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Mode and Patient-Mix Adjustment of the Long-term Care Hospital Experience of Care Survey

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Abstract

The purpose of this document is to explain the process for developing adjustments for mode and patient risk factors on the Long-term Care Hospital Experience of Care (LTCH EOC) Survey. Mode and patient risk adjustment, also known as patient-mix or case mix adjustment, is a statistical process that adjusts facility performance scores up or down to account for significant sources of bias in facilities' data that are beyond their control. The adjustments were developed based on data from a mode experiment of 1,364 patients discharged from 62 LTCHs. Patients were randomized to three modes: mail-only mode, mixed-mode (mail with telephone follow-up) and in-facility. The analyses found that mode of data collection and the following 8 patient risk factors significantly affect survey scores, and therefore should be included in adjustments of facility scores: age, sex, overall health, overall mental or emotional health, marital status, education, race, and type of respondent (patient or proxy). First, the final mode and patient-mix adjustment model was applied to the survey data; then, a nonresponse bias analysis was conducted. This revealed that nonresponse-adjusted weights were not needed to further adjust the adjusted facility scores.

Typically, the coefficients of patient risk adjusters are updated using survey data each survey period. The set of patient risk adjusters determined through the mode experiment is retained. The coefficients for mode adjusters determined through the mode experiment are reused each survey period (see Recommended Mode and Patient-mix Adjustment Model section).

Currently, CMS is not implementing the LTCH EOC Survey but may do so after future Rulemaking. This explanation of mode and patient-mix adjustment as well as the survey materials for implementing the LTCH EOC Survey are in the public domain and may be used by any LTCH or survey vendor that wishes to do so.

Introduction

The intent of the LTCH EOC Survey is to provide a standardized instrument and data collection methodology for measuring the experience of the consumers—consisting of the patient and their family or caregiver(s)—in LTCHs. These materials provide a mechanism for LTCHs to study and improve patient experience, for CMS to monitor quality in CMS-approved LTCHs, and for consumers to view publicly available and reliable information when making decisions about seeking care in LTCHs.

To ensure that publicly reported LTCH EOC performance scores allow fair and accurate comparisons across LTCHs, it is necessary to adjust for factors not in the control of LTCHs that affect patient's perspectives of care. The mode experiment studied the impact of three types of factors that could affect how patients/proxies evaluate experience of care.

- 1) Mode of survey administration. LTCHs will be given a choice of administering the survey in one of three modes: mail-only, mixed-mode (mail with telephone follow-

- up), and in-facility. The mode of administration can systematically impact patient responses; therefore, it is necessary to measure these impacts, if any, and adjust for them if they are present.
- 2) Patient characteristics. Certain patient characteristics, such as education, age, and health status, can systematically impact patients' survey responses. For example, individuals with higher levels of education tend to give statistically significantly lower scores compared to individuals with a high school education. If a facility had an above-average prevalence of higher-educated people, that facility's performance scores would suffer as a result. Therefore, this facility's performance scores would have to be adjusted higher in accordance with the education level of its respondents. This is a simple example of only one factor, education, but in reality, these adjustments are determined in a multivariate approach that evaluates the relative impact of all potential factors.
 - 3) Nonresponse. Frequently, certain types of individuals systematically participate at lower or higher rates compared to other types of individuals. Should these differential participation rates result in skewed survey estimates, then the survey data will be biased.

LTCH EOC Survey Mode Experiment

Sixty-nine LTCHs (representing 62 CMS Certification Numbers (CCNs)) participated in the mode experiment. They represented a diverse group in terms of number of beds, geographic location, urban versus rural, and whether they were part of a large health system with multiple LTCHs. Most of the participating LTCHs were already surveying all their patients using proprietary surveys, and agreed to suspend these surveys to participate in the mode experiment. All eligible patients discharged in the months of April, May, and June, 2017 were included in the survey sample. To assure uniformity in administration, a single organization, RTI International, conducted all surveys. The survey was designed to obtain a minimum of 394 completed surveys per mode.

RTI randomly assigned all eligible April and May discharged patients to either the mail-only mode or the mixed-mode, while all June discharged patients were assigned to the in-facility mode. *Table 1* displays the response rates from the LTCH EOC Survey mode experiment.

Table 1
Response rates from LTCH EOC survey mode experiment

	Mail-only mode	Mixed-mode	In-facility mode	Total
Sample size	2,156	2,160	2,379	6,695
Completed surveys	318	517	529	1,364
Response rate	14.7%	23.9%	22.2%	20.4%

Analysis of the LTCH EOC Survey Mode Experiment

Composite Scoring

The following survey items created the four composites and two global ratings:

- Global rating 1: 0 to 10 rating of the hospital (calculated from Q32)
- Global rating 2: Likelihood to recommend this hospital (calculated from Q33)
- Composite 1: Goal setting and monitoring (calculated from survey Qs 1, 2, 3, and 14)
- Composite 2: Communication with staff at the LTCH (calculated from survey Qs 5, 6, 8, 9, 11, 12, 13, 15, 16, and 17)
- Composite 3: Experience at this LTCH (calculated from survey Qs 18, 19, 20, 21, 22, 24, 25, 26)
- Composite 4: Preparing for leaving the LTCH (calculated from survey Qs 28, 29, 30, and 31)

The method used for coding the global ratings and composites was a binary top-box approach. The global rating was 1 (top-box) if the respondent's rating was 9 or 10, 0 if the respondent's rating was any score from 0 to 8, and missing if the respondent did not respond. Similarly global rating 2 was coded as 1 (top-box) if the respondent answered "definitely yes," and other responses were coded a 0. Missing values remained missing. The scoring for the questions comprising the composites was similar except the 1 (top-box) was assigned to responses that were the most positive response category ("always," "yes, definitely," "strongly agree"). This recoding occurred at the individual respondent level.

The facility score on each composite is calculated as the mean of the proportion of top-box responses for each component question in a composite. For example, the calculation of a facility's score for composite 4 will take the proportions of top-box responses for Q28, Q29, Q30, and Q31; it will then average these four proportions.

When facility performance scores are risk adjusted on the LTCH EOC Survey, the adjustments are applied to the proportion of top-box responses for each component question. The proportions post-adjustment are then averaged across the composite, as described above.

Determining the Mode and Patient-Mix Factors

Descriptive statistics were calculated for all candidate patient-mix variables (independent variable) as well as all survey items (dependent variables) to check on the number of missing values for each variable, and the sufficiency of sample sizes in each response category. The candidate variables were: mode of survey administration, age, sex, length of stay, overall health, overall mental or emotional health, marital status, highest grade or level of school completed, ethnicity, race, language spoken at home, patient functioning at admission (based on three function measures reported by LTCHs on the Continuity Assessment Record and Evaluation

[CARE] dataset), primary medical condition category (acute onset versus chronic), and respondent type (proxy versus patient).

Next, a correlation analysis was conducted on the patient risk variables. Highly correlated independent variables can cause problems for estimating regression models when both of the correlated variables are included in the models. This analysis included calculating both Pearson correlation coefficients and variance inflation factor (VIF) statistics. The results of the Pearson correlation coefficients and VIFs were used to identify changes needed in the proposed set of patient-mix variable or whether certain categories should be combined.

Next, 28 multivariate regression models were estimated—one for each survey item comprising the four composites plus the two global rating items. The individual patient was the unit of analysis. All independent variables previously noted were included. A facility indicator variable was included as a fixed effect to isolate the effects of potential model and patient-mix variables from the facilities' own characteristics of providing care. Generally, the linear form of the multivariate regression models was:

$$\text{Dependent variable} = \text{sum of (coefficients*mode indicators)} + \text{sum of (coefficients*patient characteristic indicators)}$$

Independent variables that were not statistically significant for any of the regression models were sequentially dropped, and the models rerun. To determine the best model, an impact analysis was conducted. Facility-level scores were created from the predicted values of each model and compared to determine the impact of dropping variables on the facility-level predicted values. As part of this analysis, we explored whether an acceptable model that did not use sample frame data (i.e., length of stay, patient functioning, and primary medical condition category) could be developed. This was because matching sample frame data to responding patients in the in-facility mode was error-prone.

Analysis of Unit and Item Nonresponse

Unit Nonresponse and Nonresponse Bias Analysis

A logistic regression analysis that included all patient variables known for both respondents and nonrespondents, as well as facility stratification variables of number of beds and urban/rural, was conducted. It revealed that younger patients, female patients, patients with length of stay longer than 33 days, patients with functioning scores equal or below median, patients from LTCHs in urban locations, and larger sized LTCHs had statistically significant lower response propensity.

The statistically significant predictors of response propensity were included in the final logistic regression model.

Each respondent's predicted response propensity was output. Each respondent's nonresponse-adjusted weight was calculated as the reciprocal of the predicted response propensity. Finally, the Pearson correlation coefficients between the nonresponse-adjusted

weights and the residuals from regression models including mode and the final set of patient risk factors for all 28 survey items were calculated.

No statistically significant correlations between the nonresponse adjusted weights and the residuals from regression models were found. Therefore, when using the final mode and patient-mix adjustment model, nonresponse-adjusted weights are not needed to further adjust the patient risk-adjusted facility scores.

Item Missing Data

Surveys can be affected by item missing data, such as when a patient/proxy elects to leave a question blank. Should a patient/proxy not answer a survey item that is part of a composite, the patients' and the facility's top-box scores are not impacted because the calculation method drops all missing responses from both numerator and denominator. Therefore, missing data do not lower performance scores.

Should data be missing on patient risk adjustment variables within the survey, it is recommended to impute missing values using hot-deck imputation with facility as the imputation class variable. The imputed data can be used for computing the adjusted facility-level performance scores.

RECOMMENDED MODE AND PATIENT-MIX ADJUSTMENT MODEL

The final recommended model has mode of data collection and the following 8 patient risk variables: patient age, patient sex, overall health, overall mental health, marital status, education, race, and type of respondent. The data source for all variables is the survey data, making it unnecessary to match a returned survey back to that patient's frame data for the purposes of patient-mix adjustment. The 28 adjusted R-squared values assess the fit of model. These 28 R-squared values ranged from 0.034 to 0.185. The median value was 0.115, the 25th percentile 0.094, and the 75th percentile 0.139.

Table 2 shows the mode adjustments in the recommended model. One mode must be chosen as the reference category (RC). Any mode can be chosen, and this analysis chose in-facility as the reference category. This mode was shown to significantly raise scores on all survey questions except for Q19. Therefore, the mode adjustments for the mail-only mode and mixed-mode are positive, except for Q19, which is negative.

Table 2
Mode adjustments from the LTCH EOC mode experiment

		Mail-only	Mixed-mode	In-facility
Global Rating 1	Q32 Using any number from 0 to 10, where 0 is the worst hospital possible and 10 is the best hospital possible, what number would you use to rate this hospital?	0.1473	0.1475	RC
Global Rating 2	Q33 Would you recommend this hospital to a family member or friend?	0.1826	0.1484	RC
Goal Setting and Monitoring Composite	Q1 Within the first week of this hospital stay, did the staff explain to the patient or the family/friend involved with the patient's care what to expect during the stay?	0.1391	0.1799	RC
	Q2 Within the first week of this hospital stay, did the staff ask the patient or the family/friend involved with the patient's care about aspects of care and treatment that were important to the patient?	0.2022	0.1863	RC
	Q3 Within the first week of this hospital stay, did the staff work with the patient or the family/friend involved with the patient's care to set patient's goals of care?	0.1984	0.1766	RC
	Q14 During this hospital stay, was the patient or the family/friend involved with the patient's care able to discuss needs and concerns with the staff?	0.1739	0.1351	RC
Communication with Staff at the LTCH Composite	Q5 During this hospital stay, how often did the doctors treat the patient and the family/friend involved with the patient's care with courtesy and respect?	0.0727	0.0496	RC
	Q6 During this hospital stay, how often did the doctors explain things in a way the patient or the family/friend involved with the patient's care could understand?	0.0499	0.0339	RC
	Q8 During this hospital stay, how often did the nurses treat the patient and the family/friend involved with the patient's care with courtesy and respect?	0.1288	0.1253	RC

(continued)

Table 2 (continued)
Mode adjustments from the LTCH EOC mode experiment

		Mail-only	Mixed-mode	In-facility
Communication with Staff at the LTCH Composite (continued)	Q9 During this hospital stay, how often did the nurses explain things in a way the patient or the family/friend involved with the patient's care could understand?	0.1572	0.1590	RC
	Q11 During this hospital stay, how often did the therapy staff treat the patient and the family/friend involved with the patient's care with courtesy and respect?	0.1089	0.1074	RC
	Q12 During this hospital stay, how often did the therapy staff explain things in a way the patient or family/friend involved with the patient's care could understand?	0.1546	0.1522	RC
	Q13 During this hospital stay, did the patient or the family/friend involved with the patient's care receive the same information from the different staff at the hospital about the patient's care?	0.1038	0.0955	RC
	Q15 During this hospital stay, how often did the staff give encouragement and support to the patient or the family/friend involved with the patient's care?	0.2256	0.2164	RC
	Q16 During this hospital stay, how often did the staff treat the patient and the family/friend involved with the patient's care with courtesy and respect?	0.1992	0.1765	RC
	Q17 During this hospital stay, did the staff keep the patient or the family/friend involved with the patient's care informed about the patient's condition and treatment?	0.1098	0.0865	RC
Experience at this LTCH Composite	Q18 How often was the patient's room kept clean?	0.1031	0.0972	RC
	Q19 How often was the area around the patient's room quiet at night?	0.0267	-0.0244	RC

(continued)

Table 2 (continued)
Mode adjustments from the LTCH EOC mode experiment

		Mail-only	Mixed-mode	In-facility
Experience at this LTCH Composite (continued)	Q20 During this hospital stay, the staff were considerate of the patient’s personal privacy—such as when washing, dressing, or toileting.	0.1762	0.1455	RC
	Q21 During this hospital stay, the patient’s personal hygiene needs were met.	0.1432	0.0812	RC
	Q22 During this hospital stay, the patient’s psychological or spiritual needs were met.	0.1751	0.1405	RC
	Q24 During this hospital stay, the staff frequently assessed whether the patient was in physical pain.	0.2128	0.2056	RC
	Q25 During this hospital stay, the staff were responsive to the patient’s physical pain.	0.1965	0.1997	RC
	Q26 During this hospital stay, the staff gave options about different ways to manage the patient’s physical pain.	0.2355	0.2072	RC
Preparing for Leaving the LTCH Composite	Q28 Towards the end of this hospital stay, did the staff provide the patient or the family/friend involved with the patient’s care with information about discharge including where the patient was going after leaving this hospital and why?	0.1847	0.1292	RC
	Q29 Towards the end of this hospital stay, did the staff provide the patient or the family/friend involved with the patient’s care with written information about the care necessary after discharge?	0.1443	0.1095	RC

(continued)

Table 2 (continued)
Mode adjustments from the LTCH EOC mode experiment

		Mail-only	Mixed-mode	In-facility
Preparing for Leaving the LTCH Composite (continued)	Q30 Towards the end of this hospital stay, did the staff provide the patient or the family/friend involved with the patient's care with information about the medication to be taken after discharge, including what the medication was for, how to take it, and possible side effects	0.1577	0.1078	RC
	Q31 Towards the end of this hospital stay, did the staff inform the patient or the family/friend involved with the patient's care that they could contact this hospital with any questions or concerns after the patient left this hospital?	0.2122	0.1960	RC

SAMPLE SIZE AND RESPONSE RATES

Given the variability between facilities in the test data and the variability within facilities, and assuming facility scores are adjusted using the recommended model, a sample size of 110 is sufficient to derive a statistically significant F value and produce a reliability coefficient (signal-to-noise ratio) equal to or above the recommended 0.70 level. With a facility sample of 110, point estimates have sufficient statistical power to be used with confidence by CMS, by an individual facility interested in its own results for quality improvement purposes, and by a consumer comparing one facility to a mean of many facilities. For example, if Facility A has 110 completes annually, and it has a top-box measure score of 70% or higher, or 30% or lower, this score is precise with a margin of error of +/- 8.5 percentage points. This target will also allow a consumer to compare Facility A's score on a measure to the mean of many facilities to decide if Facility A is better or worse than the mean on that measure.

The response rates observed in the mode experiment are noted in **Table 3**. This experience, as well as an LTCH's own experience with response rates on surveys it may be conducting, should guide the LTCH in the number of cases to sample to obtain the target of 110 completes per year.

Table 3
Planning the sample size for the LTCH EOC based on observed response rates

Mode	Observed response rate	Sample size per month for 10 responses/month (or 110 responses/year)
Mail-only	14.70%	68
Mixed	23.90%	42
In-facility	22.20%	45

If an LTCH's patient volume exceeds the sample size needed to obtain 110 completes annually, the LTCH may direct its vendor to select a random sample of patients. We recommend that acceptable sampling methods are simple random sampling, proportionate stratified random sampling, and disproportionate stratified random sampling. If the LTCH wishes to receive more survey data, it may direct the vendor to survey all eligible patients. If an LTCH's patient volume is lower than the sample sizes needed to obtain 110 completes annually, the LTCH will need to direct the vendor to survey all patients.