Technical Notes for HCAHPS Star Ratings
(Revised for October 2019 Public Reporting)

Overview of HCAHPS Star Ratings
As part of the initiative to add five-star quality ratings to its Compare Web sites, the Centers for Medicare & Medicaid Services (CMS) publish HCAHPS Star Ratings on its Hospital Compare Web site. Star Ratings make it easier for consumers to use the information on the Compare Web sites and spotlight excellence in healthcare quality. Eleven HCAHPS Star Ratings appear on Hospital Compare: one for each of the 10 publicly reported HCAHPS measures, plus an HCAHPS Summary Star Rating. CMS updates the HCAHPS Star Ratings each quarter. HCAHPS Star Ratings are based on the same data that are used to create the HCAHPS measures reported on the Hospital Compare Web site.

In this document we explain, through a series of steps, how the HCAHPS Star Ratings are created and provide an extended example to illustrate each step of the process. A set of Appendices (A, B and C) contain the current measure values for the adjustment and assignment of HCAHPS Star Ratings. Appendix D briefly describes the clustering algorithm.

The public reporting of the HCAHPS Star Ratings in October 2019 will be based on patients discharged between January 1, 2018 and December 31, 2018.

HCAHPS Measures Receiving HCAHPS Stars
HCAHPS Star Ratings are applied to each of the 10 publicly reported HCAHPS measure. Measures are created from specific questions (also referred to as items) on the HCAHPS Survey, as follows:
  - ➢ **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. Communication about Medicines (Q16, Q17)
    5. Discharge Information (Q19, Q20)
    6. Care Transition (Q23, Q24, Q25)
  - ➢ **HCAHPS Individual Items**
    7. Cleanliness of Hospital Environment (Q8)
    8. Quietness of Hospital Environment (Q9)
  - ➢ **HCAHPS Global Items**
    9. Hospital Rating (Q21)
    10. Recommend the Hospital (Q22)

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

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 scored linearly, adjusted, rescaled, averaged across quarters, and rounded to produce a 0-100 linear-scaled score ("Linear Score"). The five steps occur as follows:

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One: Linear scoring
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.

Individual responses to the HCAHPS Survey are scored as follows:
For items 1-9, 11, and 16-17:
  ➢ "Never" = 1; "Sometimes" = 2; "Usually" = 3; and "Always" = 4
For items 19 and 20:
  ➢ "No" = 0; and "Yes" = 1
For item 21:
  ➢ Hospital Rating "0" = 0; Hospital Rating "1" = 1; Hospital Rating "2" = 2 … Hospital Rating "10" = 10
For item 22:
  ➢ "Definitely No" = 1; "Probably No" = 2; "Probably Yes" = 3; and "Definitely Yes" = 4
For items 23, 24, and 25:
  ➢ "Strongly Disagree" = 1; "Disagree" = 2; "Agree" = 3; and "Strongly Agree" = 4

The item responses are averaged at the hospital level to form the hospital-level mean for each measure.

Two: Adjustment of HCAHPS linear scores
CMS applies adjustments for the effects of patient mix, survey mode, and quarterly weighting through a series of steps, as follows.

First, CMS applies 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 enables 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 1a and 1b). Appendix A also contains the national means (Table 2a and 2b) for patient-mix variables. These adjustments are applied to HCAHPS scores on the scale shown above. These values are shown for each answer option on the survey instrument. 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.

Please note: The HCAHPS Patient-Mix Adjustment (PMA) model was updated to add Question 28, patient's self-reported overall mental or emotional health, beginning with July 1, 2018 (Quarter 3, 2018) discharges. The new PMA variable is called Self-Rated Mental Health. In addition, the label for overall health was changed to "Self-Rated Overall Health."

Self-Rated Mental Health follows the same linear parameterization as Self-Rated Overall Health: patient responses are coded as 1 ("Excellent") through 5 ("Poor"). The patient-mix adjustment model will thus include both Self-Rated Overall Health and Self-Rated Mental Health. HCAHPS survey results were adjusted using the new PMA model beginning with July 1, 2018 discharges.

Adjustments and national means contained in Tables 1a and 2a, respectively, are needed to estimate PMA for discharges prior to July 1, 2018. To estimate PMA for discharges on or after July 1, 2018 please see Tables 1b and 2b.
Second, HCAHPS quarterly 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 are included in Appendix B. Similar to PMA, these adjustment are applied on the original scale shown on the HCAHPS survey instrument for each measure. For detailed information about the mode experiment and survey mode adjustment, please see www.hcahpsonline.org.

If the measure is a multi-item composite, averaging of items within composites takes place at this point.

Three: Rescaling of HCAHPS linear adjusted scores

Each adjusted HCAHPS linear measure score on the original scale (shown above) is then transformed into a 0-100 linear-scaled score using the following conversion:

The PMA- and mode-adjusted hospital-level measure mean, **M**, minus the lowest possible response to the measure, **R**, divided by the highest possible response to the measure, **K**, minus the lowest response, R. An example follows:

$$100 * \frac{M - R}{K - R}$$

Four: Weighted Average of Quarters of HCAHPS linear scores

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.

Five: Rounding of HCAHPS linear scores

The four-quarter averages of HCAHPS linear scores are rounded to integer values (whole numbers) using standard rounding rules, as follows:

If the unrounded four-quarter average is less than [X.5], then round down to nearest whole integer. If the unrounded four-quarter average is equal to or greater than [X.5], then round up to nearest whole integer.

An example of the calculation of an HCAHPS Linear Score

The following is an example of the construction and adjustment of an HCAHPS linear score.

> **Step 1: Linear scoring**
> For a single quarter from Hospital A, 5 patients responded by telephone to HCAHPS Survey Cleanliness item (item 8) as follows: 4, 4, 3, 2, and 4. The mean of these responses is **3.4**.

> **Step 2: Adjustment of HCAHPS linear scores**
> This hospital has a total patient-mix adjustment of **-0.038** and a telephone mode adjustment of **-0.018** (as found in the Appendices that follow).

>> Patient-mix adjustment applied: 3.4 – 0.038 = **3.362**
>> Phone mode adjustment applied: 3.362 – 0.018 = **3.344** (M)
>> Cleanliness has a maximum response of 4 (K) and a minimum response of 1 (R).

> **Step 3: Rescaling of HCAHPS linear scores**
> To put this score into the 0-100 scale:
>> 100*((3.344 – 1) / (4 - 1)) = **78.13**
>> Thus, **78.13** is the quarterly Linear Mean Score for Cleanliness for Hospital A.

> **Step 4: Weighted Average of Quarters of HCAHPS linear scores**
> 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. For instance; a hospital has the following scores and numbers of eligibles for the four quarters in a reporting period:

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Q1: 72.35, 4 eligibles; Q2: 67.26, 7 eligibles; Q3: 75.94, 8 eligibles; Q4: 76.33, 5 eligibles.

$$4 + 7 + 8 + 5 = 24\ total\ eligibles$$

$$\left(72.35 * \left(\frac{4}{24}\right)\right) + \left(67.26 * \left(\frac{7}{24}\right)\right) + \left(75.94 * \left(\frac{8}{24}\right)\right) + \left(76.33 * \left(\frac{5}{24}\right)\right) = 72.89\ four\ quarter\ average$$

Step 5: Rounding of HCAHPS linear scores
Four-quarter averages of HCAHPS linear scores are rounded to integer values using standard rounding rules, as follows:

72.89: .89 is greater than .5; so the linear score is rounded up to the next integer, 73.

Conversion of Linear Scores into HCAHPS Star Ratings for the 10 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 10 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 the current HCAHPS Star Ratings are shown in Appendix C. Additional information about the clustering method can be found in Appendix D.

The HCAHPS Summary Star Rating
In addition to Star Ratings for the 10 HCAHPS measures, CMS introduced 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 Star Ratings from each of the 6 HCAHPS Composite Measures
  - o Communication with Nurses, Communication with Doctors, Responsiveness of Hospital Staff, 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 Hospital Rating and Recommend the Hospital.

The 8 Star Ratings (6 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 8-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 10 HCAHPS measures as shown in following table.

	10 HCAHPS Measure Star Ratings	8 Star Ratings Used in HCAHPS Summary Star Rating	8-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		
Communication about Medicines	4	4		
Discharge Information	4	4	(4+3+4+4+4+3+5+3.5)/8 = 3.813	**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				
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 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 6 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+4+4+3+5+3.5)/8= 3.813.

Step 4: Lastly, round the 8-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:

8-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 1a: HCAHPS Patient-Mix Adjustments of Linear Scores for Patients Discharged Between Quarter 1, 2018 and Quarter 2, 2018 (January 1, 2018 to June 30, 2018)

	Comm. with Nurses	Comm. with Doctors	Responsiveness of Hosp. Staff	Comm. About Medicines	Cleanliness of Hosp. Env.	Quietness of Hosp. Env.	Discharge Information	Care Transition	Hospital Rating	Recommend the Hospital
Education (per level; 1=8th grade or less and 6=More than 4-year college degree)	0.0132	0.0174	0.0230	0.0470	0.0136	0.0458	0.0035	0.0008	0.1032	0.0161
Self-Rated Overall Health (per level; 1=Excellent and 5=Poor)	0.0677	0.0699	0.0908	0.1017	0.0648	0.0666	0.0108	0.0819	0.2590	0.0820
Response Percentile (per 1% of response percentile)	0.0026	0.0026	0.0036	0.0039	0.0009	0.0004	0.0004	0.0026	0.0070	0.0024
LANGUAGE SPOKEN AT HOME										
Spanish	-0.0186	-0.0513	-0.0281	-0.0643	0.0065	-0.0900	-0.0173	-0.0245	-0.4357	-0.1402
Chinese	0.0745	0.0597	0.0902	0.0369	0.0183	-0.0429	-0.0237	0.0855	0.0464	0.0079
R/V/P/O	0.0269	0.0127	0.0581	-0.0200	0.0524	-0.0812	0.0039	0.0604	0.0404	-0.0072
English (REFERENCE)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
AGE										
Age 18-24	0.0658	0.0630	0.1378	-0.1412	0.0412	0.0051	-0.0335	-0.0422	0.6903	0.2280
Age 25-34	0.0358	0.0436	0.0538	-0.1661	0.0337	-0.0175	-0.0367	-0.0784	0.5632	0.1697
Age 35-44	0.0218	0.0270	0.0362	-0.1571	0.0555	0.0006	-0.0377	-0.0700	0.4636	0.1384
Age 45-54	-0.0169	-0.0208	-0.0160	-0.1934	0.0475	0.0028	-0.0474	-0.0925	0.2527	0.0670
Age 55-64	-0.0411	-0.0428	-0.0455	-0.1794	0.0405	0.0039	-0.0490	-0.0984	0.1088	0.0274
Age 65-74	-0.0586	-0.0633	-0.0618	-0.1694	0.0289	-0.0137	-0.0492	-0.0997	-0.0297	-0.0064
Age 75-84	-0.0390	-0.0436	-0.0411	-0.1012	0.0243	-0.0072	-0.0239	-0.0497	-0.0480	-0.0119
Age 85+ (REFERENCE)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SERVICE LINE										
Male Medical	-0.0170	0.0021	-0.0254	-0.1055	-0.1158	-0.0031	-0.0240	-0.0257	-0.0453	-0.0349
Male Surgical	-0.0492	-0.1516	-0.0793	-0.1837	-0.1350	-0.0468	-0.0664	-0.1090	-0.3537	-0.1465
Female Medical (REFERENCE)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Female Surgical	-0.0287	-0.1587	-0.0544	-0.0646	-0.0242	-0.0742	-0.0560	-0.0841	-0.3084	-0.1161
Female Maternity	-0.1107	-0.2010	-0.2303	-0.2515	-0.0117	-0.2160	-0.0613	-0.1040	-0.6230	-0.2439
INTERACTIONS										
Surgical Line * Age[1]	0.0019	0.0109	-0.0009	0.0012	-0.0034	0.0032	-0.0011	0.0052	0.0246	0.0096
Maternity Line * Age[1]	0.0081	0.0121	0.0018	0.0162	-0.0064	0.0013	0.0091	0.0066	0.0789	0.0254

[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 A, Table 1b: HCAHPS Patient-Mix Adjustments of Linear Scores for Patients Discharged Between Quarter 3, 2018 and Quarter 4, 2018 (July 1, 2018 to December 31, 2018)

	Comm. with Nurses	Comm. with Doctors	Responsiveness of Hosp. Staff	Comm. About Medicines	Cleanliness of Hosp. Env.	Quietness of Hosp. Env.	Discharge Information	Care Transition	Hospital Rating	Recommend the Hospital
Education (per level; 1=8th grade or less and 6=More than 4-year college degree)	0.0181	0.0226	0.0290	0.0550	0.0170	0.0505	0.0047	0.0100	0.1156	0.0203
Self-Rated Overall Health (per level; 1=Excellent and 5=Poor)	0.0401	0.0409	0.0587	0.0636	0.0447	0.0441	0.0052	0.0391	0.1785	0.0561
Self-Rated Mental Health (per level; 1=Excellent and 5=Poor)	0.0506	0.0533	0.0577	0.0743	0.0354	0.0436	0.0136	0.0875	0.1497	0.0480
Response Percentile (per 1% of response percentile)	0.0022	0.0022	0.0030	0.0031	0.0004	-0.0001	0.0003	0.0021	0.0054	0.0020
LANGUAGE SPOKEN AT HOME										
Spanish	-0.0206	-0.0578	-0.0266	-0.0662	0.0163	-0.0811	-0.0182	-0.0197	-0.4413	-0.1388
Chinese	0.0377	0.0215	0.0519	-0.0004	-0.0098	-0.0842	-0.0310	0.0775	-0.0718	-0.0192
R/V/P/O	0.0065	-0.0093	0.0410	-0.0452	0.0393	-0.0941	-0.0007	0.0336	-0.0402	-0.0353
English (REFERENCE)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
AGE										
Age 18-24	0.0551	0.0700	0.1317	-0.1506	0.0436	-0.0056	-0.0298	-0.0469	0.6856	0.2231
Age 25-34	0.0228	0.0451	0.0472	-0.1782	0.0355	-0.0325	-0.0363	-0.0868	0.5594	0.1642
Age 35-44	0.0167	0.0342	0.0345	-0.1589	0.0580	-0.0104	-0.0377	-0.0708	0.4761	0.1379
Age 45-54	-0.0203	-0.0106	-0.0201	-0.1807	0.0562	-0.0007	-0.0482	-0.0894	0.2694	0.0656
Age 55-64	-0.0360	-0.0305	-0.0375	-0.1727	0.0519	0.0052	-0.0490	-0.0862	0.1368	0.0338
Age 65-74	-0.0514	-0.0489	-0.0500	-0.1573	0.0402	-0.0074	-0.0467	-0.0849	0.0081	0.0040
Age 75-84	-0.0337	-0.0345	-0.0319	-0.0900	0.0343	-0.0005	-0.0226	-0.0407	-0.0213	-0.0038
Age 85+ (REFERENCE)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SERVICE LINE										
Male Medical	-0.0140	0.0043	-0.0240	-0.1013	-0.1130	0.0011	-0.0243	-0.0235	-0.0463	-0.0310
Male Surgical	-0.0314	-0.1466	-0.0553	-0.1668	-0.1374	-0.0227	-0.0663	-0.0996	-0.3217	-0.1302
Female Medical (REFERENCE)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Female Surgical	-0.0150	-0.1569	-0.0385	-0.0484	-0.0302	-0.0512	-0.0574	-0.0791	-0.2846	-0.1040
Female Maternity	-0.0848	-0.1925	-0.2193	-0.2318	0.0009	-0.1898	-0.0629	-0.0807	-0.5619	-0.2218
INTERACTIONS										
Surgical Line * Age[1]	-0.0001	0.0111	-0.0031	0.0007	-0.0018	0.0000	-0.0010	0.0047	0.0216	0.0080
Maternity Line * Age[1]	0.0042	0.0120	0.0039	0.0192	-0.0055	0.0010	0.0109	0.0020	0.0699	0.0225

[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+).

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Appendix A, Table 2a: National Means of PMA Variables for Patients Discharged Between Quarter 1, 2018 and Quarter 2, 2018 (January 1, 2018 to June 30, 2018)

	National Mean
Education (per level; 1=8th grade or less and 6=More than 4-year college degree)	3.594
Self-Rated Overall Health (per level; 1=Excellent and 5=Poor)	2.882
Response Percentile	14.5%
LANGUAGE SPOKEN AT HOME	
Spanish	4.3%
Chinese	0.3%
R/V/P/O	1.4%
English (REFERENCE)	94.0%
AGE	
Age 18-24	2.5%
Age 25-34	7.3%
Age 35-44	4.8%
Age 45-54	7.6%
Age 55-64	17.8%
Age 65-74	26.6%
Age 75-84	22.7%
Age 85+ (REFERENCE)	10.8%
SERVICE LINE	
Male Medical	27.9%
Male Surgical	12.9%
Female Medical (REFERENCE)	35.8%
Female Surgical	14.6%
Female Maternity	8.7%
INTERACTIONS	
Surgical Line * Age[1]	1.526
Maternity Line * Age[1]	0.176

[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 A, Table 2b: National Means of PMA Variables for Patients Discharged Between Quarter 3, 2018 and Quarter 4, 2018 (July 1, 2018 to December 31, 2018)

	National Mean
Education (per level; 1=8th grade or less and 6=More than 4-year college degree)	3.609
Self-Rated Overall Health (per level; 1=Excellent and 5=Poor)	2.925
Self-Rated Mental Health (per level; 1=Excellent and 5=Poor)	2.309
Response Percentile	14.3%
LANGUAGE SPOKEN AT HOME	
Spanish	4.2%
Chinese	0.3%
R/V/P/O	1.4%
English (REFERENCE)	94.2%
AGE	
Age 18-24	2.3%
Age 25-34	7.6%
Age 35-44	5.0%
Age 45-54	7.4%
Age 55-64	17.7%
Age 65-74	26.3%
Age 75-84	22.7%
Age 85+ (REFERENCE)	10.9%
SERVICE LINE	
Male Medical	27.7%
Male Surgical	13.3%
Female Medical (REFERENCE)	34.8%
Female Surgical	15.2%
Female Maternity	9.0%
INTERACTIONS	
Surgical Line * Age[1]	1.585
Maternity Line * Age[1]	0.181

[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 (for HCAHPS score adjustments beginning with April 2017 discharges)

	Phone Only	Mixed	Active IVR
HCAHPS Composite Measures			
Communication with Nurses	-0.043	-0.049	0.013
Communication with Doctors	-0.020	-0.008	0.036
Responsiveness of Hospital Staff	-0.010	-0.055	0.042
Communication about Medicines	-0.011	-0.004	0.023
Discharge Information	-0.017	-0.012	-0.016
Care Transition	-0.024	-0.028	0.009
HCAHPS Individual Items			
Cleanliness of Hospital Environment	-0.018	-0.046	0.019
Quietness of Hospital Environment	-0.105	-0.080	-0.056
HCAHPS Global Items			
Hospital Rating	-0.166	-0.142	0.079
Recommend the Hospital	-0.043	-0.035	0.030

Appendix C: HCAHPS Star Rating Cut Points for Patients Discharged Between Quarter 1, 2018 and Quarter 4, 2018 (January 1, 2018 to December 31, 2018)

	1 Star	2 Stars	3 Stars	4 Stars	5 Stars
HCAHPS Composite Measures					
Communication with Nurses	<86	≥86 to <90	≥90 to <92	≥92 to <95	≥95
Communication with Doctors	<88	≥88 to <91	≥91 to <93	≥93 to <95	≥95
Responsiveness of Hospital Staff	<79	≥79 to <83	≥83 to <87	≥87 to <91	≥91
Communication about Medicines	<73	≥73 to <77	≥77 to <81	≥81 to <86	≥86
Discharge Information	<81	≥81 to <85	≥85 to <89	≥89 to <93	≥93
Care Transition	<79	≥79 to <81	≥81 to <83	≥83 to <87	≥87
HCAHPS Individual Items					
Cleanliness of Hospital Environment	<83	≥83 to <87	≥87 to <90	≥90 to <94	≥94
Quietness of Hospital Environment	<77	≥77 to <82	≥82 to <86	≥86 to <89	≥89
HCAHPS Global Items					
Hospital Rating	<82	≥82 to <86	≥86 to <90	≥90 to <93	≥93
Recommend the Hospital	<80	≥80 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;
```

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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.