Technical Notes for HCAHPS Star Ratings

Overview of HCAHPS Star Ratings

As part of a new initiative to add five-star quality ratings to its Compare Web sites, the Centers for Medicare & Medicaid Services (CMS) will add HCAHPS Star Ratings to the Hospital Compare Web site in April 2015. Star Ratings will make it easier for consumers to use the information on the Compare Web sites and spotlight excellence in healthcare quality. Twelve HCAHPS Star Ratings will appear on Hospital Compare: one for each of the 11 publicly reported HCAHPS measures, plus the new HCAHPS Summary Star Rating. HCAHPS Star Ratings will be the first star ratings to appear on Hospital Compare; CMS plans to update the HCAHPS Star Ratings each quarter. HCAHPS Star Ratings are based on the same data that are used to create the HCAHPS measures publicly reported on the Hospital Compare Web site. The public reporting of the HCAHPS Star Ratings in July 2015 will be based on patients discharged between October 1, 2013 and September 30, 2014.

HCAHPS Measures Receiving HCAHPS Stars

HCAHPS Star Ratings will be applied to each of the 11 publicly reported HCAHPS measures, which are created from specific questions on the HCAHPS Survey, as noted:
- ➢ HCAHPS Composite Measures
    1. Communication with Nurses (Q1, Q2, Q3)
    2. Communication with Doctors (Q5, Q6, Q7)
    3. Responsiveness of Hospital Staff (Q4, Q11)
    4. Pain Management (Q13, Q14)
    5. Communication about Medicines (Q16, Q17)
    6. Discharge Information (Q19, Q20)
    7. Care Transition (Q23, Q24, Q25)
- ➢ HCAHPS Individual Items
    8. Cleanliness of Hospital Environment (Q8)
    9. Quietness of Hospital Environment (Q9)
- ➢ HCAHPS Global Items
    10. Overall Hospital Rating (Q21)
    11. Recommend the Hospital (Q22)

100 Survey Minimum for HCAHPS Star Ratings

In order to receive HCAHPS Star Ratings, hospitals must have at least 100 completed HCAHPS surveys over a given four-quarter period. In addition, hospitals must be eligible for public reporting of HCAHPS measures. Hospitals with fewer than 100 completed HCAHPS surveys will not receive Star Ratings; however their HCAHPS measure scores will be publicly reported on Hospital Compare.

I: Construction and Adjustment of HCAHPS Linear Scores

CMS employs all survey responses in the construction of the HCAHPS Star Ratings. The responses to the survey items used in each HCAHPS measure (shown below) are combined and converted to a 0-100 linear-scaled score ("Linear Score"). The Linear Score used in HCAHPS Star Ratings is closely related to the "top-box," "middle-box" and "bottom-box" scores publicly reported on the Hospital Compare Web site. Responses to the HCAHPS Survey are converted to Linear Scores in the following manner:

- ➢ "Never" = 0; "Sometimes" = 33 1/3; "Usually" = 66 2/3; and "Always" = 100
    - o For HCAHPS Survey items 1-9, 11, 13-14, and 16-17
- ➢ "No" = 0; and "Yes" = 100
    - o For items 19 and 20

- ➢ Overall Rating "0" = 0; Overall Rating "1" = 10; Overall Rating "2" = 20 … Overall Rating "10" = 100
    - o For item 21
- ➢ "Definitely No" = 0; "Probably No" = 33 1/3; "Probably Yes" = 66 2/3; and "Definitely Yes" = 100
    - o For item 22
- ➢ "Strongly Disagree" = 0; "Disagree" = 33 1/3; "Agree" = 66 2/3; and "Strongly Agree" = 100
    - o For items 23, 24, and 25

The 0-100 linear-scaled HCAHPS scores are then adjusted for the effects of patient mix, survey mode, and quarterly weighting through a series of steps, as follows.

First, CMS applies the patient-mix adjustment (PMA) to quarterly HCAHPS scores to account for the tendency of certain patient sub-groups to respond more positively or negatively to the HCAHPS Survey. PMA allows for fair comparisons across hospitals by adjusting hospital scores as if all hospitals had an identical mix of patient characteristics. The patient-mix adjustment table can be found in Appendix A, Table 1, while Appendix A, Table 2 contains the national means for patient-mix variables. Additional information about the application of the HCAHPS patient-mix adjustments, including the definition of the PMA factors, can be found in the documents on the HCAHPS On-Line Web site, www.hcahpsonline.org, under the *"Mode & Patient-Mix Adj"* button.

Second, HCAHPS Linear Scores are adjusted for the effect of mode of survey administration (mail, telephone, mixed mode or Interactive Voice Response). CMS derived the survey mode adjustments from a large-scale, randomized mode experiment. The mode adjustments for the HCAHPS Linear Scores are included in Appendix B. For detailed information about the mode experiment and survey mode adjustment, please see www.hcahpsonline.org.

Next, the four-quarter averages of HCAHPS linear scores are weighted proportionately to the number of eligible patients seen by the hospital in each quarter of the reporting period. Specifically, each quarter's score has a quarterly weight equal to that quarter's eligible discharge size divided by the total eligible discharge size for the four quarters that make up the reporting period.

Finally, four-quarter averages of HCAHPS linear scores are rounded to integer values using standard rounding rules, as follows:

Let X represent the unrounded four-quarter average for an HCAHPS 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.

II: Conversion of Linear Scores into HCAHPS Star Ratings for the 11 HCAHPS Measures
Next, CMS assigns 1, 2, 3, 4, or 5 whole stars (only whole stars are assigned; partial stars are not used) for each HCAHPS measure by applying statistical methods that utilize relative distribution and clustering.

The Star Rating for each of the 11 HCAHPS measures is determined 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 hospitals in the same score category (star rating) are as similar as possible, and scores of hospitals in different categories are as different as possible. This clustering algorithm is the same one employed by CMS to determine Medicare Part C and Part D Star Ratings.

The variance in measure scores is separated into within-cluster 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. The cut points (boundaries) for star assignments are derived from the range of individual measure Star Ratings per cluster. The star levels associated with each cluster are determined by ordering the means of each cluster. The cut points for HCAHPS Star Ratings are shown in Appendix C. Additional information about the clustering method can be found in Appendix D.

III: HCAHPS Summary Star Rating
In addition to Star Ratings for the 11 HCAHPS measures, CMS is introducing a new metric, the HCAHPS Summary Star Rating, which is the average of all of the Star Ratings of the HCAHPS measures. The HCAHPS Summary Star Rating is constructed from the following components:

- ➢ The 7 Star Ratings from each of the 7 HCAHPS composite measures.
    - o Communication with Nurses, Communication with Doctors, Responsiveness of Hospital Staff, Pain Management, Communication about Medicines, Discharge Information, and Care Transition.
- ➢ A single Star Rating for the HCAHPS Individual Items
    - o The average of the Star Ratings assigned to Cleanliness of Hospital Environment and Quietness of Hospital Environment.
- ➢ A single Star Rating for the HCAHPS Global Items
    - o The average of the Star Ratings assigned to Overall Hospital Rating and Recommend the Hospital.

The 9 Star Ratings (7 composite measure Star Ratings + Star Rating for Individual Items + Star Rating for Global Items) are combined as a simple average to form the HCAHPS Summary Star Rating. In the final step, normal rounding rules are applied to the 9-measure average to arrive at the HCAHPS Summary Star Rating (1, 2, 3, 4, or 5 stars).

An example of the calculation of the HCAHPS Summary Star Rating
The following is an example of how to calculate the HCAHPS Summary Star Rating. Suppose a hospital has Star Ratings for each of the 11 HCAHPS measures as shown in following table.

	11 HCAHPS Measure Star Ratings	9 Star Ratings Used in HCAHPS Summary Star Rating	9-Measure HCAHPS Summary Star Rating Average *(unrounded)*	HCAHPS Summary Star Rating *(rounded)*
HCAHPS Composite Measures				
Communication with Nurses	4	4		
Communication with Doctors	3	3		
Responsiveness of Hospital Staff	4	4		
Pain Management	5	5		
Communication about Medicines	4	4		
Discharge Information	4	4	(4+3+4+5+4+4+3+5+3.5)/9 = 3.944	**4**
Care Transition	3	3		
HCAHPS Individual Items				
Cleanliness of Hospital Environment	5	(5+5)/2 = 5		
Quietness of Hospital Environment	5			
HCAHPS Global Items				
Overall Hospital Rating	4	(4+3)/2 = 3.5		
Recommend the Hospital	3			

Step 1: Calculate a Star Rating for HCAHPS Individual Items by averaging the Star Ratings for Cleanliness of Hospital Environment and Quietness of Hospital Environment.
In this example, the Star Rating for HCAHPS Individual Items = (5+5)/2 = 5.

Step 2: Calculate a Star Rating for HCAHPS Global Items by averaging the Star Ratings for Overall Hospital Rating and Recommend the Hospital.

In this example, the Star Rating for HCAHPS Global Items = (4+3)/2 = 3.5. ***Note: Do not round this average***.

Step 3: Calculate the HCAHPS Summary Star Rating as the average of the 7 composite measure Star Ratings, the Star Rating for HCAHPS Individual Items, and the Star Rating for HCAHPS Global Items.

In this example, the HCAHPS Summary Star Rating = (4+3+4+5+4+4+3+5+3.5)/9 = 3.944.

Step 4: Lastly, round the 9-Measure HCAHPS Summary Star Rating Average using the rounding table below.

In this example, the hospital's HCAHPS Summary Star Rating rounds to 4 stars.

CMS uses standard rounding rules for the assignment of HCAHPS Summary Stars, as follows:

9-Measure HCAHPS Summary Star Rating Average	HCAHPS Summary Star Rating 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

Appendix A, Table 1: HCAHPS Patient-Mix Adjustments of Linear Scores for Patients Discharged Between Quarter 4, 2013 and Quarter 3, 2014 (October 1, 2013 to September 30, 2014)

Patient-Mix Adjustment (PMA)	Comm. with Nurses	Comm. with Doctors	Responsiveness of Hosp. Staff	Pain Management	Comm. About Medicines	Cleanliness of Hosp. Env.	Quietness of Hosp. Env.	Discharge Information	Care Transition	Overall Hospital Rating	Recommend the Hospital
Education (per level; 1=8th grade or less and 6=More than 4-year college degree)	0.0176	0.0206	0.0259	0.0274	0.0550	0.0167	0.0507	0.0060	0.0035	0.1170	0.0193
Self-Rated Health (per level; 1=Excellent and 5=Poor)	0.0647	0.0669	0.0856	0.0900	0.0937	0.0600	0.0619	0.0103	0.0769	0.2339	0.0736
Response Percentile (per 1% of response percentile)	0.0022	0.0021	0.0029	0.0019	0.0032	0.0008	0.0002	0.0003	0.0021	0.0056	0.0020
LANGUAGE SPOKEN AT HOME											
Spanish	-0.0151	-0.0380	-0.0136	-0.0713	-0.0787	0.0052	-0.0907	-0.0120	-0.0067	-0.4514	-0.1246
Chinese	0.1005	0.0926	0.1443	0.1359	0.0575	0.0334	-0.0210	-0.0234	0.1267	0.0976	0.0389
R/V/O	0.0146	0.0061	0.0535	0.0282	-0.0405	0.0322	-0.0866	-0.0017	0.0540	-0.0087	-0.0216
English (REFERENCE)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
AGE											
Age 18-24	0.0676	0.0777	0.1347	0.1369	-0.1375	0.0679	-0.0425	-0.0318	-0.0490	0.6764	0.2244
Age 25-34	0.0356	0.0480	0.0418	0.0920	-0.1554	0.0667	-0.0505	-0.0414	-0.0827	0.5520	0.1625
Age 35-44	0.0140	0.0253	0.0183	0.0672	-0.1732	0.0715	-0.0255	-0.0461	-0.0831	0.4356	0.1282
Age 45-54	-0.0206	-0.0099	-0.0228	0.0196	-0.1788	0.0622	-0.0022	-0.0491	-0.1020	0.2361	0.0646
Age 55-64	-0.0455	-0.0379	-0.0547	-0.0188	-0.1792	0.0398	-0.0041	-0.0543	-0.1136	0.0749	0.0220
Age 65-74	-0.0563	-0.0603	-0.0629	-0.0512	-0.1611	0.0381	-0.0163	-0.0491	-0.1085	-0.0305	-0.0063
Age 75-84	-0.0356	-0.0391	-0.0405	-0.0344	-0.0933	0.0251	-0.0028	-0.0233	-0.0521	-0.0543	-0.0100
Age 85+ (REFERENCE)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SERVICE LINE											
Maternity	-0.1009	-0.2210	-0.2191	-0.2108	-0.2320	0.0233	-0.1757	-0.0657	-0.1039	-0.5290	-0.2113
Surgical	-0.0071	-0.1654	-0.0197	-0.0688	-0.0391	-0.0104	-0.0302	-0.0485	-0.0687	-0.2631	-0.0928
Medical (REFERENCE)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
INTERACTIONS											
Surgical Line * Age[1]	0.0003	0.0134	-0.0029	-0.0021	-0.0014	-0.0025	0.0013	-0.0013	0.0043	0.0251	0.0089
Maternity Line * Age[1]	0.0142	0.0236	0.0194	0.0247	0.0406	0.0049	0.0068	0.0156	0.0172	0.0744	0.0287

[1] Age takes on the values of 1 to 8 as follows: (1: 18 to 24); (2: 25 to 34); (3: 35 to 44); (4: 45 to 54); (5: 55 to 64); (6: 65 to 74); (7: 75 to 84); and (8: 85+).

HCAHPS Star Ratings. www.hcahpsonline.org. Centers for Medicare & Medicaid Services, Baltimore, MD. Originally posted April 3, 2015.

Appendix A, Table 2: National Means of PMA Variables for Patients Discharged Between Quarter 4, 2013 and Quarter 3, 2014 (October 1, 2013 to September 30, 2014)

Patient-Mix Adjustment (PMA)	National Mean
Education (per level; 1=8th grade or less and 6=More than 4-year college degree)	3.759
Self-Rated Health (per level; 1=Excellent and 5=Poor)	2.747
Response Percentile	14.9%
LANGUAGE SPOKEN AT HOME	
Spanish	4.7%
Chinese	0.3%
R/V/O	1.8%
English (REFERENCE)	93.2%
AGE	
Age 18-24	4.1%
Age 25-34	11.3%
Age 35-44	7.0%
Age 45-54	10.5%
Age 55-64	19.1%
Age 65-74	23.4%
Age 75-84	17.4%
Age 85+ (REFERENCE)	7.1%
SERVICE LINE	
Maternity	13.8%
Surgical	35.8%
Medical (REFERENCE)	50.5%
INTERACTIONS	
Surgical Line * Age[1]	1.904
Maternity Line * Age[1]	0.289

[1] Age takes on the values of 1 to 8 as follows: (1: 18 to 24); (2: 25 to 34); (3: 35 to 44); (4: 45 to 54); (5: 55 to 64); (6: 65 to 74); (7: 75 to 84); and (8: 85+).

Appendix B: Survey Mode Adjustments of HCAHPS Linear Scores to Adjust to a Reference of Mail Mode

	Phone Only	Mixed	Active IVR
HCAHPS Composite Measures			
Communication with Nurses	-0.031	0.005	-0.010
Communication with Doctors	0.011	0.028	0.009
Responsiveness of Hospital Staff	-0.049	0.024	-0.001
Pain Management	-0.042	-0.012	-0.021
Communication about Medicines	-0.044	0.013	-0.011
Discharge Information	-0.013	0.002	-0.032
Care Transition	-0.064	-0.030	0.061
HCAHPS Individual Items			
Cleanliness of Hospital Environment	-0.072	-0.032	-0.037
Quietness of Hospital Environment	-0.044	-0.038	-0.109
HCAHPS Global Items			
Overall Hospital Rating	-0.057	0.008	-0.001
Recommend the Hospital	-0.049	-0.008	-0.018

Appendix C: HCAHPS Star Rating Cut Points for Patients Discharged Between Quarter 4, 2013 and Quarter 3, 2014 (October 1, 2013 to September 30, 2014)

	1 Star	2 Stars	3 Stars	4 Stars	5 Stars
HCAHPS Composite Measures					
Communication with Nurses	<85	≥85 to <89	≥89 to <91	≥91 to <93	≥93
Communication with Doctors	<90	≥90 to <92	≥92 to <93	≥93 to <95	≥95
Responsiveness of Hospital Staff	<78	≥78 to <82	≥82 to <86	≥86 to <90	≥90
Pain Management	<84	≥84 to <86	≥86 to <88	≥88 to <90	≥90
Communication about Medicines	<74	≥74 to <78	≥78 to <80	≥80 to <85	≥85
Discharge Information	<80	≥80 to <84	≥84 to <88	≥88 to <90	≥90
Care Transition	<78	≥78 to <80	≥80 to <82	≥82 to <85	≥85
HCAHPS Individual Items					
Cleanliness of Hospital Environment	<81	≥81 to <85	≥85 to <89	≥89 to <93	≥93
Quietness of Hospital Environment	<78	≥78 to <82	≥82 to <86	≥86 to <90	≥90
HCAHPS Global Items					
Overall Hospital Rating	<82	≥82 to <86	≥86 to <90	≥90 to <92	≥92
Recommend the Hospital	<82	≥82 to <86	≥86 to <90	≥90 to <94	≥94

Appendix D: Individual Measure Star Assignment Process

Below are detailed steps of the clustering method to develop individual measure stars. For each measure, the clustering method does the following:

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.

1. Produce the individual measure distance matrix.
For each pair of hospital j and k (j>=k) among the n hospitals with measure score data, compute the Euclidian distance of their measure scores (e.g., the absolute value of the difference between the two measure scores). Enter this distance in row j and column k of a distance matrix with n rows and n columns. This matrix can be produced using the DISTANCE procedure in SAS as follows:

```
proc distance data=inclusterdat out=distancedat method=Euclid;
     var interval(measure_score);
     id CCN;
  run;
```

In the above code, the input data set, *inclusterdat,* is the list of hospitals with scores for a particular measure. Each record has a unique identifier, CCN. The option *method=Euclid* specifies that distances between hospital measure scores should be based on Euclidean distance. The input data contain a variable called *measure_score.* In the *var* call, the parentheses around *measure_score* indicate that *measure_score* is considered to be an interval or numeric variable. The distances computed by this code are stored to an output data set called *distancedat.*

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 using the CLUSTER procedure in SAS:
   a. The input measure score distances are squared.
   b. The clusters are initialized by assigning each hospital to its own cluster.
   c. In order 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-cluster and between-cluster sum of squares components.
   d. From the existing clusters, two clusters will be 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 hospitals results.

The result is a data set that contains a tree-like structure of cluster assignments, from which any number of clusters between 1 and the number of hospital measure scores could be computed. The SAS code for implementing these steps is:

```
proc cluster data=distancedat method=ward outtree=treedat noprint;
     id CCN;
  run;
```

The *distancedat* data set containing the Euclidian distances was created in Step 1. The option *method=ward* indicates that Ward's minimum variance method should be used to group clusters. The output data set is denoted with the outtree option and is called *treedat*.

3. Select the final set of clusters from the tree of cluster assignments.
The process outlined in Step 2 will produce a tree of cluster assignments, from which the final number of clusters is selected using the TREE procedure in SAS as follows:

```
proc tree data=treedat ncl=NSTARS horizontal out=outclusterdat noprint;
      id CCN;
    run;
```

The input data set, treedat, is created in Step 2 above. The syntax, ncl=NSTARS, denotes the desired final number of clusters (or star levels). NSTARS equals 5.

Final Threshold and Star Creation
The cluster assignments produced by the above approach have cluster labels that are unordered. The final step after applying the above steps to all hospital measure scores is to order the cluster labels so that the 5-star category reflects the cluster with the best performance and the 1-star category reflects the cluster with the worst performance. The measure thresholds are defined by examining the range of measure scores within each of the final clusters.