Comorbidity Adjustment Strategy

The primary model for comorbidity adjustment will be through the use of Hierarchical Condition Categories (HCC), reflecting the risk adjustment methodology used by CMS and recently evaluated by NCQA for their Relative Resource Use (RRU) measures. However, there is an important distinction between the use of HCCs by CMS and the model evaluated by NCQA and the objective of this project. The CMS and NCQA model use HCCs to adjust for TOTAL costs of care whereas, we are focused on the episode-specific costs of care. Briefly, NCQA has created weights for each of the HCCs on total costs of care using data from a large population that has one of the conditions in their RRU measure. These weights can then be applied to different populations to adjust for the presence of comorbid conditions when estimating total costs. This method has been tested in three health plans with varying degrees of success in the implementation of this model for risk adjustment. The primary concern with applying the adjustment factors available from either CMS or NCQA are the fact they are total costs and not related to the episode-specific costs of care. Therefore, it is important that we consider this when developing our risk adjustment methodology for episode based costs.

We plan to control for different comorbidities for each condition because patients with each of the measurement conditions may have very different risk profiles. Therefore, we propose to evaluate a risk adjustment model for each of the conditions independently. For each of the conditions we propose to use the following strategy for comorbidity adjustment:

1. The base case for identification of comorbid conditions for each of the measures will be for the 12 month period prior to the beginning of the episode. Both inpatient and outpatient claims will be used to identify comorbidities based on the HCC algorithm.
2. From the HCC list of 70 conditions used by CMS (Table 1), the work group will categorize comorbidities into three groups. The 70 conditions used by CMS were reduced from a total of 189 unique categories. Several conditions were not included in the original HCC payment model and others are not relevant to the CMS population (e.g. child delivery categories). Therefore, we will focus on the 70 conditions that are used in the current HCC models by CMS. Work groups will categorize this comorbidities into one of the following categories:

   a) definitely include;

   b) possibly include; or

   c) exclude.

   Each of the work groups were surveyed on the HCC factors to be included in a risk adjustment model. Each HCC was then categorized into one of the above groups based on survey responses. Survey responses were reviewed with each of the work groups, where they were allowed to move HCCs to one of the other categories if there was group consensus. Sequential regression models will be fit using the HCCs identified in the definitely and possibly include lists. Items in the ‘exclude’ list will not be considered for inclusion in the regression model.

3. The impact of each of the combinations of HCCs on the predicted costs will be evaluated sequentially for each of the episodes. First, a regression model will be

fit that includes all of the HCCs identified by the work group on the definitely include list, along with other important adjusters (e.g. age, sex). A second model will be fit that includes only those covariates where $p<0.1$ from the original model. Next, the HCCs from the ‘possibly include’ list will be added to the regression model. Only those ‘possibly include’ HCCs where $p<0.1$ will be included in a subsequent model. Models with all of the HCCs included as covariates and the subset of all the HCCs where $p<0.1$ will be fit. For each of the analyses, we will use Generalized Linear Models where two versions of the models are fit for each iteration of the model that is tested. A model with a gamma distribution and a log link function and then a model with a normal distribution and an identity link function will be fit. The first will produce beta-coefficients in log costs while the second will produce beta-coefficients in dollars.

4. Models will be evaluated by comparing observed and predicted values, mean squared errors, absolute differences between predicted and observed and the observed-to-expected ratio. We will preferentially recommend models that perform better than other models, with the overall goal of arriving at the most parsimonious model in an effort to facilitate implementation of the risk adjustment models. Therefore, we will select a model in dollars over one if log dollars if the models perform similarly.

5. For each condition, we will develop the model in a 75% sample of the population and test the model in the remaining 25%. Model performance characteristics will be examined in both the development and test samples.

6. Risk adjustment models will be estimated separately for the commercial and Medicare populations. We anticipate differences in the risk profile of the population could result in substantial differences in the risk adjustment models.

Table 1. Hierarchical condition categories used by CMS for consideration in risk adjustment models

HCC	Label
1	HIV/AIDS
2	Septicemia/Shock
5	Opportunistic Infections
7	Metastatic Cancer and Acute Leukemia
8	Lung, Upper Digestive Tract, and Other Severe Cancers
9	Lymphatic, Head and Neck, Brain, and Other Major Cancers
10	Breast, Prostate, Colorectal and Other Cancers and Tumors
15	Diabetes with Renal or Peripheral Circulatory Manifestation
16	Diabetes with Neurologic or Other Specified Manifestation
17	Diabetes with Acute Complications
18	Diabetes with Ophthalmologic or Unspecified Manifestation
19	Diabetes without Complication
21	Protein-Calorie Malnutrition
25	End-Stage Liver Disease
26	Cirrhosis of Liver
27	Chronic Hepatitis
31	Intestinal Obstruction/Perforation
32	Pancreatic Disease
33	Inflammatory Bowel Disease
37	Bone/Joint/Muscle Infections/Necrosis
38	Rheumatoid Arthritis and Inflammatory Connective Tissue Disease
44	Severe Hematological Disorders
45	Disorders of Immunity
51	Drug/Alcohol Psychosis
52	Drug/Alcohol Dependence
54	Schizophrenia
55	Major Depressive, Bipolar, and Paranoid Disorders
67	Quadriplegia, Other Extensive Paralysis
68	Paraplegia
69	Spinal Cord Disorders/Injuries
70	Muscular Dystrophy
71	Polyneuropathy
72	Multiple Sclerosis
73	Parkinsons and Huntingtons Diseases
74	Seizure Disorders and Convulsions
75	Coma, Brain Compression/Anoxic Damage
77	Respirator Dependence/Tracheostomy Status
78	Respiratory Arrest
79	Cardio-Respiratory Failure and Shock
80	Congestive Heart Failure
81	Acute Myocardial Infarction
82	Unstable Angina and Other Acute Ischemic Heart Disease
83	Angina Pectoris/Old Myocardial Infarction
92	Specified Heart Arrhythmias
95	Cerebral Hemorrhage
96	Ischemic or Unspecified Stroke
100	Hemiplegia/Hemiparesis

101 Cerebral Palsy and Other Paralytic Syndromes
104 Vascular Disease with Complications
105 Vascular Disease
107 Cystic Fibrosis
108 Chronic Obstructive Pulmonary Disease
111 Aspiration and Specified Bacterial Pneumonias
112 Pneumococcal Pneumonia, Emphysema, Lung Abscess
119 Proliferative Diabetic Retinopathy and Vitreous Hemorrhage
130 Dialysis Status
131 Renal Failure
132 Nephritis
148 Decubitus Ulcer of Skin
149 Chronic Ulcer of Skin, Except Decubitus
150 Extensive Third-Degree Burns
154 Severe Head Injury
155 Major Head Injury
157 Vertebral Fractures without Spinal Cord Injury
158 Hip Fracture/Dislocation
161 Traumatic Amputation
164 Major Complications of Medical Care and Trauma
174 Major Organ Transplant Status
176 Artificial Openings for Feeding or Elimination
177 Amputation Status, Lower Limb/Amputation Complications