



MDS 3.0 Quality Measures

DRAFT USER'S MANUAL

APPENDIX A

Technical Details

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DRAFT

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Quality Measures (QM) Technical Details

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Section 1

Introduction

This appendix presents technical details regarding the calculation of the nursing home quality measures (QMs), including the methodology used for risk adjustment.

Overview of QM Calculations

The QMs are created from counts of nursing facility long-stay residents or short-stay residents who have certain conditions or problems (e.g., falls resulting in major injury). For example, facility-level scores for the long-stay falls QM are computed by: 1) counting residents in the facility who had a fall resulting in major injury and 2) computing the percent of residents in the facility who had valid MDS data and who experienced such a fall. The detailed logic for defining the resident-level outcomes for each QM is presented in the QM Sample and Record Selection Methodology section and in the Quality Measure Logic Specifications section of this manual. This logic is listed under the "Numerator" entry for each QM.

A Note on Risk Adjustment

Risk adjustment refines raw QM scores to better reflect the prevalence of problems that facilities should be able to address. Two complementary approaches to risk adjustment are applied to the QMs.

One approach involves exclusion of residents whose outcomes are not under nursing facility control (e.g., outcome is evidenced on admission to the facility) or the outcome may be unavoidable (e.g., the resident has end-stage disease or is comatose). All of the QMs, except the vaccination QMs, are shaped by one or more exclusions. For each QM, the prevalence of the outcome across all residents in a nursing facility, after exclusions, is the *facility-level observed QM score*.

A second approach involves adjusting QM scores directly, using logistic regression. This method of adjustment employs *resident-level covariates* that are found to increase the risks of an outcome. Detailed specifications for resident-level covariates are presented in the Quality Measure Logical Specifications section of this manual. This approach involves the following steps:

- First, resident-level covariates were used in a logistic regression model to calculate a *resident-level expected QM score* (the probability that the resident will evidence the outcome, given the presence or absence of characteristics measured by the covariates). Section 3 of this Appendix presents the details for calculating expected scores for residents.
- Then, an average of all resident-level expected QM scores for the nursing facility was calculated to create a *facility-level expected QM score*.

- The final *facility-level adjusted QM score* was based on a calculation which combines the *facility-level expected score* and the *facility-level observed score*. The details for calculating facility-level adjusted scores are presented in Section 4 of this Appendix. The parameters used for each release of the QMs are presented in Appendix B.

Only three of the QMs are adjusted using resident level covariates for public reporting:

- SS_0678: Percent of Residents With Pressure Ulcers That Are New or Worsened (Short Stay)
- LS_0677: Percent of Residents Who Self-Report Moderate to Severe Pain (Long Stay)
- LS_0686: Percent of Residents Who Have/Had a Catheter Inserted and Left in Their Bladder (Long Stay)

The remaining QMs are not adjusted using resident-level covariates. For these measures, facility-level observed QM scores are reported.

Section 2

Steps Used In National QM Calculation

Introduction

This section outlines the processing steps used to calculate QMs. The description below uses the [quarter TBA] as the target period. The dates associated with these steps would be updated, as appropriate, for subsequent quarterly releases of the QMs.

It is important to note two items that recurred throughout the process:

- Every step in file construction and QM calculation proceeded in parallel for two samples of residents and facilities: a “Long-stay” (LS) sample and a “Short-stay” (SS) sample.
- Two “target periods” were defined:
 - a “Current Period” which was one quarter, [quarter TBA], for LS residents and two quarters, [quarters TBA], for SS residents. Data from the current periods were used as the target period for final QM reporting;
 - a “Regression Calculation”, [quarters TBA] data which were used to estimate logistic regressions for risk adjustment.

Processing Steps:

1. **MDS Selection.** All MDS records for U.S. nursing facilities [quarters TBA] were selected.
2. **Sampling for LS QMs.** Nursing facilities and residents were sampled to provide data for LS QM and covariate calculations.
 - a. LS samples of residents: selection was based on specifications in the Quality Measure Sample and Record Selection Methodology (specifically, Long-Stay Record Definitions) section of this manual. Samples for two “target periods” were drawn:
 - i. “Current Period” target sample for computing QMs: all U.S. nursing facilities and residents selected from the target quarter.
 - ii. “Regression Calculation” target sample for estimating logistic regressions: residents from of all U.S. nursing facilities with a long-stay admission in the period [quarters TBA].
 - b. LS resident records were selected for each target period using the methodology described in the Quality Measure Sample and Record Selection Methodology (specifically, Long-Stay Record Definitions) section of this manual.

3. **Sampling for SS QMs.** Nursing facilities and residents were sampled to provide data for SS QM and covariate calculations.
 - a. SS samples of residents: selection was based on specifications in the Quality Measure Sample and Record Selection Methodology (specifically, Short-Stay Record Definitions) section of this manual. Samples for two “target periods” were created:
 - i. “Current Period” target sample for computing QMs: all U.S. nursing facilities and SS residents, selected from the target quarter period [quarters TBA] and the preceding quarter.
 - ii. “Regression Calculation” target sample for estimating logistic regressions: SS residents from all nursing facilities with a short-stay admission in the period [quarters TBA].
 - b. All SS resident records were selected for each target period using the methodology described in the Quality Measure Sample and Record Selection Methodology (specifically, Short-Stay Record Definitions) section of this manual.
4. **Resident-level QM Calculation Files.** At this point, resident-level QM calculation files were created, separately for LS residents and SS residents, for the two target periods, using the specified target, prior, and initial assessments for each resident record, if available.
5. **Resident-level QM and Covariate Calculation Files.** Next, resident-level QM scores were calculated (and covariate values were calculated for the risk-adjusted QMs), separately for each LS resident and SS resident, in the Current and Regression Calculation periods.
 - a. Resident-level QM calculation (all QMs):
 - i. Resident exclusions: For each QM, excluded residents were assigned a missing value for that QM.
 - ii. QM values: does the resident “trigger” the QM?
 1. If “Yes”, then store a value of 1 for that QM in the resident-level QM calculation record appropriate to that resident for a target period.
 2. If “No”, then store a value of 0 for that QM in the resident-level QM calculation record appropriate to that resident for a target period.
 - b. Resident-level covariate calculation (risk-adjusted QMs):
 - i. Resident exclusions: For each QM, excluded residents were assigned a missing value for that QM.
 - ii. Covariate: does the resident “trigger” the covariate?
 1. If “Yes”, then store a value of 1 for that covariate in the resident-level QM calculation record appropriate to that resident for a target period.

2. If “No”, then store a value of 0 for that covariate in the resident-level QM calculation record appropriate to that resident for a target period.
6. **Logistic Regressions.** With the resident-level files complete, and all relevant exclusions applied, logistic regressions for the risk-adjusted QMs were estimated using the Regression Calculation LS and SS samples.
- a. Input: resident-level file from the nursing facility sample from the Regression Calculation target period.
 - b. Dependent variable: was the QM triggered? (yes = 1, no = 0).
 - c. Predictors: resident-level covariates.
 - d. Calculation of logistic regressions: (See Section 3 in this Appendix).
 - e. Output values: logistic regression constant term and resident-level covariate coefficients for each of the five risk-adjusted QMs. The resulting values are given in Table B.1 of Appendix B.
7. **Resident-level Expected QM Scores.** For the QMs that were risk adjusted, resident-level expected QM scores were calculated for each resident for the Current Period LS and SS samples. (See Section 3 in this Appendix for calculation formulas).
- a. Input: logistic regression constant term and resident-level covariate coefficients from Step 6 and resident-level covariate values from Step 5, for each adjusted QM.
 - b. Output values: resident-level expected QM scores for each resident, for each of the risk-adjusted QMs.
8. **National Mean QMs.** National mean observed QMs were needed for calculating the facility-level adjusted QM scores in Step 11, below. The overall national mean observed QM scores for the Current Period LS and SS samples were calculated, for each risk adjusted QM:
- a. Numerator: for each QM, count the total number of residents that triggered the QM and sum for the nation.
 - b. Denominator: for each QM, count the total number of residents retained after exclusions and sum for the nation. Note that the sample will include only those residents with non-missing data for the component covariates.
 - c. Overall national mean observed QM score: divide the numerator by the denominator. The resulting values are given in Table B.2 of Appendix B.
9. **Facility-level Observed QM Scores.** For all QMs, the facility-level observed QM scores were calculated for the Current Period LS and SS samples -- for the QMs that were not risk adjusted, these are the measures that will be publicly reported.
- a. Numerator: for each QM, count the total number of residents who triggered the QM in each facility and sum for the nursing facility.

- b. Denominator: for each QM, count the total number of residents retained after exclusions for each facility and sum for the nursing facility. Note that the sample will include only those residents with non-missing data for the component covariates.
 - c. Facility-level observed QM scores: divide the numerator by the denominator for each QM and nursing facility.
10. ***Facility-level Expected QM Scores.*** For the risk-adjusted QMs, the facility-level expected QM scores are calculated for the Current Period LS and SS samples. This is done by averaging the resident-level expected QM scores for each QM within each nursing facility. Note that the sample will include only those residents with non-missing data for the component covariates.
11. ***Facility-level Adjusted QM Scores.*** Finally, for the risk-adjusted QMs, the facility-level adjusted QM scores were calculated for the Current Period LS and SS samples.
- a. Input -- for each of the risk-adjusted QMs
 - i. Facility-level observed QM scores
 - ii. Facility-level expected QM scores
 - iii. National mean observed QM scores
 - b. Calculation: (See Section 4 of this Appendix for calculation formulas)
 - c. Output: Facility-level adjusted QM scores for the five risk-adjusted QMs
12. ***Final Facility-level Output File.*** The final facility-level output files for the Current Period LS and SS QMs contained the following:
- a. For all QMs:
 - i. Facility numerator counts
 - ii. Facility denominator counts
 - iii. Facility-level observed QM scores (publicly reported for the unadjusted QMs)
 - b. For the risk-adjusted QMs: Facility-level adjusted QM scores (publicly reported scores)

Section 3

Calculation of the Expected QM Score

For the QMs adjusted with resident-level covariates, the resident-level expected QM score was calculated as an intermediate step to obtaining an adjusted QM score for the facility. This section describes the technical details of Step 7, referred to in Section 2 of this Technical Appendix.

Calculating Resident-level Expected QM Scores

The resident-level expected score for a QM is an estimate of the risk that a resident will trigger the QM. This estimate is based on consideration of the resident-level covariates associated with the QM.

For each of the risk-adjusted QMs, a resident-level logistic regression was estimated. Data came from the short stay and long stay samples described in the prior section of this appendix. The resident-level observed QM score was the dependent variable. The predictor variables were one or more resident-level covariates associated with the QM. Calculation of the QM and covariate scores is described in Section 2 (Step 5) of this Appendix.

Each logistic regression had the following form:

$$[1] \text{ QM triggered (yes = 1, no = 0)} = B_0 + B_1 * COV_A + B_2 * COV_B + \dots + B_N * COV_N$$

where B_0 is the logistic regression constant, B_1 is the logistic regression coefficient for the first covariate, COV_A is the resident-level score for the first covariate, B_2 is the logistic regression coefficient for the second covariate (where applicable), and COV_B is the resident-level score for the second covariate (where applicable), and so on.

Each resident's expected QM score could then be calculated with the following formula:

$$[2] \text{ Resident-level expected QM score} = 1 / [1 + e^{-X}]$$

where e is the base of natural logarithms and

X is a linear combination of the constant and the logistic regression coefficients times the covariate scores (from Formula [1], above). A covariate score will be 1 if the covariate is triggered for that resident, and 0 if not.

As an example, consider the actual calculation used for the expected score for the LS "Percent of residents who have moderate to severe pain" QM (LS_0677). The covariate for that QM is an indicator of independence in daily decision-making on the prior assessment. The equation used for this QM (with the parameters from Table B.1 for the [target period] is:

$$\text{LS_0677 Score} = 1 / [1 + e^{-(B_0 + B_1 * \text{IndpDec})}]$$

Where B_0 is the logistic regression constant, B_1 is the logistic regression coefficient for $IndpDec$, and $IndpDec$ is the resident-level covariate indicating independence in daily decision-making.

The LS_0677 score for a resident who triggers the independence in decision making covariate (covariate score = 1) is expected to be

$$LS_0677\ Score = 1 / [1 + e^{-(B_0 + B_1 * 1)}]$$

For a resident who does not trigger the independence covariate (covariate score = 0), the LS_0677 score is expected to be:

$$LS_0677\ Score = 1 / [1 + e^{-(B_0 + B_1 * 0)}]$$

Thus a resident with independence deficits is $[X]$ as likely to experience severe pain (X percent, compared to X percent for a resident who does not have these deficits).

The parameters used for calculating the resident-level expected QM scores are presented in Table B.1 of Appendix B.

Calculating Facility-level Expected QM Scores

Once an expected QM score has been calculated for all residents at risk, the facility-level expected QM score is simply the average of all resident-level scores for each of the risk-adjusted QMs.

Section 4

Calculation of the Adjusted QM Score

The risk-adjusted QM score is a facility-level QM score adjusted for the specific risk for that QM in the nursing facility. The risk-adjusted QM score can be thought of as an estimate of what the nursing facility's QM rate would be if the facility had residents with average risk.

The facility-level adjusted score is calculated on the basis of

- The facility-level observed QM score,
- The facility-level average expected QM score, and
- The national average observed QM score.

The actual calculation of the adjusted score uses the following equation:

$$[3] \text{ Adj} = 1 / [1 + e^{-y}]$$

where

Adj is the facility-level adjusted QM score, and

$$y = (\text{Ln}(\text{Obs}/(1-\text{Obs})) - \text{Ln}(\text{Exp}/(1-\text{Exp})) + \text{Ln}(\text{Nat}/(1-\text{Nat})))$$

Obs is the facility-level observed QM rate,

Exp is the facility-level expected QM rate,

Nat is the national observed QM rate, and

Ln indicates a natural logarithm.

e is the base of natural logarithms

Note that the adjusted QM rate (**Adj**) is calculated differently in two special cases:

1. When **Obs** equals 0.00, then **Adj** is set to 0.00 (without using the equation).
2. When **Obs** equals 1.00, then **Adj** is set to 1.00 (without using the equation).

The adjusted QM score equation will produce adjusted scores in the range of 0 to 1. These adjusted scores can then be converted to percentages for ease of interpretation.

These adjusted score calculations are applied to QMs that use expected scores based on resident-level covariates (See Section 3 of this Appendix). The national average observed QM rates, required for these calculations, are presented in Appendix B.

Section 5

Data Dictionary for National QM SAS Output

This section presents a data dictionary for the SAS Quality Measure output table generated for the QMs. This table is generated once per quarter and contains one record for each facility. The record for a facility contains the MDS facility ID, which consists of the state code (ST_CODE) and the internal facility ID (FAC_ITL). For each of the QMs for this period, three variables are reported:

1. The numerator (i.e., the number of cases at the facility that triggered the QM), named N_qm-name.
2. The denominator (i.e., the number of cases at the facility that were considered), named D_qm-name.
3. The reported value of the QM, named Q_qm-name.

<qm-name> values used as the SAS variable names are presented in Table A.1. For each QM, this table gives <qm-name> (the SAS name) and “Description” (brief description). Table A.2 describes the contents of the Facility QM Output Table.

Table A.1 QM Name and Label Conventions

<qm-name>	Description
SS_0675	The Percentage of Residents on a Scheduled Pain Medication Regimen on Admission Who Self-Report a Decrease in Pain Intensity or Frequency (short stay)
SS_0676	Percent of Residents Who Self-Report Moderate to Severe Pain (short stay)
SS_0678	Percent of Residents with Pressure Ulcers that are New or Worsened (short stay)
SS_0680	Percent of Nursing Home Residents Who Were Assessed and Appropriately Given the Seasonal Influenza Vaccine (short stay)
SS_0682	Percent of Residents Assessed and Appropriately Given the Pneumococcal Vaccine (short stay)
LS_0674	Percent of Residents Experiencing One or More Falls with Major Injury (long stay)
LS_0677	Percent of Residents who Self-Report Moderate to Severe Pain (long stay)
LS_0679	Percent of High-Risk Residents with Pressure Ulcers (long stay)
LS_0681	Percent of Residents Assessed and Appropriately Given the Seasonal Influenza Vaccine (long stay)

<qm-name>	Description
LS_0683	Percent of Long Stay Residents Assessed and Appropriately Given the Pneumococcal Vaccine (long stay)
LS_0684	Percent of Residents with a Urinary Tract Infection (long stay)
LS_0685	Percent of Low Risk Residents Who Lose Control of their Bowels or Bladder (long stay)
LS_0686	Percent of Residents Who Have/Had a Catheter Inserted and Left in Their Bladder (long stay)
LS_0687	Percent of Residents Who Were Physically Restrained (long stay)
LS_0688	Percent of Residents Whose Need for Help with Activities of Daily Living Has Increased (long stay)
LS_0689	Percent of Residents Who Lose Too Much Weight (long stay)
LS_0690	Percent of Residents Who Have Depressive Symptoms (long stay)

**Table A.2 Facility QM Output Table
(1 Record per Facility)**

SAS Name	Type	Length	SAS Label/Description
Facility Id Codes			
ST_CODE	CHAR	2	SAS Label: STATE ID CODE Description: Facility state
FAC_ITL	CHAR	10	SAS Label: SYSTEM INTERNAL FACILITY ID Description: MDS System unique facility ID code
Facility-Level Measures Repeated for Each of the 14 QMs			
D_<qm-name>	NUM	8	SAS Label: DENOMINATOR,<qm-name> Description: Complete-data QM denominator. Number of residents for QM calculation, after QM exclusions AND exclusion of cases with any missing covariate scores (if applicable).
N_<qm-name>	NUM	8	SAS Label: NUMERATOR,<qm-name> Description: Complete-data QM numerator. Number of residents triggering the QM, after QM exclusions AND exclusion of cases with any missing covariate scores (if applicable).
Q_<qm-name>	NUM	8	SAS Label: QM SCORE,<QM-NAME> Description: Complete-data QM rate. Percent of residents triggering the QM, after QM exclusions AND exclusion of cases with any missing covariate scores (if applicable); risk adjusted if applicable.



MDS 3.0 Quality Measures

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APPENDIX B

Parameters Used for each Quarter

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Introduction

This appendix presents the model parameters that were estimated for the risk adjusted QMs. for the following time period:

- The period ending [quarter TBA], referred to as QX 2011.

The purpose of this document is to present the parameters used in the risk adjustment calculations that were applied to the risk-adjusted QMs. Two sets of parameters were used: logistic regression coefficients and national observed QM means. These parameters are presented in the following two sections. For details regarding the use of these parameters, please refer to Appendix A.

Logistic Regression Coefficients

Three QMs are risk adjusted. The logistic regression coefficients used are presented in Table B.1. Where risk adjustment involves the use of more than one resident-level covariate, coefficients are listed in the order presented in the LS and SS matrices that are presented in the MDS 3.0 Quality Measures Logical Specifications section of this manual.

Table B.1. Logistic Regression Coefficients

QM	Constant (Intercept)	Resident-Level Covariates
SS_0678	TBA	1. Covariate 1 TBA 2. Covariate 2 TBA 3. Covariate 3 TBA 4. Covariate 4 TBA
LS_0677	TBA	1. Covariate TBA
LS_0686	TBA	1. Covariate 1 TBA 2. Covariate 2 TBA

National Observed Means

The national observed QM means are updated for each quarterly release. Table B.2 presents these means for [quarter TBA], as an example.

Table B.2. National Observed QM Means

QM	[quarter TBA]
SS_0678	TBA
LS_0677	TBA
LS_0686	TBA
