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Methodology for Producing Star Ratings for In-Center Hemodialysis CAHPS Survey Ratings and Composite Measures

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## Recommended Method for Calculating Star Ratings for ICH CAHPS Survey Measures

### 1. Overview

The In-center Hemodialysis Consumer Assessment of Healthcare Providers and Systems (ICH CAHPS) Survey is conducted to collect data from patients about the hemodialysis care they receive from Medicare-certified in-center hemodialysis (ICH) facilities. Survey results from the national implementation of the survey are used by consumers to help inform their choice of a hemodialysis center, by ICH facilities in their quality initiatives, and by the Centers for Medicare & Medicaid Services (CMS) to monitor the quality of care provided to patients with end-stage renal disease. The national implementation of the survey is conducted with samples of hemodialysis patients 18 years old and older who receive outpatient hemodialysis for 3 months or longer at their ICH facility.

The ICH CAHPS Survey is conducted on a semiannual basis. The Spring Survey is typically conducted from April through early July of each year, with sample patients who received in-center hemodialysis in October through December of the previous year. The Fall Survey is conducted from October through early January with sample patients who received in-center hemodialysis in April through June of that year. Data from the two most recent survey periods are combined and analyzed to produce survey results that are publicly reported on Medicare.gov’s Care Compare. CMS updates the results on the compare tool on Medicare.gov each April and October. Survey results are publicly reported for each ICH facility that has 30 or more completed surveys combined in the two survey periods included in the public reporting period. The results that are publicly reported are statistically adjusted for mode effects and patient-mix.

CMS uses star ratings to publicly report the ICH CAHPS quality measures that are published on the compare tool on Medicare.gov. Star ratings make it easier for consumers to use the on Medicare.gov and spotlight excellence in health care quality. Star ratings are generated for each of the three publicly reported ICH CAHPS Survey global ratings (rating of the kidney doctors (nephrologists), dialysis center staff, and dialysis center) and three composite measures (kidney doctors’ (nephrologists’) communication and caring, quality of dialysis center and operations, and providing information to patients). These individual star ratings are shown in the Provider Data Catalog on Medicare.gov. An overall Survey summary star rating is calculated and shown on Medicare.gov’s Care Compare for each dialysis facility – this is called the Patient Survey Rating. The Survey summary star rating is a simple average of the six individual star ratings.

RTI International, which is assisting CMS with the national implementation of the ICH CAHPS Survey, analyzes ICH CAHPS Survey data to produce survey results that are publicly reported on the compare tool on Medicare.gov. RTI project staff developed methods for calculating star ratings for ICH facilities participating in the ICH CAHPS Survey. As part of developing a method for calculating star ratings, RTI project staff used data from the 2016 ICH CAHPS Spring and Fall Surveys to calculate linear means for each ICH facility. The linear means for the 2016 ICH Surveys are shown in ***Appendix A***. This information is provided for informational purposes only; the linear scores will not be publicly reported on the compare tool on Medicare.gov nor will they be provided to participating ICH facilities. Please note that the original report on star ratings, submitted in June 2017, was based on 2015 survey data and then was revised with using 2016 survey data.

### 2. Method for Producing Star Ratings for the ICH CAHPS Survey Measures

The ICH CAHPS measures that are publicly reported on the Medicare.gov’s Care Compare and a description of the method for producing star ratings for these measures are described in the following sections.

#### 2.1 ICH CAHPS Measures That Receive a Star Rating

ICH CAHPS star ratings are applied to each of the three publicly reported global ratings and three composite measures, which are created from specific questions on the ICH CAHPS Survey, as shown below.

* Global rating of kidney doctors (calculated from Q8 in the survey)
* Global rating of dialysis center staff (calculated from survey Q32)
* Global rating of dialysis center (calculated from survey Q35)
* Six questions that comprise the Kidney Doctors’ (Nephrologists’) Communication and Caring composite (Qs 3, 4, 5, 6, 7, and 9)
* Seventeen questions that comprise the Quality of Dialysis Center and Operations composite (Qs 10, 11, 12, 13, 14, 15, 16, 17, 21[[1]](#footnote-1)\*, 22, 24, 25, 26, 27, 33, 34, and 43)
* Nine questions that comprise the Providing Information to Patients composite (calculated from survey Qs 19, 28, 29, 30, 31, 36, 38, 39, and 40)
* Top-box scores are published on the compare tool on Medicare.gov for each of these six measures.
* The individual star ratings for these six measures are combined to create an overall survey summary star rating, called the Patient Survey Rating on Medicare.gov’s Care Compare, for each dialysis facility. The individual star ratings for each of the six measures can be found in the Provider Data Catalog.

#### 2.2 Methods for Calculating Star Rating

The methodology that is used to calculate a star rating for each ICH CAHPS Survey measure that is publicly reported is described below.

##### a. Construction and Adjustment of ICH CAHPS Linear Scores

The responses to the survey items used in each ICH CAHPS measure are combined as needed and converted to a 0–100 linear-scaled score. Responses to the ICH CAHPS Survey are converted to linear scores in the following manner:

For ICH CAHPS Survey global ratings (Survey items 8, 32, and 35)

* Overall Rating “0” = 0; Overall Rating “1” = 10; Overall Rating “2” = 20; …; Overall Rating “10” = 100

For ICH CAHPS Survey items 9, 16, 17, 19, 26, 28-31, 36, and 38-40:

* “No” = 0; and “Yes” = 100

For ICH CAHPS Survey items 3-7, 10-15, 21[[2]](#footnote-2)\*, 22, 24, 25, 27, 33, 34, and 43:

* 1 = 0; 2 = 33 1/3; 3 = 66 2/3; and 4 = 100

The 0–100 linear-scaled ICH CAHPS scores are statistically adjusted for data collection mode and for patient-mix to account for the tendency of certain patient subgroups to respond more positively or negatively to the ICH CAHPS Survey based on data collection mode and specific patient characteristics. Patient-mix adjustment allows for fair comparisons across all CCNs (CMS Certification Numbers) or ICH facilities by adjusting their scores as if all CCNs had an identical mix of patient characteristics. The patient-mix adjustment factors and coefficients for the 2016 ICH CAHPS Surveys are shown in Table 1 in ***Appendix A***, while Table 2 in ***Appendix A*** contains the national means for patient-mixvariables.

Averages of ICH CAHPS linear scores across two survey periods are rounded to integer values using standard rounding rules, as follows:

* Let X represent the unrounded two-period average for an ICH CAHPS linear score.
* If X is less than [X.5], then round down to nearest whole integer.
* If X is equal to or greater than [X.5], then round up to nearest whole integer.

##### b. Conversion of Linear Scores Into ICH CAHPS Star Ratings

After the ICH CAHPS scores are linearized, adjusted, and rounded, we assign 1, 2, 3, 4, or 5 *whole stars* (only whole stars are assigned; partial stars are not used) for each of the six ICH CAHPS measures by applying statistical methods that use relative distribution and clustering. We determine the star rating for each of the six ICH CAHPS measures by applying a clustering algorithm to the individual measure scores. Conceptually, the clustering algorithm identifies the “gaps” in the data and creates five categories (one for each star rating) such that scores of CCNs in the same score category (star rating) are as similar as possible, and scores of CCNs in different categories are as different as possible. The clustering algorithm that we use is the same one used by CMS to determine star ratings for most of the Medicare Part C and Part D measures, the Home Health CAHPS (HHCAHPS) Survey, and the Hospital CAHPS Survey.

The goal of the clustering algorithm is to minimize the differences within each cluster and maximize the differences between each cluster. The variance in measure scores is separated into within- and between-cluster sum of squares components. The algorithm develops clusters that minimize the variance of measure scores within the clusters. More specifically, the clustering algorithm minimizes the within-cluster sum of squares for each of the star ratings levels. Additional information about the clustering method is provided in ***Appendix B***.

The cut points (boundaries) for star assignments are derived from the range of individual measures per cluster. The star levels associated with each cluster are determined by ordering the means of each cluster. The cut points for ICH CAHPS star ratings for the two 2016 ICH CAHPS Surveys are shown in ***Appendix C***. Cut points are recalculated for each reporting period.

Consideration has been given to identifying outliers before implementing the clustering procedure. If outliers are eliminated, it could reduce the within-cluster variability. It could potentially improve the consistency of cut point ranges between reporting periods. It should be noted that CAHPS scores are often skewed and non-normal so the methodology from Hubert and Vandervieren’s adjusted box plot[[3]](#footnote-3) that incorporates the medcouple was used to flag outliers. Once the outliers are removed and the cut points are generated, the outliers were reincorporated back into the star assignments as a 1-star or 5-star facility. However, investigation of this method showed that the removal of outliers was not found to improve the consistency of star ratings between reporting periods. At this time, outliers will remain in the analysis, which parallels the methodology in other CAHPS projects.

##### c. Calculating an ICH CAHPS Summary Star Rating

CMS publishes an ICH CAHPS Survey summary star rating on Medicare.gov’s Care Compare, which is the average of all star ratings of the ICH CAHPS measures—the three global ratings and the three composite measures for each participating ICH facility. To calculate the summary star rating, we combine the star ratings for the six ICH CAHPS measures as a simple average. We apply the standard rounding rules described above to the six-measure average to arrive at the ICH CAHPS Survey summary star rating (1, 2, 3, 4, or 5 stars). The following is an example of calculation of an ICH CAHPS Survey summary star rating.

Example Calculation of an ICH CAHPS Survey Summary Star Rating

**Step 1: Average the six star ratings**. In this example, the individual star ratings are 4, 3, 4, 4, 3, and 3. These ratings are averaged and then rounded to arrive at the summary star rating.

|   | Individual ICH CAHPS Measure Star Ratings | ICH CAHPS Survey Summary Star Rating Average (unrounded) | ICH CAHPS Survey Summary Star Rating (rounded) |
| --- | --- | --- | --- |
| **Global Ratings** |   | (4 + 3 + 4 + 4 + 3 +3) =21 ÷ 6 = 3.5 | 4 |
| Nephrologist | 4 |
| Dialysis Center Staff | 3 |
| Dialysis Center | 4 |
| **Composite Scores** |   |
| Communication and Caring | 4 |
| Quality and Operations | 3 |
| Providing Information | 3 |

**Step 2: Round the ICH CAHPS Survey summary star rating average** using the roundingtable below. In this example, the CCN’s ICH CAHPS Survey summary star rating rounds to four stars. As done on other CAHPS Surveys, we use standard rounding rules for the assignment of ICH CAHPS Survey summary stars.

| 6-Measure ICH CAHPS SurveySummary Star Rating Average | ICH CAHPS Survey Summary StarRating Assignment |
| --- | --- |
| ≥ 1.00 and < 1.50 | 1 Star |
| ≥ 1.50 and < 2.50 | 2 Stars |
| ≥ 2.50 and < 3.50 | 3 Stars |
| ≥ 3.50 and < 4.50 | 4 Stars |
| ≥ 4.50 and ≤ 5.00 | 5 Stars |

### 3. ICH CAHPS Star Ratings for the 2016 ICH CAHPS Surveys

Star ratings are produced for each of the CCNs that had 30 or more completed surveys combined from the two semiannual surveys conducted in 2016. Table 4in ***Appendix C*** shows the frequency of CCNs assigned to each star rating for all six ratings and composite scores and the final Survey summary star rating based on data from the two 2016 ICH CAHPS Surveys.

### 4. Recommended Minimum Number of Completed Surveys Required for ICH CAHPS Star Ratings

To receive ICH CAHPS star ratings, ICH facilities must have 30 or more completed ICH CAHPS surveys over two consecutive survey periods. CCNs with 29 or fewer completed ICH CAHPS surveys do not receive star ratings. A minimum of 30 completed surveys is the same number currently required for survey results to be publicly reported on the compare tool on Medicare.gov.

### 5. Periodicity of Reporting Star Ratings

ICH CAHPS Survey results are updated on the compare tool on Medicare.gov in April and October of each year. Survey results that are published are based on data from the two most recent survey periods, with the data from the oldest survey period replaced by data from the most recent survey period.

Appendix A:
Patient-Mix Adjustment Factors for ICH CAHPS Linear Means from the 2016 ICH CAHPS Surveys

Table 1. ICH CAHPS Patient-Mix Adjustment Factors of Linear Means (Average for the Two 2016 ICH CAHPS Semiannual Surveys)

| Patient Mix Characteristic Patient Mix Level | Rating of Kidney Doctors (Q8) | Rating of Dialysis Center Staff (Q32) | Rating of Dialysis Center (Q35) | Average of survey items comprising the Kidney Doctors’ Communication and Caring Composite | Average of survey items comprising the Quality of Dialysis Center and Operations Composite | Average of survey items comprising the Providing Information to Patients Composite |
| --- | --- | --- | --- | --- | --- | --- |
| Survey ModeMail-Only | 2.252 | 2.058 | 2.825 | 2.851 | 1.362 | 2.893 |
| Phone-Only | RC | RC | RC | RC | RC | RC |
| Mixed Mode | -0.073 | -0.094 | 0.479 | -0.242 | -0.648 | 1.292 |
| Someone Helped Patient Complete SurveyYes | -0.494 | -0.3491 | -0.2264 | -0.8021 | -1.468 | -4.0909 |
| No | RC | RC | RC | RC | RC | RC |
| Patient Speaks Language other than English at HomeYes | 0.974 | 0.4518 | -0.4487 | 3.4405 | 1.7737 | 1.8038 |
| No | RC | RC | RC | RC | RC | RC |
| Overall HealthExcellent | -3.8877 | -4.8047 | -4.7477 | -3.7305 | -5.1307 | -2.3797 |
| Very Good | -1.931 | -2.0075 | -2.0389 | -2.0014 | -2.0722 | -1.3033 |
| Good | RC | RC | RC | RC | RC | RC |
| Fair | 1.0951 | 1.1762 | 1.2063 | 1.3603 | 1.3724 | 1.0013 |
| Poor | 3.3743 | 2.9243 | 3.0612 | 4.1643 | 2.9804 | 2.5829 |
| Mental HealthExcellent | -3.6481 | -3.2411 | -2.8746 | -4.4805 | -3.5249 | -2.7657 |
| Very Good | -1.734 | -1.4363 | -1.2554 | -2.309 | -1.7509 | -1.4014 |
| Good | RC | RC | RC | RC | RC | RC |
| Fair | 2.0882 | 1.6441 | 1.615 | 2.9755 | 2.3664 | 2.3396 |
| Poor | 6.3712 | 5.5931 | 5.4036 | 8.6008 | 6.8579 | 7.8298 |
| Treated for Heart Disease or ProblemsYes | -1.4689 | -0.9542 | -0.7777 | -1.9343 | -1.4007 | -2.044 |
| No | RC | RC | RC | RC | RC | RC |

(continued)

Table 1. ICH CAHPS Patient-Mix Adjustment Factors of Linear Means (Average for the Two 2016 ICH CAHPS Semiannual Surveys) (continued)

| Patient Mix Characteristic Patient Mix Level | Rating of Kidney Doctors (Q8) | Rating of Dialysis Center Staff (Q32) | Rating of Dialysis Center (Q35) | Average of survey items comprising the Kidney Doctors Communication and Caring Composite | Average of survey items comprising the Quality of Dialysis Center and Operations Composite | Average of survey items comprising the Providing Information to Patients Composite |
| --- | --- | --- | --- | --- | --- | --- |
| Deaf or Difficulty HearingYes | 0.6308 | 0.19 | -0.1244 | 1.1164 | 0.4423 | 1.5508 |
| No | RC | RC | RC | RC | RC | RC |
| Blind or Difficulty SeeingYes | 0.5797 | 0.3088 | -0.1487 | 1.1109 | 0.7968 | 1.376 |
| No | RC | RC | RC | RC | RC | RC |
| Difficulty Dressing or BathingYes | 1.3243 | 1.5612 | 1.2281 | 2.0841 | 2.0068 | 3.0542 |
| No | RC | RC | RC | RC | RC | RC |
| Age18–44 | 2.2637 | 2.7124 | 3.6422 | 0.3309 | 1.5729 | -6.6307 |
| 45–54 | 1.5628 | 2.9151 | 3.2427 | 0.3063 | 2.1927 | -4.1492 |
| 55–64 | 0.6743 | 1.4675 | 1.6014 | 0.0928 | 1.322 | -2.3116 |
| 65–74 | RC | RC | RC | RC | RC | RC |
| 75+ | -0.6539 | -1.0067 | -1.3122 | -0.0258 | -0.8847 | 5.1674 |
| GenderMale | 1.3695 | 0.6934 | 0.5898 | 0.6851 | -0.4707 | -0.0065 |
| Female | RC | RC | RC | RC | RC | RC |
| Education8th Grade or Less | -1.1376 | -1.8598 | -2.4601 | 0.5702 | -0.6584 | 1.0238 |
| Some High School | -0.9167 | -1.4343 | -1.6717 | 0.1641 | -0.4919 | 0.6761 |
| High School | RC | RC | RC | RC | RC | RC |
| Some College | 1.5963 | 2.2607 | 2.6907 | 1.5679 | 1.9833 | -0.2164 |
| 4-year Degree | 2.3397 | 2.9239 | 3.5403 | 2.2484 | 2.4653 | 1.069 |
| More than 4-year college | 2.7102 | 3.7688 | 4.3925 | 2.7442 | 3.1164 | 1.1016 |
| Years on Dialysis1 Year | -0.128 | -1.9216 | -1.9108 | 0.0235 | -2.4204 | 1.3991 |
| 2 Years | 0.0136 | -0.8275 | -0.7759 | -0.1075 | -1.042 | 0.4164 |
| 3–4 Years | RC | RC | RC | RC | RC | RC |
| 5–7 Years | -0.4848 | 0.4143 | 0.415 | -0.6139 | 0.5584 | -0.5333 |
| 8+ Years | -1.237 | 0.3484 | 0.2715 | -1.5419 | 0.6692 | -1.7871 |

RC = Reference Category

Table 2. National Means on Patient-Mix Adjustment Factors (Average for the Two 2016 ICH CAHPS Semiannual Surveys)

| Patient Mix CharacteristicPatient Mix Level | Mean |
| --- | --- |
| Survey ModeMail-Only | 0.043 |
| Phone-Only | 0.014 |
| Mixed Mode | 0.943 |
| Patient Assisted with SurveyYes | 0.099 |
| No | 0.901 |
| Patient Speaks Language Other than English at HomeYes | 0.150 |
| No | 0.850 |
| Overall HealthExcellent | 0.056 |
| Very Good | 0.163 |
| Good | 0.374 |
| Fair | 0.326 |
| Poor | 0.081 |
| Mental HealthExcellent | 0.183 |
| Very Good | 0.267 |
| Good | 0.347 |
| Fair | 0.177 |
| Poor | 0.026 |
| Treated for Heart Disease or ProblemsYes | 0.443 |
| No | 0.557 |
| Deaf or Difficulty HearingYes | 0.159 |
| No | 0.841 |
| Blind or Difficulty SeeingYes | 0.201 |
| No | 0.799 |
| Difficulty Dressing or BathingYes | 0.186 |
| No | 0.814 |

(continued)

Table 2. National Means on Patient-Mix Adjustment Factors (Average for the Two 2016 ICH CAHPS Semiannual Surveys) (continued)

| Patient Mix CharacteristicPatient Mix Level | Mean |
| --- | --- |
| Age18–44 | 0.064 |
| 45–54 | 0.131 |
| 55–64 | 0.251 |
| 65–74 | 0.292 |
| 75+ | 0.262 |
| GenderMale | 0.563 |
| Female | 0.437 |
| Education8th Grade or Less | 0.118 |
| Some High School | 0.143 |
| High School | 0.336 |
| Some College | 0.258 |
| 4-year Degree | 0.074 |
| More than 4-year college | 0.071 |
| Years on Dialysis1 Year | 0.180 |
| 2 Years | 0.193 |
| 3–4 Years | 0.262 |
| 5–7 Years | 0.208 |
| 8+ Years | 0.157 |

Appendix B:
Additional Information on the Clustering Method Used to Create ICH CAHPS Star Ratings

The sequence of steps taken in the clustering methodology to develop the six ICH CAHPS star ratings is provided below. For each ICH CAHPS linear measure, the clustering method:

1. Produces the individual measure distance matrix.

2. Groups the measure scores into an initial set of clusters.

3. Selects the final set of clusters.

Step 1. Produce the individual measure distance matrix.

For each pair of ICH facilities *j* and *k* (*j*> = *k*) among the *n* ICH facilities with measure score data, the Euclidian distance of the measure scores (e.g., the absolute value of the difference between the two measure scores) is computed. The clustering method then enters this distance in row *j* and column *k* of a distance matrix with *n* rows and *n* columns. This matrix is produced using the DISTANCE procedure in SAS.

Step 2. Create a tree of cluster assignments.

The distance matrix calculated in Step 1 is the input to the clustering procedure. The stored distance algorithm is implemented to compute cluster assignments. The following process is implemented by the CLUSTER procedure in SAS:

a. The input measure score distances are squared.

b. The clusters are initialized by assigning each ICH facility to its own cluster.

c. To determine which pair of clusters to merge, Ward’s minimum variance method is used to separate the variance of the measure scores into within- and between-cluster sum of squares components.

d. From the existing clusters, two clusters are selected for merging to minimize the within-cluster sum of squares over all possible sets of clusters that might result from a merge.

e. Steps b and c are repeated to reduce the number of clusters by one until a single cluster containing all ICH facilities results.

Step 3. Select the final set of clusters from the tree of cluster assignments.

The process outlined in Step 2 produces a tree of cluster assignments from which the five final clusters (which represent the five-star rating categories) are selected using the TREE procedure in SAS.

Appendix C:
2016 ICH CAHPS Star Rating Cut Points

Table 3. ICH CAHPS Star Rating Cut Points (Average for the Two 2016 ICH CAHPS Semiannual Surveys)

|   | 1 Star | 2 Stars | 3 Stars | 4 Stars | 5 Stars |
| --- | --- | --- | --- | --- | --- |
| Rating of Kidney Doctors (Q8) | <74 | ≥74 to <82 | ≥82 to <85 | ≥85 to <89 | ≥89 |
| Rating of Dialysis Care Staff (Q32) | <78 | ≥78 to <82 | ≥82 to <86 | ≥86 to <91 | ≥91 |
| Rating of Dialysis Center (Q35) | <79 | ≥79 to <83 | ≥83 to <87 | ≥87 to <92 | ≥92 |
| Communication and Caring Composite | <72 | ≥72 to <79 | ≥79 to <83 | ≥83 to <89 | ≥89 |
| Quality and Operations Composite | <72 | ≥72 to <76 | ≥76 to <80 | ≥80 to <84 | ≥84 |
| Providing Information Composite | <73 | ≥73 to <77 | ≥77 to <80 | ≥80 to <84 | ≥84 |

Table 4. Frequency of ICH CAHPS CCNs Assigned to Each Star Rating (Average for the Two 2016 ICH CAHPS Semiannual Surveys)

|   | 1 Star | 2 Stars | 3 Stars | 4 Stars | 5 Stars |
| --- | --- | --- | --- | --- | --- |
| Rating of Kidney Doctors (Q8) | 107 | 805 | 644 | 916 | 690 |
| Rating of Dialysis Care Staff (Q32) | 255 | 457 | 864 | 1,165 | 421 |
| Rating of Dialysis Center (Q35) | 234 | 420 | 783 | 1,210 | 515 |
| Communication and Caring Composite | 245 | 805 | 743 | 1,048 | 321 |
| Quality and Operations Composite | 249 | 507 | 858 | 917 | 631 |
| Providing Information Composite | 366 | 569 | 580 | 823 | 824 |
| Survey Summary Star Rating | 74 | 492 | 1,021 | 1,157 | 418 |

1. \* For Q21, response option 5 (“I insert my own needles”) is coded as missing and not included when calculating the composite. [↑](#footnote-ref-1)
2. [↑](#footnote-ref-2)
3. Hubert, M., & Vandervieren, E. (2008). An adjusted boxplot for skewed distributions. *Computational Statistics & Data Analysis Archive, 52*(12), 5186-5201. doi:10.1016/j.csda.2007.11.008 [↑](#footnote-ref-3)