

## 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 first public reporting of the HCAHPS Star Ratings in April 2015 will be based on patients discharged between July 1, 2013 through June 30, 2014. The cut points and information in the Appendices of this document cover the data from January 1, 2013 through December 31, 2013, which is a dry run for hospitals to view their HCAHPS Star Ratings for informational purposes.

### 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
  - For HCAHPS Survey items 1-9, 11, 13-14, and 16-17
- "No" = 0; and "Yes" = 100
  - For items 19 and 20

- Overall Rating “0” = 0; Overall Rating “1” = 10; Overall Rating “2” = 20; ...; Overall Rating “10” = 100
  - For item 21
- “Definitely No” = 0; “Probably No” = 33 1/3; “Probably Yes” = 66 2/3; and “Definitely Yes” = 100
  - For item 22
- “Strongly Disagree” = 0; “Disagree” = 33 1/3; “Agree” = 66 2/3; and “Strongly Agree” = 100
  - 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](http://www.hcahpsonline.org), under the “Mode & Patient-Mix Adj” navigation 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](http://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
  - 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
  - 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
  - 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)		
<b>HCAHPS Composite Measures</b>						
Communication with Nurses	4	4	$(4+3+4+5+4+4+3+5+3.5)/9$ $= 3.944$	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				
Care Transition	3	3				
<b>HCAHPS Individual Items</b>						
Cleanliness of Hospital Environment	5	$(5+5)/2$				
Quietness of Hospital Environment	5	= 5				
<b>HCAHPS Global Items</b>						
Overall Hospital Rating	4	$(4+3)/2$				
Recommend the Hospital	3	= 3.5				

**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
$\geq 1.00$ and $< 1.50$	1 Star
$\geq 1.50$ and $< 2.50$	2 Stars
$\geq 2.50$ and $< 3.50$	3 Stars
$\geq 3.50$ and $< 4.50$	4 Stars
$\geq 4.50$ and $\leq 5.00$	5 Stars

**Appendix A, Table 1: HCAHPS Patient-Mix Adjustments of Linear Scores for Patients Discharged Between Quarter 1, 2013 and Quarter 4, 2013 (January 1, 2013 to December 31, 2013) -- For use in the Dry Run of HCAHPS Star Ratings included in the December 2014 Hospital Compare Preview Reports.**

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)	0.0181	0.0206	0.0270	0.0278	0.0563	0.0173	0.0516	0.0066	0.1204	0.0197	0.0038
Self-Rated Health (per level; 1=Excellent and 5=Poor)	0.0645	0.0670	0.0852	0.0896	0.0942	0.0591	0.0604	0.0105	0.2317	0.0728	0.0763
Response Percentile (per 1% of response percentile)	0.0022	0.0021	0.0028	0.0019	0.0031	0.0008	0.0002	0.0002	0.0055	0.0019	0.0020
<b>LANGUAGE SPOKEN AT HOME (1Q13 to 4Q13)</b>											
Non-English	0.0030	-0.0126	0.0125	-0.0236	-0.0502	0.0132	-0.0612	-0.0093	-0.2045	-0.0618	0.0081
English (REFERENCE)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
<b>LANGUAGE SPOKEN AT HOME (4Q13 only)</b>											
Spanish	-0.0042	-0.0093	-0.0041	-0.0189	-0.0212	0.0009	-0.0229	-0.0027	-0.1141	-0.0318	-0.0008
Chinese	0.0314	0.0284	0.0423	0.0417	0.0228	0.0097	0.0030	-0.0038	0.0379	0.0171	0.0322
R/V/O	0.0033	0.0018	0.0108	0.0071	-0.0120	0.0072	-0.0251	0.0003	-0.0024	-0.0043	0.0158
English (REFERENCE)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
<b>AGE</b>											
Age 18-24	0.0700	0.0809	0.1424	0.1390	-0.1422	0.0737	-0.0366	-0.0312	0.6856	0.2311	-0.0490
Age 25-34	0.0360	0.0515	0.0452	0.0935	-0.1544	0.0729	-0.0445	-0.0402	0.5558	0.1657	-0.0782
Age 35-44	0.0122	0.0257	0.0145	0.0632	-0.1726	0.0743	-0.0227	-0.0453	0.4307	0.1291	-0.0781
Age 45-54	-0.0206	-0.0074	-0.0203	0.0209	-0.1795	0.0645	0.0059	-0.0491	0.2417	0.0685	-0.0947
Age 55-64	-0.0448	-0.0375	-0.0547	-0.0224	-0.1826	0.0436	0.0050	-0.0539	0.0811	0.0260	-0.1087
Age 65-74	-0.0539	-0.0601	-0.0622	-0.0523	-0.1645	0.0404	-0.0103	-0.0482	-0.0223	-0.0018	-0.1025
Age 75-84	-0.0328	-0.0367	-0.0416	-0.0337	-0.0935	0.0264	0.0032	-0.0225	-0.0475	-0.0069	-0.0447
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
<b>SERVICE LINE</b>											
Maternity	-0.1072	-0.2271	-0.2402	-0.2156	-0.2334	0.0061	-0.1934	-0.0713	-0.5570	-0.2209	-0.1085
Surgical	-0.0030	-0.1657	-0.0209	-0.0682	-0.0323	-0.0037	-0.0261	-0.0493	-0.2500	-0.0898	-0.0671
Medical (REFERENCE)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
<b>INTERACTIONS</b>											
Surgical Line * Age <sup>1</sup>	0.0000	0.0138	-0.0022	-0.0017	-0.0017	-0.0034	0.0007	-0.0014	0.0246	0.0089	0.0042
Maternity Line * Age <sup>1</sup>	0.0168	0.0252	0.0266	0.0269	0.0403	0.0098	0.0118	0.0152	0.0825	0.0313	0.0172

<sup>1</sup> 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 A, Table 2: National Means of PMA Variables for Patients Discharged Between Quarter 1, 2013 and Quarter 4, 2013 (January 1, 2013 to December 31, 2013) -- For use in the Dry Run of HCAHPS Star Ratings included in the December 2014 Hospital Compare Preview Reports.**

Patient-Mix Adjustment (PMA)	National Mean
Education (per level; 1=8th grade or less and 6=More than 4-year college degree)	3.737
Self-Rated Health (per level; 1=Excellent and 5=Poor)	2.749
Response Percentile	15.5%
<b>LANGUAGE SPOKEN AT HOME</b>	
Non-English	6.7%
English (REFERENCE)	93.2%
Spanish	4.6%
Chinese	0.4%
R/V/O	1.8%
English (REFERENCE)	93.2%
<b>AGE</b>	
Age 18-24	4.3%
Age 25-34	11.3%
Age 35-44	7.1%
Age 45-54	10.8%
Age 55-64	18.8%
Age 65-74	23.0%
Age 75-84	17.6%
Age 85+ (REFERENCE)	7.1%
<b>SERVICE LINE</b>	
Maternity	13.8%
Surgical	35.6%
Medical (REFERENCE)	50.6%
<b>INTERACTIONS</b>	
Surgical Line * Age <sup>1</sup>	1.887
Maternity Line * Age <sup>1</sup>	0.290

<sup>1</sup> 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 -- For use in the Dry Run of HCAHPS Star Ratings included in the December 2014 Hospital Compare Preview Reports.**

	Phone Only	Mixed	Active IVR
<b>HCAHPS Composite Measures</b>			
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
<b>HCAHPS Individual Items</b>			
Cleanliness of Hospital Environment	-0.072	-0.032	-0.037
Quietness of Hospital Environment	-0.044	-0.038	-0.109
<b>HCAHPS Global Items</b>			
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 1, 2013 and Quarter 4, 2013 (January 1, 2013 to December 31, 2013) -- For use in the Dry Run of HCAHPS Star Ratings included in the December 2014 Hospital Compare Preview Reports.**

	1 Star	2 Stars	3 Stars	4 Stars	5 Stars
<b>HCAHPS Composite Measures</b>					
Communication with Nurses	<88	≥88 to <90	≥90 to <92	≥92 to <95	≥95
Communication with Doctors	<90	≥90 to <92	≥92 to <94	≥94 to <96	≥96
Responsiveness of Hospital Staff	<78	≥78 to <82	≥82 to <86	≥86 to <92	≥92
Pain Management	<83	≥83 to <85	≥85 to <88	≥88 to <90	≥90
Communication about Medicines	<74	≥74 to <78	≥78 to <82	≥82 to <86	≥86
Discharge Information	<79	≥79 to <83	≥83 to <87	≥87 to <91	≥91
Care Transition	<78	≥78 to <80	≥80 to <82	≥82 to <85	≥85
<b>HCAHPS Individual Items</b>					
Cleanliness of Hospital Environment	<81	≥81 to <85	≥85 to <89	≥89 to <93	≥93
Quietness of Hospital Environment	<74	≥74 to <80	≥80 to <83	≥83 to <87	≥87
<b>HCAHPS Global Items</b>					
Overall Hospital Rating	<81	≥81 to <87	≥87 to <90	≥90 to <92	≥92
Recommend the Hospital	<83	≥83 to <87	≥87 to <89	≥89 to <93	≥93

## Appendix D: Additional Information on the Clustering Method Used to Create the HCAHPS Star Ratings

Appendix D outlines the sequence of steps taken in the clustering methodology to develop the 11 HCAHPS Star Ratings. For each HCAHPS 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 hospitals  $j$  and  $k$  ( $j \neq k$ ) among the  $n$  hospitals 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 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 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 hospitals 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.