Data and Methods

Risk-Adjusted PU Quality Measure

For the New York State Pay-for-Performance Program

Data used in this study came from the MDS data from all nursing home facilities in New York State for chronic care (long-stay) residents for the period of July 1, 2006 through June 30, 2008. The risk-adjusted pressure ulcer rate is calculated using EQUIP predicted model. We estimate a logistic regression model based on the most recent non-admission assessment for each resident in each quarter for the period of July 1, 2006 through June 30, 2008. The model generates probability of having pressure ulcer for each resident. The average probability is defined as an expected pressure ulcer rate for each facility given its resident characteristics that are related to the likelihood of developing a pressure ulcer. The expected rate of a facility is compared to its observed rate and a risk-adjusted pressure ulcer rate for each facility can be calculated (please see the technical specs at the end of this summary). The risk-adjusted rates allow "apples to apples" comparisons across facilities since population differences are fully accounted for. Because residents characteristics that are out of control of the facility are accounted for, we can attribute differences in pressure ulcer rates to differences in the quality of care provided.

The dependent variable of the model is an indicator of having pressure ulcer of stage 1-4. The explanatory variables are selected based on the literature and our analysis. These explanatory variables are from current and historical MDS data identifying resident characteristics that are not under the control of the facility but put residents at risk for developing a pressure ulcer. Residents who came to facility with pressure ulcer have high risk to continue having a pressure ulcer or to develop a new pressure ulcer. Since these pressure ulcers are not under the control of facilities then this variable is included in the model. History of resolved pressure ulcer is also included in the model because residents with history of developing pressure ulcer have higher risk of developing a new pressure ulcer. Other factors included in the model are chronic conditions and physical functioning that are related to the likelihood of developing pressure ulcer. Those factors are comatose condition, low body mass index, malnutrition,

end-stage disease, impaired in bed mobility, impaired in transfer, bedfast, bowel incontinence, diabetes, congestive heart failure, deep vein thrombosis, peripheral vascular disease, missing limb, Parkinson's disease, paraplegia/quadriplegia, anemia, cancer, renal failure, edema, and desensitized skin. We also include a dummy variable identifying resident aged 17 years or younger. This variable will lower the expected rate of pediatric facilities as pediatric residents have much lower risk of developing a pressure ulcer than old residents have. There are some other risk factors that are not included in the model because their effects are picked up by the included variables.

Table 1 presents the coefficient estimates of the logistic regression model. These coefficient estimates are used to calculate an expected rate of PU for each facility based on its resident risk factors. The table shows that the coefficient estimates of some variables are smaller than expected. This should not be interpreted as that the variables are not important risk factors for developing pressure ulcer, but it could be due to their effects are shared with other variables. For example, the coefficient estimate of comatose is very small compared to the other variables. This small coefficient can not be interpreted as comatose is not an important factor of developing pressure ulcer, but it is due to residents in comatose condition are also in total dependent in bed mobility and transfer, where these 2 variables are included in the model.

The pressure ulcer rates are calculated based on the most recent non-admission assessments for each resident in each quarter for thee different one-year periods. The first period is used for the award of best performers, which is from January 1, 2007 through December 31 2007. The other 2 periods is base and evaluation periods for the award of best improvement. The base period for the best improvement is from July 1, 2006 through June 30, 2007 and the evaluation period is from July 1, 2007 through June 30, 2008. Each period consists of 4 quarter data, so that each resident could have up to 4 assessments used in the calculation of the rate. The purpose of pooling 4 quarter data for the calculation of the rates is to have a more stable measure, especially for small facilities. In addition, pooling 4 quarters of data also could eliminate a seasonal factor that might exist in the measure.

Table 1:

The Coefficient Estimates Used in the Calculation of the Risk-adjusted PU Rates based on MDS data from July1, 2006 through June30, 2008 and AA8a=2,3,4,5,10

Variable	Definition	Coefficient	p-value
Intercept		-4.919	<.0001
PU stage 1 at admission	M2a=1 at admission	0.375	<.0001
PU stage 2 at admission	M2a=2 at admission	0.628	<.0001
PU stage 3 at admission	M2a=3 at admission	1.150	<.0001
PU stage 4 at admission	M2a=4 at admission	1.768	<.0001
Male	AA2=1	0.269	<.0001
Children	Age<=17	-1.678	<.0001
Comatose	B1=1	0.129	0.0072
Low body mass index	BMI<18.5	0.683	<.0001
Malnutrition	ICD-9=260,261,262,263,263.0, 263.1,263.2,263.8,263.9	0.514	0.0002
End-state disease	J5c=1	0.616	<.0001
Bed mobility: limited assistance	G1aa=2	0.316	<.0001
Bed mobility: extensive assistance	G1aa=3	0.646	<.0001
Bed mobility: total dependence	G1aa=4,8	0.931	<.0001
Transfer: limited assistance	G1ba=2	0.612	<.0001
Transfer: extensive assistance	G1ba=3	1.001	<.0001
Transfer: total dependence	G1ba=4,8	1.499	<.0001
Bedfast all or most of time	G6a=1	0.658	<.0001
Bowel incontinence	H1a=4	0.182	<.0001
Diabetes	I1a=1 or ICD-9	0.295	<.0001
Congestive heart failure	I1f=1 or ICD-9	0.130	<.0001
Deep vein thrombosis	I1g=1 or ICD-9	0.246	<.0001
Peripheral vascular disease	I1j=1 or ICD-9	0.103	<.0001
Missing limb	I1n=1	0.158	<.0001
Parkinson's disease	I1y=1 or ICD-9	0.080	<.0001
Paraplegia/Quadriplegia	I1x=1 or I1z=1 or ICD-9	0.526	<.0001
Anemia	I1oo=1 or ICD-9	0.221	<.0001
Cancer	I1pp=1 or ICD-9	0.199	<.0001
Renal failure	I1qq=1 or ICD-9	0.296	<.0001
Edema	J1g=1	0.458	<.0001
Had an ulcer resolved in last 90 days	M3=1	0.778	<.0001
Desensitized skin/decreased sensory perception	M4e=1	0.291	<.0001

Technical Specs of the Risk-Adjusted PU Quality Measures

Unadjusted QM Rate (Observed Rate):

Numerator: Residents with pressure ulcers (stage 1-4) on target assessment (M2a>0 or I3a-I3e=ICD-9 707.0).
Denominator: All residents with a valid target assessment (AA8a=2, 3, 4, 5, or 10).
Exclusion: The QM did not trigger (resident is not included in the QM numerator) and the value of M2a is missing on the target assessment.

Expected QM Rate:

Resident-level expected QM score = $\frac{1}{1+e^{-(c_0+c_1x_1+\ldots+c_kx_k)}}$

Where $x_1, \ldots, x_k$ are variables included in the logistic regression, c_0 is the logistic regression constant, c_1 is the logistic regression coefficient (from table 1) for the first variable (x_1), and so on.

Facility-level expected QM rate is the average of resident-level scores in the facility.

Risk-Adjusted QM Rate:

Risk-adjusted QM Rate = $\frac{1}{1+\exp(-y)}$

Where $y = \ln\left(\frac{Obs}{1-Obs}\right) - \ln\left(\frac{Exp}{1-Exp}\right) + \ln\left(\frac{State}{1-State}\right)$,

Obs is the facility-level unadjusted QM rate (observed rate),
Exp is the facility-level expected QM rate,
State is the state average unadjusted QM rate,
Ln is a natural logarithm,
e is the base of natural logarithm.