of the coefficient, its indirect relationship to the outcome of rehospitalization, and the fact that it does not contribute to explained variance of the predictive model all argue against changing the PointRight® Pro 30™ risk adjustment model to include it.

Ultimately we choose not to include the SDS variables because they failed to meet the four criteria outlined in Question 3.

References

Cai S, Mukamel DB, Temkin-Greener H. Pressure ulcer prevalence among black and white nursing home residents in New York state: evidence of racial disparity? *Med Care* 2010;48:233-9.

Calvillo-King L, Arnold D, Eubank KJ, Lo M, Yunyongying P, Stieglitz H, et al. Impact of social factors on risk of readmission or mortality in pneumonia and heart failure: systematic review. *J Gen Intern Med*. 2013;28(2):269–82.

Grabowski DC, McGuire TG. "Black-White Disparities in Care in Nursing Homes" *Atlantic Economic Journal*. 2009;37(3):299–314.

Hu J, Gonsahn M, Nerenz D. Socioeconomic Status and Readmission: Evidence from an Urban Teaching Hospital. *Health Affairs* 33, No. 5 (2014): 778–785.

Question 6. Describe the method of testing/analysis used to develop and validate the adequacy of the statistical model or stratification approach (describe the steps—do not just name a method; what statistical analysis was used).

We conducted three additional tests of the adequacy of the PointRight® Pro 30™ risk model, in addition to the extensive reliability and validity testing performed in the original NQF application. First, we reviewed the C-statistic for the measure as currently specified, under all versions of the risk model discussed in this submission; these results were also those used in our response to Question 5. Second, just on the non-SDS model, we re-reviewed the model fit for the currently-endorsed measure across the spectrum of observed rates for the measure. Third, again just on the non-SDS model, we reviewed the stability of the risk model when calibrated on CY2014 data and applied to CY2015 data. We did not examine the SDS versions of the models in our second and third analyses as the analyses performed for Question 5 had already led us to conclude the SDS factors should not be included in the model.

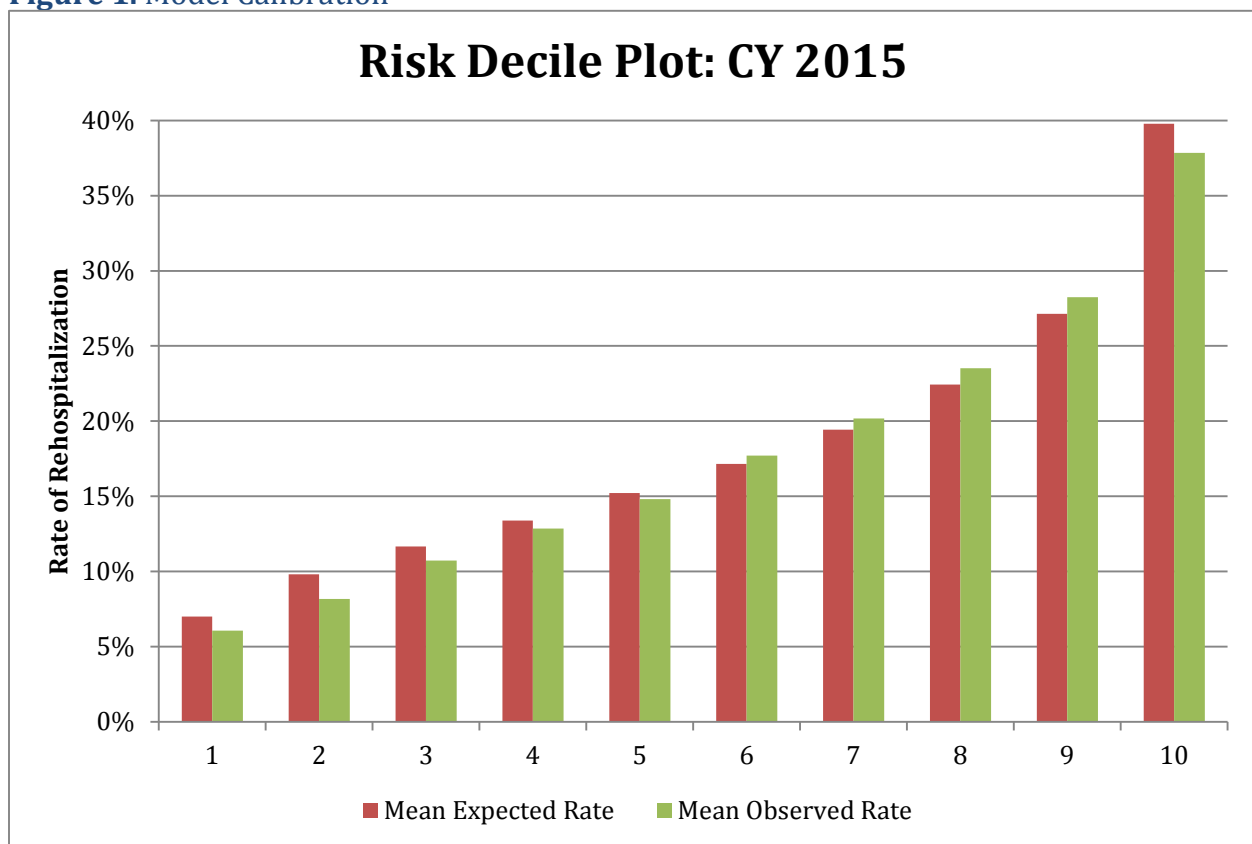
1. We reviewed the C statistic, or the area under the receiver operating characteristic (ROC) curve for all of the models and present the results below. The c-statistics were identical throughout all the models, suggesting that the models' discrimination ability remains unchanged from the current PointRight® Pro 30™ model.

Table 8. C-Statistic of Pro 30 Model Forms

Pro30 Rehospitalization Models	C-Statistic
Ordinary Logistic Regression	0.676
Ordinary Logistic Regression + SDS	0.676
Fixed-Effects Logistic Regression Model + SDS	0.676
Ordinary Logistic Regression + restricted SDS coefficients	0.676

2. We received the decile plot for predictive ability across the spectrum of observed rehospitalization rates and present the results in Figure 1 below. The risk model predicts accurately, with very minimal bias up or down, across the full spectrum of observed rehospitalization rates.

Figure 1. Model Calibration



We assessed whether rates were consistent across time and present the results in Table 9. To do this, expected rates were calculated by the model that was trained on CY2014 admissions (N=745,832 admissions), and observed rates were calculated from admissions in CY2015 (N=616,544 admissions). The Table shows very little change in the SRRs between the training and validation samples, indicating appropriateness of the risk model for use in the field.

Table 9. Comparison of standardized rehospitalization rates in CY2014 training vs, CY2015 validation samples

Denominator Size	Number of Facilities	Variable	Mean	Standard Deviation	5th Percentile	95th Percentile
30-149	648	SRR CY2014	0.93	0.30	0.45	1.46
		SRR CY2015	0.93	0.32	0.45	1.46
		Changes in SRR (2014 minus 2015)	0.00	0.34	-0.56	0.53
150-349	851	SRR CY2014	0.99	0.25	0.60	1.40
		SRR CY2015	0.99	0.24	0.61	1.40
		Difference (2014 - 2015)	0.00	0.23	-0.35	0.40
350+	623	SRR CY2014	0.98	0.22	0.61	1.35
		SRR CY2015	1.01	0.21	0.67	1.36
		Difference (2014 - 2015)	-0.03	0.18	-0.26	0.33

In conclusion, the currently-endorsed PointRight® Pro 30™ risk model exhibits very robust statistical properties for its use in the measure.

Question 7. Discuss the risks for misuse of the specified performance measure. This discussion could include information on the known limitations of the performance measure that could impact its use in accountability programs.

Through the life of this measure to date, we have not identified risks for misuse of the measure, either relating to or not relating to sociodemographic mix. Users and stakeholders of the measure have, however, occasionally enquired whether SDS factors should be added to the measure (not advocating that they should, but just raising the question); and have occasionally asked whether planned readmissions can be excluded from the measure (because during initial development, the MDS item for planned discharges did not exist). While neither of these represents a risk for misuse, per-se, the question of whether SDS factors should be added to the risk model led us to participate in the NQF trial period, and we plan to examine the question of planned readmissions as we evaluate our measure for its next measure maintenance cycle.

Question 8. If a performance measure includes SDS variables in its risk adjustment model, the measure developer should provide the information required to stratify a clinically-adjusted only version of the measure results for those SDS variables. This information may include the stratification variables, definitions, specific data

collection items/responses, code/value sets, and the risk-model covariates and coefficients for the clinically-adjusted version of the measure when appropriate.

N/A

Question 9. Please enter the details of the final statistical risk model and variables here.

Because we have elected to *not* include SDS factors into our risk model, here we present the original risk model as specified in our endorsed NQF application. Note that the coefficients presented here are those from our NQF application (from an earlier time period) rather than those re-calculated for the comparisons presented in this memo.

The formula for adjusting facility's adjusted rehospitalization rate is as follows:

$$\text{Facility_Adjusted_Rate} = \text{Facility_Observed_Rate} * \text{National_Mean} / \text{Facility_Expected_Rate},$$

where Facility_Expected_Rate is the mean of stay-level predictions for the facility, over the rolling 12 month performance window, applying the sample selection methodology and denominator exclusions described in the original NQF application for NQF #2375. The Expected Rate Calculation for each stay is in turn:

VARIABLE CALCULATION

Age Under 65: if age<65 then Variable=1; else Variable=0; (If Date of Birth is missing, then Variable=0)

End Stage Prognosis: if J1400=1 then Variable=1; else Variable=0;

Hospice Care: if O0100K2=1 then Variable=1; else Variable=0;

Male: if A0800=1 then Variable=1; else Variable=0;

Medicare: if A0310B = 01 or 06, then Variable=1; else Variable=0;

SNF Admission is Return to Same SNF Following Hospitalization: if A0310B=06 AND A1600 minus A2000 (on a previous MDS where

A2100=3) < 30 then Variable=1; else if A1700=2 then Variable=1; else Variable=0;

Diagnoses

Anemia: if I0200=1 then Variable=1; else Variable=0;

Asthma: if I6200=1 then Variable=1; else Variable=0;

Diabetes Mellitus: if I2900=1 then Variable=1; else Variable=0;

Diabetic Foot Ulcer: if M1040B=1 then Variable=1; else Variable=0;

Pressure Ulcer Stage 2: if M0300B2>0 then Variable=1; else Variable=0;

Pressure Ulcer Stage 3: if M0300C2>0 then Variable=1; else Variable=0;

Pressure Ulcer Stage 4: if M0300D2>0 then Variable=1; else Variable=0;

Pressure Ulcer Unstageable: if M0300E2>0 or M0300F2>0 or M0300G2>0 then Variable=1; else Variable=0;

Respiratory Failure: if I6300=1 then Variable=1; else Variable=0;

Septicemia: if I2100=1 then Variable=1; else Variable=0;

Vascular Ulcer: if M1030>0 then Variable=1; else Variable=0;

Viral Hepatitis: if I2400=1 then Variable=1; else Variable=0;

Heart Failure: if I0600=1 then Variable=1; else Variable=0;
Internal Bleeding: if J1550D=1 then Variable=1; else Variable=0;
Functional Status
Daily Pain: if J0400=1 or J0850=3 then Variable=1; else Variable=0;
Eating Dependence- Total: if G0110H1 = 4,7, or 8, then Variable=1; else Variable=0;
Two Person assist Needed with One or More ADLs: if G0110A2=3 or G0110B2=3 or
G0110C2=3 or G0110D2=3 or G0110E2=3 or
G0110F2=3 or G0110G2=3 or G0110H2=3 or G0110I2=3 or G0110J2=3 then Variable=1;
else Variable=0;
Cognition not Completely Intact: if C0100=1 AND if C0500=15 then Variable=0;
if C0100=1 AND if C0500 <>15 then Variable=1; if C0100=0 AND if C0700=0 AND C0800=0
AND C1000=0 AND C0900A=1 AND C0900B=1
AND C0900C=1 AND C0900D=1 then Variable=0; else Variable=1;
Total Bowel Incontinence: if H0400>0 then Variable=1; else Variable=0;
Treatment
Cancer Chemotherapy: if O0100A1=1 then Variable=1; else Variable=0;
Dialysis: if O0100J1=1 then Variable=1; else Variable=0;
Insulin: if N0350A>0 or N0350B>0 then Variable=1; else Variable=0;
IV Medications Continuing from Hospital: if O0100H1=1 and O0100H2=1 then Variable=1;
else Variable=0;
Ostomy Care: if H0100C=1 then Variable=1; else Variable=0;
Oxygen Continuing from Hospital: if O0100C1=1 and O0100C2=1 then Variable=1; else
Variable=0;
Radiation Therapy: if O0100B1=1 then Variable=1; else Variable=0;
Tracheostomy Continuing from Hospital: if O0100E1=1 and O0100E2=1 then Variable=1;
else Variable=0;

FORMULA

LogOdds =		-2.9658 +
End Stage Prognosis	*	-0.7109+
Hospice Care	*	-1.4028+
Anemia	*	0.1188+
Asthma	*	0.1125+
Daily Pain	*	0.0940+
Diabetes Mellitus	*	0.0711+
Diabetic Foot Ulcer	*	0.1389+
Dialysis	*	0.6328+
Insulin	*	0.1772+
Ostomy Care	*	0.3993+
Pressure Ulcer Stage 2	*	0.1816+
Pressure Ulcer Stage 3	*	0.1558+
Pressure Ulcer Stage 4	*	0.0971+
Pressure Ulcer Unstageable	*	0.1907+
Septicemia	*	0.0407+
Total Bowel Incontinence	*	0.1970+
Venous Arterial Ulcer	*	0.1830+
Viral Hepatitis	*	0.3793+

Age Under 65	*	0.0619+
Chemotherapy	*	0.5697+
IV Medication Continued from Hospital	*	0.1899+
Oxygen Continuing from Hospital	*	0.3394+
Tracheostomy Continuing from Hospital	*	0.0697+
Eating Dependency	*	0.5957+
Heart Failure	*	0.1934+
Internal Bleeding	*	1.0899+
Male	*	0.1465+
Return to Same SNF Following Hospitalizations	*	0.2443+
Medicare	*	0.4894+
Two Person Assist Required for One or More ADLs	*	0.2364+
Radiation Therapy	*	0.5066+
Respiratory Failure	*	0.1729+
Cognition Not Completely Intact	*	0.3421;

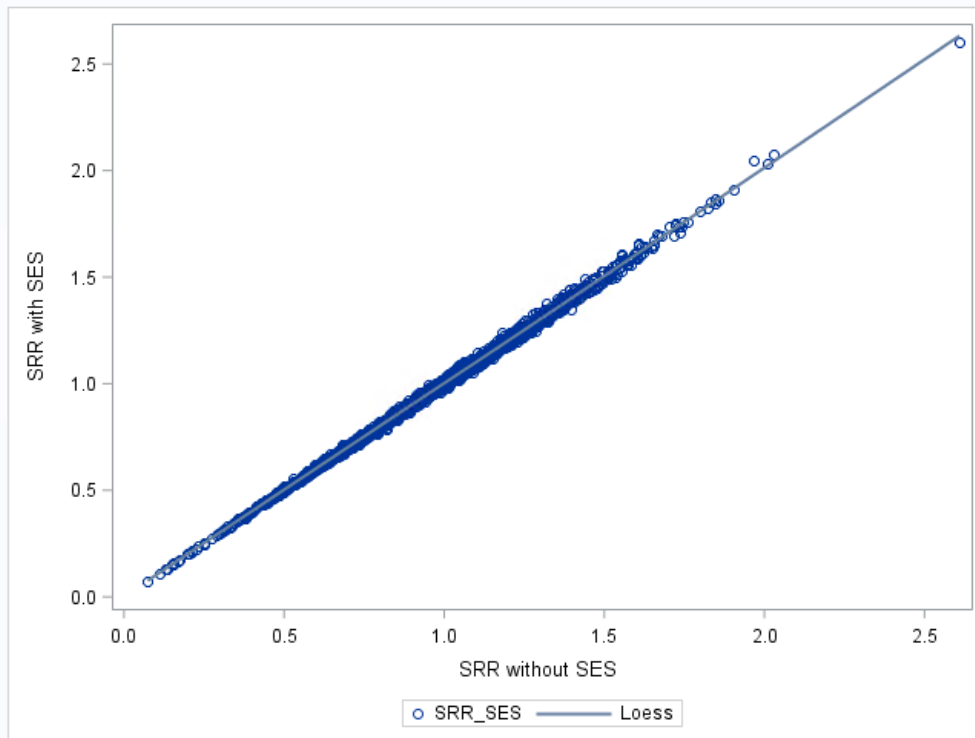
30day_Rehosp_Risk_Probability= $1/(1+\exp(-\text{LogOdds}))$

Question 10. Compare measure performance scores with and without SDS factors in the risk adjustment model. Include the method of testing conducted to compare performance scores with and without SDS factors in the risk adjustment model for the same entities, the statistical results from testing the differences in the performance scores with and without SDS factors in the risk adjustment model. (e.g., correlation, rank order) and provide an interpretation of your results in terms of the differences in performance scores with and without SDS factors in the risk adjustment model for the same entities.

We performed three comparisons of the risk adjusted rates of the PointRight® Pro 30™ model as it is currently specified versus implementing our two-stage risk model including the SDS factors married, Medicaid enrollment, and black. First, a simple scatter plot between the rates. Second, a simple correlation between the plots. Third, a cross-tabulation of the decile ranking under the two methodologies.

First, Figure 2 presents a scatter plot of the risk adjusted rates without the SDS factors (X-axis) against those with the SDS factors (Y-axis). The facilities form an almost perfect line along the least squares line.

Figure 2. Scatter plot of SNF-level risk adjusted Pro 30 rates without (X) vs with (Y) SDS factors



Second, we calculated the correlation coefficient between the two versions of rates. The Pearson's correlation coefficient was 0.99900 with a p-value < 0.0001. This is an almost perfect match between the rates without vs with SDS factors.

Third, we produced a cross-tabulation of the facility decile rankings under without vs with SDS factors. See Table 10. Replacing the existing Pro 30 risk adjustment model with a logistic regression that includes black race, Medicaid status and marital status, with coefficients for race and Medicaid plugged in from a fixed effects model, has minimal effect on the qualitative classification of facilities as under-performing or over-performing. Only one of 2760 facilities changes by more than one decile - a single facility went from 6th decile under the old model to 4th decile under the new one. 499 of the 2,760 facilities tested move 1 decile in their SRR rank. Only 1 SNF has a jump of two deciles.

Table 10. Comparison of SRR Distribution between Original Pro 30 and Pro 30 with SDS

		Decile of SRR (O/E) With Plug-In Model Including New SDS Variables for Risk Adjustment										
		1	2	3	4	5	6	7	8	9	10	Total
Decile of SRR Using the Current Pro30 Model	1	260	16	0	0	0	0	0	0	0	0	276
	2	16	233	27	0	0	0	0	0	0	0	276
	3	0	27	223	26	0	0	0	0	0	0	276
	4	0	0	26	212	38	0	0	0	0	0	276
	5	0	0	0	37	195	44	0	0	0	0	276
	6	0	0	0	1	43	195	37	0	0	0	276
	7	0	0	0	0	0	37	206	33	0	0	276
	8	0	0	0	0	0	0	33	217	26	0	276
	9	0	0	0	0	0	0	0	26	234	16	276
	10	0	0	0	0	0	0	0	0	16	260	276
	Total	276	276	276	276	276	276	276	276	276	276	2760

These three analyses confirm that adding SDS factors does almost nothing to the risk adjusted rates generated by the measure.

Question 11. Appendix (includes literature review, reference list, etc.)

N/A