# ATTACHMENT C – HCAHPS MODE EXPERIMENT III

## Objectives

a. For the new Coordination of Care (CoC) composite measure, analyze Mode Experiment III results for the following:

   i. Patient-mix adjustment to inform how patient sub-groups respond to the new measure.

   ii. Potential mode effects for the CoC measure.

   iii. Describe how CoC relates to other measures using psychometric analyses.

b. Analyze the potential effectiveness of new patient-mix adjustment survey items related to self-rated mental health and emergency room admission.

Table of Contents

**Appendices:**

and hospital by mode as random effects.

**APPENDIX A**

A. Descriptive Statistics

a. METHODS

We produced tables that present descriptive statistics for age, service line, and all survey items for completed surveys overall and by mode. The descriptive statistics include means and simple frequencies. For each survey item, we produced a version of the descriptive statistics that includes percent missing and a version that excludes the missing cases

b. RESULTS

The mean, standard deviation, and number observed are presented for questions with ordinal response (Appendix A.1). The frequencies, overall and by mode, for the all variables are presented in Appendix A.2 (including percent missing) and A.3 (excluding the missing cases).

After reversing coding, the mean overall health and mental health perceptions on a scale from poor (1) to excellent (5) are 3.15 and 3.77 respectively, which corresponds to good health and very good mental health. More than half (62%) of patients reported having been admitted via the emergency room.

c. CONCLUSIONS

The distributions of HCAHPS items are as expected, with the exception that self-reported emergency room admission rates notably exceeded the rates seen for the administrative measures of emergency room admission, which was nearer to 40%.

**APPENDIX B**

B. Coordination of Care (CoC)/Transition Items

a. METHODS

There are three CoC items on a 4-point scale (strongly agree - strongly disagree), but one of the items has a fifth response value (a tailored not applicable) that we treated as missing. We generated two versions of each CoC item: 1) linear mean scoring on a 0-100 scale and b) top-box scoring (top = strongly agree vs. all other except not applicable/missing). We used both the linear and top-box versions of the three CoC items and the CoC composite in all analyses below.

For each of the three CoC items, we generated an inter-item correlation matrix and Cronbach's Alpha. We also examined the correlation of the CoC composite and each CoC item with each of the 10 reported HCAHPS measures (correlating top-box with top-box and linear with linear).

b. RESULTS

The mean score for the CoC composite, with 0-100 linear mean scoring, is 80, which is between agree and strongly agree. The top-box proportion (strongly agree) for the CoC composite is 47%.

The inter-item correlations with linear scoring are between 0.50 and 0.65, and the standardized Cronbach's alphas are 0.82 and 0.80 for the linear and top-box CoC composites, respectively (Appendix B.1). The Pearson and Spearman correlations for linear and top-box CoC

composite and items with other HCAHPS measures are presented in Appendices B.2 and B.3, respectively. The Pearson correlations for the linearly scored CoC composite with other linearly scored HCAHPS measures are between 0.3 and 0.5, and slightly lower for the three individual CoC items (highest for Q23-staff took preferences into account and lowest for Q25-understood medications). The Spearman correlations show a similar pattern, and overall are lower than the Pearson correlations. The highest correlation with the linearly scored CoC composite is for recommending hospital (r=0.51) followed by Communication with Nurses (r=0.50), Communication about Medicine (0.49) and Rating of Hospital (0.48).

c. CONCLUSIONS

The CoC measure shows no evidence of a ceiling effect. The high Cronbach's alpha suggests that the CoC measure has very good internal consistency reliability. The moderately high association with hospital rating and recommendation are evidence of validity and suggest that patients value good coordination of care. The moderate correlations with other HCAHPS measures indicate that the CoC composite is not redundant with other HCAHPS measures. The strong association of CoC with Communication with Nurses and Communication about Medicine suggests the importance of coordination of care to those domains.

**APPENDIX C**

C. Patient-Mix Adjustment (PMA)

a. METHODS

The purpose of the patient-mix adjustment analyses was to evaluate two new items: ER admission (ERA) and Mental Health Perception (MHP). We compared four sets of models:

i. Base model that corresponds to current official HCAHPS PMA[1] (hospital intercepts plus current PMAs)
ii. Alternate model 1: add ERA to base model
iii. Alternate model 2: add 1df (linear) MHP to the base model
iv. Alternate model 3: add both ERA and MHP to base model

For each patient mix model we ran four versions (one version corresponding to the base model, and three to Alternate Models 1-3) of 22 linear models (11 total outcomes, including the new CoC composite x linear/top-box scoring). We report the coefficients associated with the patient-mix adjusters for all 4 models. The new (candidate) patient-mix adjusters (ERA and MHP) appear on top of the table. We will also examine shifts in current patient-mix adjusters, including general health perception and service line, from the base model to the alternative models (these coefficients appear just below ERA and MHP).

b. RESULTS

For each linear measure the parameter estimates and significance from the four models are presented side-by-side in Appendix C.1. Similarly, the results for the top-box measures are

[1] The PMA are indicators for age (18-24, 25-34, 35-44, 45-55, 56-64, 65-74, 75-84 and 85 or older (reference)), linear education, linear overall health, indicators for maternity and surgical service lines, indicator for language other than English spoken at home, response percentile, and interaction of linear age with maternity and surgical.

presented in Appendix C.2. Regardless of linear or top-box coding, MHP is significant for all measures in both Models 2 and 3. In all instances the MHP coefficient indicates more positive experiences with better MHP. In contrast, ER admission alone or in combination with MHP is significant for only 3 (doctor communication, discharge info, CoC) of the 11 linear measures and 2 (doctor communication and discharge info) of the 11 top-box measures. In all of these instances the coefficient for ERA was negative, indicating less positive experiences for those admitted through the ER.

c. CONCLUSIONS

The associations of MHP and ERA with HCAHPS items are in the direction expected. Future research will inform the advisability of these items as patient-mix adjustors.

**APPENDIX D**

D. Mode Analyses

a. METHODS

We estimated a base series of models. Each model predicted CoC outcomes (linear and top-box) from hospital indicator and the three mode indicators (reference=mail mode). This version is not patient-mix adjusted.

b. RESULTS

The coefficients and significance for three mode indicators (CATI, Mixed, and TT-IVR) versus Mail Only mode are presented in Appendix D.

With respect to the CoC composite, the scores for CATI are significantly higher than Mail Alone mode for both linear and top-box scoring. However, we find no significant differences between IVR and Mixed mode relative to Mail Only mode.

c. CONCLUSIONS

The mode effect results for CoC are similar to what has been observed previously in Mode Experiment 1.

**APPENDIX E**

A. Coordination of Care (CoC)/Transition Items

a. METHODS

We will calculate the interclass correlation coefficient (ICC) at the hospital-level and Spearman-Brown (hospital-level) reliability of the new potential CoC composite and compare these to the ICCs for the 10 currently reported HCAHPS measures (linear mean and top-box versions of each).

b. RESULTS

Appendix F presents the ICC and the reliability statistics. ICC measures similarity of patients within a hospital and ranges between 0 and 1 (theoretically negative values are possible). The observed ICC's (linear and top-box coded) across all measures are very low indicating that patients within hospitals are dissimilar with respect to the eleven HCAHPS measures. The reliabilities (at an average 130 completes) range from poor (<0.50) for Pain Management and Communication about Medicines to high (>0.90) for Quiet and Hospital Recommendation. The estimated Spearman-Brown reliabilities (at n=300) are good ranging between 0.71 and 0.92. The ICC and reliability (including Spearman-Brown Reliability) statistics are consistent across scoring methods (i.e., linear scoring and top-box scoring). The new Coordination of Care measure has ICC and reliability (at n=130) above the median for current HCAHPS measures under both linear and top-box scoring.

c. CONCLUSIONS

The new CoC measure has psychometric properties as good or better than current HCAHPS measures, having both ICC and reliability (at n=130) above the median with respect to the ten current measures.

**APPENDIX F**

Part II

a. METHODS

We will generate patient-mix-adjusted scores for each hospital for each of the 4 models, and calculate 1-R^2 where R is the correlation of final adjusted score for the base model with one of the three alternative models.. We will do this for linear and top-box coded versions of each measure. We will table these results by measure (for each of 11 measures).

b. RESULTS

The results are presented in Appendix H. For all measures, the adjusted means across the four models are very similar for both linear and top-box scoring. The adjusted means correlations between Model 1 and each of the alternate Models are very high. The informativeness ($1-R^2$) is less than 1%, which indicates very small added information resulting from the added PMA (ERA and/or MHP). The Communication with Doctors measure (linear and top-box scoring) and Coordination of Care (top-box) show the biggest

impact. However, on average the addition of ERA and MHP matter the same amount on measures linearly scored, while MHP matters a little more than ERA on top-box measures.

c. CONCLUSIONS
Overall, ERA and MHP have very little impact on informativeness. Thus, we recommend against addition of either item as a patient-mix adjuster. However, CMS will continue collection of these variables for analysis and oversight purposes.

**APPENDIX G**

Part III

a. METHODS
We will produce difference in hospital-level scores under standard PMA model and each of the alternative PMA models. We will show histograms and univariate descriptive statistics of these differences, and list the five hospitals with the biggest gains and losses for each measure, along with mean patient-mix-adjusters for those hospitals.

b. RESULTS
The results are presented in Appendix I. The alternate models have little impact on hospital-level adjusted means. In general, hospitals are effected by less than 1 point with the exception of top-box score Coordination of Care with 1 point on a 0-100 scale.

c. CONCLUSIONS
Overall, ERA and PMA have little effect on hospital scores. Furthermore, there are concerns about the validity of ERA because it is believed to be over-reported by patients, and MHP is moderately correlated with GHP and varies little from hospital to hosptial. For these reasons, we recommend against addition of ERA or MHP as PMA.

**APPENDIX H**

B. <u>Mode Effects</u>

<u>Part I</u>

a. METHODS
We will add patient-mix adjusters to the two base models that predict Coordination of Care outcome (in linear mean and top-box form) from hospital indicator and the three assigned mode indicators (with Mail Only mode as the reference mode). The top-box version of these patient-mix adjusted mode estimates would potentially be used for adjustment.

b. RESULTS
The CATI (phone) mode mode effects are larger for the CoC measure, with and without PMA. These mode effects are larger for top-box scored measures, ranging from 3.13 to 3.50 for with and without PMA, respectively. In contrast, the effects for IVR and Mixed mode are small.

c. CONCLUSIONS

Findings are similar to Mode Experiment I, with CATI having a larger adjustment for the new measure Coordination of Care..

**APPENDIX I**

METHODS

To evaluate heterogeneity of survey mode affects within hospitals, we will run mixed effect models with mode and standard PMA as fixed effects, hospital and hospital by mode random effects.

RESULTS

Since the interactions of CATI by hospital and Mixed mode by hospital are not significant there is no evidence that modes CATI and Mixed vary much from hospital to hospital with respect to CoC. However, the IVR variance component is significant indicating some variability in IVR mode from hospital to hospital.

# Appendices

Appendix A.1

| | | N | | | | | Mean | | | | | SD | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Overall | CATI | Mail | IVR | Mixed | Overall | CATI | Mail | IVR | Mixed | Overall | CATI | Mail | IVR | Mixed |
| q23 | Staff took preferences into account in deciding what care needs would be when I left | 6098 | 1661 | 1478 | 1060 | 1899 | 3.27 | 3.32 | 3.25 | 3.19 | 3.29 | 0.71 | 0.65 | 0.71 | 0.78 | 0.70 |
| q24 | When I left the hospital, had good understanding of things I was responsible for managing health | 6256 | 1733 | 1501 | 1064 | 1958 | 3.41 | 3.47 | 3.37 | 3.35 | 3.40 | 0.67 | 0.62 | 0.66 | 0.75 | 0.67 |
| q25 | When I left the hospital, clearly understood the purpose for taking each of my medications | 5233 | 1357 | 1308 | 941 | 1627 | 3.49 | 3.54 | 3.46 | 3.44 | 3.49 | 0.66 | 0.58 | 0.67 | 0.72 | 0.67 |
| care | Coordination of Care Composite (3) | 6304 | 1742 | 1510 | 1071 | 1981 | 79.19 | 80.85 | 78.45 | 77.19 | 79.37 | 19.78 | 17.67 | 20.15 | 22.11 | 19.80 |
| care_tb | Coordination of Care top-box (average of top-box items) | 6304 | 1742 | 1510 | 1071 | 1981 | 47.13 | 48.82 | 45.31 | 45.86 | 47.72 | 42.45 | 41.48 | 43.22 | 42.81 | 42.48 |

## Appendix A.2

Table of Q23 by MODE

Q23(Staff took preferences into account in deciding what care needs would be when I left)
MODE(Survey Mode (CATI/Telephone only, Mail, MIXED, TT-IVR)

| Frequency<br>Col Pct | CATI | Mail | TT-IVR | MIXED | Total |
|---|---|---|---|---|---|
| . | 90<br>5.14 | 87<br>5.56 | 52<br>4.68 | 125<br>6.18 | 354 |
| 1 Strongly disagree | 29<br>1.66 | 44<br>2.81 | 49<br>4.41 | 53<br>2.62 | 175 |
| 2 Disagree | 88<br>5.03 | 105<br>6.71 | 96<br>8.63 | 113<br>5.58 | 402 |
| 3 Agree | 872<br>49.80 | 773<br>49.39 | 516<br>46.40 | 964<br>47.63 | 3125 |
| 4 Strongly agree | 672<br>38.38 | 556<br>35.53 | 399<br>35.88 | 769<br>37.99 | 2396 |
| Total | 1751 | 1565 | 1112 | 2024 | 6452 |

Table of Q24 by MODE

Q24(When I left the hospital, had good understanding of things I was responsible for managing health)
MODE(Survey Mode (CATI/Telephone only, Mail, MIXED, TT-IVR)

| Frequency<br>Col Pct | CATI | Mail | TT-IVR | MIXED | Total |
|---|---|---|---|---|---|
| . | 18<br>1.03 | 64<br>4.09 | 48<br>4.32 | 66<br>3.26 | 196 |
| 1 Strongly disagree | 22<br>1.26 | 25<br>1.60 | 38<br>3.42 | 43<br>2.12 | 128 |
| 2 Disagree | 46<br>2.63 | 81<br>5.18 | 61<br>5.49 | 75<br>3.71 | 263 |
| 3 Agree | 764<br>43.63 | 706<br>45.11 | 452<br>40.65 | 890<br>43.97 | 2812 |
| 4 Strongly agree | 901<br>51.46 | 689<br>44.03 | 513<br>46.13 | 950<br>46.94 | 3053 |
| Total | 1751 | 1565 | 1112 | 2024 | 6452 |

Table of Q25 by MODE

Q25(When I left the hospital, clearly understood the purpose for taking each of my medications)
MODE(Survey Mode (CATI/Telephone only, Mail, MIXED, TT-IVR)

| Frequency<br>Col Pct | CATI | Mail | TT-IVR | MIXED | Total |
|---|---|---|---|---|---|
| . | 38<br>2.17 | 65<br>4.15 | 58<br>5.22 | 64<br>3.16 | 225 |

Not given meds , 356 , 192 , 113 , 333 , 994
, 20.33 , 12.27 , 10.16 , 16.45 ,
ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆ
1 Strongly , 14 , 26 , 31 , 39 , 110
disagree , 0.80 , 1.66 , 2.79 , 1.93 ,
ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆ
2 Disagree , 19 , 56 , 37 , 46 , 158
, 1.09 , 3.58 , 3.33 , 2.27 ,
ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆ
3 Agree , 540 , 513 , 364 , 627 , 2044
, 30.84 , 32.78 , 32.73 , 30.98 ,
ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆ
4 Strongly agree , 784 , 713 , 509 , 915 , 2921
, 44.77 , 45.56 , 45.77 , 45.21 ,
ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆ
Total 1751 1565 1112 2024 6452

Table of Q23 by MODE

Q23(Staff took preferences into account in deciding what care needs would be when I left)
MODE(Survey Mode (CATI/Telephone only, Mail, MIXED, TT-IVR)

| Frequency<br>Col Pct | CATI | Mail | TT-IVR | MIXED | Total |
|---|---|---|---|---|---|
| 1 Strongly disagree | 29<br>1.75 | 44<br>2.98 | 49<br>4.62 | 53<br>2.79 | 175 |
| 2 Disagree | 88<br>5.30 | 105<br>7.10 | 96<br>9.06 | 113<br>5.95 | 402 |
| 3 Agree | 872<br>52.50 | 773<br>52.30 | 516<br>48.68 | 964<br>50.76 | 3125 |
| 4 Strongly agree | 672<br>40.46 | 556<br>37.62 | 399<br>37.64 | 769<br>40.49 | 2396 |
| Total | 1661 | 1478 | 1060 | 1899 | 6098 |

Frequency Missing = 354

Table of Q24 by MODE

Q24(When I left the hospital, had good understanding of things I was responsible for managing health)
MODE(Survey Mode (CATI/Telephone only, Mail, MIXED, TT-IVR)

| Frequency<br>Col Pct | CATI | Mail | TT-IVR | MIXED | Total |
|---|---|---|---|---|---|
| 1 Strongly disagree | 22<br>1.27 | 25<br>1.67 | 38<br>3.57 | 43<br>2.20 | 128 |
| 2 Disagree | 46<br>2.65 | 81<br>5.40 | 61<br>5.73 | 75<br>3.83 | 263 |
| 3 Agree | 764<br>44.09 | 706<br>47.04 | 452<br>42.48 | 890<br>45.45 | 2812 |
| 4 Strongly agree | 901<br>51.99 | 689<br>45.90 | 513<br>48.21 | 950<br>48.52 | 3053 |
| Total | 1733 | 1501 | 1064 | 1958 | 6256 |

Frequency Missing = 196

Table of Q25 by MODE

Q25(When I left the hospital, clearly understood the purpose for taking each of my medications)
MODE(Survey Mode (CATI/Telephone only, Mail, MIXED, TT-IVR)

| Frequency<br>Col Pct | CATI | Mail | TT-IVR | MIXED | Total |
|---|---|---|---|---|---|
| 1 Strongly disagree | 14<br>1.03 | 26<br>1.99 | 31<br>3.29 | 39<br>2.40 | 110 |
| 2 Disagree | 19<br>1.40 | 56<br>4.28 | 37<br>3.93 | 46<br>2.83 | 158 |

3 Agree , 540 , 513 , 364 , 627 , 2044
, 39.79 , 39.22 , 38.68 , 38.54 ,
ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆ
4 Strongly agree , 784 , 713 , 509 , 915 , 2921
, 57.77 , 54.51 , 54.09 , 56.24 ,
ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒˆ
Total 1357 1308 941 1627 5233

Frequency Missing = 1219

## Appendix B.1

**Linear coding**

Cronbach Coefficient Alpha

| Variables | Alpha |
|---|---|
| Raw | 0.818870 |
| Standardized | 0.819706 |

Pearson Correlation Coefficients, N = 5064
Prob > |r| under H0: Rho=0

| | Q23 | Q24 | Q25 |
|---|---|---|---|
| Q23 | 1.00000 | 0.64079 | 0.53106 |
| Staff took preferences into account in deciding what care needs would be when I left | | <.0001 | <.0001 |
| Q24 | 0.64079 | 1.00000 | 0.63554 |
| When I left the hospital, had good understanding of things I was responsible for managing health | <.0001 | | <.0001 |
| Q25 | 0.53106 | 0.63554 | 1.00000 |
| When I left the hospital, clearly understood the purpose for taking each of my medications | <.0001 | <.0001 | |

**Top-box coding**

Cronbach Coefficient Alpha

| Variables | Alpha |
|---|---|
| Raw | 0.804103 |
| Standardized | 0.803886 |

Pearson Correlation Coefficients, N = 5064
Prob > |r| under H0: Rho=0

| | rq23_tb | rq24_tb | rq25_tb |
|---|---|---|---|
| rq23_tb | 1.00000 | 0.60453 | 0.50339 |
| (Top-box) Staff took preferences into account in deciding what care needs would be when I left | | <.0001 | <.0001 |
| rq24_tb | 0.60453 | 1.00000 | 0.62431 |
| (Top-box) When I left the hospital, had good understanding of things I was responsible for managing health | <.0001 | | <.0001 |
| rq25_tb | 0.50339 | 0.62431 | 1.00000 |
| (Top-box) When I left the hospital, clearly understood the purpose for taking each of my medications | <.0001 | <.0001 | |

## Appendix B.2

**Linear coding**

**Pearson Correlations:**

| | CoC | Q23 | Q24 | Q25 |
|---|---|---|---|---|
| Nurse communication Composite | 0.49586 | 0.45955 | 0.43899 | 0.39580 |
| | <.0001 | <.0001 | <.0001 | <.0001 |
| | 6292 | 6088 | 6246 | 5223 |

| | | | | |
|---|---|---|---|---|
| | 0.46687 | 0.40369 | 0.43257 | 0.37435 |
| Doctor communication Composite | <.0001 | <.0001 | <.0001 | <.0001 |
| | 6282 | 6078 | 6235 | 5217 |
| | 0.39208 | 0.37004 | 0.35160 | 0.29872 |
| Responsiveness of hospital staff Composite | <.0001 | <.0001 | <.0001 | <.0001 |
| | 5742 | 5570 | 5698 | 4840 |
| | 0.43102 | 0.40108 | 0.38750 | 0.33000 |
| Pain management Composite | <.0001 | <.0001 | <.0001 | <.0001 |
| | 4554 | 4433 | 4526 | 3909 |
| | 0.49176 | 0.42734 | 0.42095 | 0.44382 |
| Communication about medicines Composite | <.0001 | <.0001 | <.0001 | <.0001 |
| | 3572 | 3474 | 3544 | 3142 |
| | 0.41069 | 0.38573 | 0.36170 | 0.29870 |
| Discharge information Composite | <.0001 | <.0001 | <.0001 | <.0001 |
| | 5904 | 5719 | 5864 | 4936 |
| | 0.30425 | 0.26776 | 0.27647 | 0.24951 |
| Quiet | <.0001 | <.0001 | <.0001 | <.0001 |
| | 6263 | 6062 | 6217 | 5199 |
| | 0.32255 | 0.32193 | 0.28734 | 0.22954 |
| Clean | <.0001 | <.0001 | <.0001 | <.0001 |
| | 6261 | 6060 | 6213 | 5199 |
| | 0.48049 | 0.44864 | 0.42519 | 0.36346 |
| Rate hospital | <.0001 | <.0001 | <.0001 | <.0001 |
| | 6233 | 6035 | 6187 | 5174 |
| | 0.50586 | 0.47413 | 0.44763 | 0.38463 |
| Recommend hospital | <.0001 | <.0001 | <.0001 | <.0001 |
| | 6253 | 6054 | 6207 | 5192 |

Appendix B.3

**Top-box coding**

**Spearman Correlations:**

| | CARE_tb | rq23_tb | rq24_tb | rq25_tb |
|---|---|---|---|---|
| Nurse communication top-box (average of top-box items) | 0.39736 <.0001 6292 | 0.34257 <.0001 6088 | 0.36234 <.0001 6246 | 0.32614 <.0001 5223 |
| Doctor communication top-box (average of top-box items) | 0.39455 <.0001 6282 | 0.32021 <.0001 6078 | 0.36502 <.0001 6235 | 0.32495 <.0001 5217 |
| Responsiveness of hospital staff top-box (average of top-box items) | 0.31590 <.0001 5742 | 0.27899 <.0001 5570 | 0.28785 <.0001 5698 | 0.24704 <.0001 4840 |
| Pain management top-box (average of top-box items) | 0.34275 <.0001 4554 | 0.28059 <.0001 4433 | 0.32299 <.0001 4526 | 0.28451 <.0001 3909 |
| Communication about medicines top-box (average of top-box items) | 0.43816 <.0001 3572 | 0.36459 <.0001 3474 | 0.37405 <.0001 3544 | 0.40300 <.0001 3142 |
| Discharge information top-box (average of top-box items) | 0.30304 <.0001 5904 | 0.26795 <.0001 5719 | 0.26319 <.0001 5864 | 0.23492 <.0001 4936 |
| Quiet top-box (Always) | 0.24378 <.0001 6263 | 0.20341 <.0001 6062 | 0.22498 <.0001 6217 | 0.20806 <.0001 5199 |
| Clean top-box (Always) | 0.26302 <.0001 6261 | 0.24238 <.0001 6060 | 0.23428 <.0001 6213 | 0.20292 <.0001 5199 |
| Rate hospital top-box (9 or 10) | 0.39271 <.0001 6233 | 0.33693 <.0001 6035 | 0.35120 <.0001 6187 | 0.32085 <.0001 5174 |
| Recommend hospital top-box (Definitely Yes) | 0.40812 <.0001 6253 | 0.34280 <.0001 6054 | 0.37075 <.0001 6207 | 0.33439 <.0001 5192 |

Appendix C.1 (linear measures)

| | Coordination of Care Composite | | | |
|---|---|---|---|---|
| | Base Model | Model 1 | Model 2 | Model 3 |
| ER admit | | -1.58 ** | | -1.49 * |
| MHP | | | -2.33 *** | -2.32 *** |
| Maternity | 9.82 *** | 8.78 *** | 9.39 *** | 8.41 ** |
| Surgical | 6.66 ** | 6.08 ** | 6.67 ** | 6.12 ** |
| Age: | | | | |
| 18-24 | 0.16 | 0.13 | 0.11 | 0.08 |
| 25-34 | 2.28 | 2.01 | 2.34 | 2.09 |
| 35-44 | 2.29 | 2.11 | 2.5 | 2.32 |
| 45-54 | 2.38 | 2.31 | 2.38 | 2.32 |
| 55-64 | 3.31 ** | 3.21 ** | 3.27 ** | 3.18 ** |
| 65-74 | 3.93 *** | 3.84 *** | 3.72 *** | 3.64 *** |
| 75-84 | 1.42 | 1.38 | 1.36 | 1.32 |
| Education | -0.02 | -0.05 | -0.28 | -0.31 |
| GHP | -2.71 *** | -2.67 *** | -1.62 *** | -1.58 *** |
| Language other than | -1.08 | -0.98 | -1.18 | -1.09 |
| Response Percentile | -1.23 | -1.17 | -1.16 | -1.11 |
| Maternity*Age | -2.43 * | -2.3 * | -2.42 * | -2.3 * |
| Surgical*Age | -0.77 * | -0.8 * | -0.82 * | -0.85 * |

*** p<0.001, ** p<0.01 and * p<0.

Appendix C.2 (top-box measures)

| | Coordination of Care Composite | | | |
|---|---|---|---|---|
| | Base Model | Model 1 | Model 2 | Model 3 |
| ER admit | | -2.08 | | -1.86 |
| MHP | | | -5.89 *** | -5.88 *** |
| Maternity | 18.43 *** | 17.07 ** | 17.33 ** | 16.12 ** |
| Surgical | 8.35 | 7.59 | 8.38 | 7.7 |
| Age: | | | | |
| 18-24 | 5.77 | 5.73 | 5.64 | 5.6 |
| 25-34 | 9.56 ** | 9.2 ** | 9.72 ** | 9.4 ** |
| 35-44 | 10.4 ** | 10.16 ** | 10.91 *** | 10.7 *** |
| 45-54 | 11.97 *** | 11.88 *** | 11.98 *** | 11.9 *** |
| 55-64 | 12.7 *** | 12.57 *** | 12.6 *** | 12.49 *** |
| 65-74 | 10.92 *** | 10.8 *** | 10.39 *** | 10.29 *** |
| 75-84 | 3.19 | 3.13 | 3.04 | 2.99 |
| Education | 0.89 * | 0.84 | 0.23 | 0.19 |
| GHP | -5.55 *** | -5.49 *** | -2.78 *** | -2.73 *** |
| Language other than English | -4.82 | -4.68 | -5.06 | -4.94 |
| Response Percentile | -4.02 * | -3.95 * | -3.84 * | -3.78 * |
| Maternity*Age | -5.31 * | -5.14 * | -5.29 * | -5.14 * |
| Surgical*Age | -0.68 | -0.72 | -0.8 | -0.83 |

*** p<0.001, ** p<0.01 and * p<0.05

Appendix D

| **Mode** (Mail only as reference): | CARE model1 | CARE model2 | CARE model3 | CARE model4 | CARE tb model1 | CARE tb model2 | CARE tb model3 | CARE tb model4 |
|---|---|---|---|---|---|---|---|---|
| CATI | **2.14** ** | **2.17** ** | **2.07** ** | **2.1** ** | **3.33** * | **3.37** * | **3.16** * | **3.19** * |
| MIXED | 1 | 1 | 0.97 | 0.97 | **2.96** * | **2.97** * | **2.89** * | **2.89** * |
| IVR | **-2.03** ** | **-2** ** | **-2.28** ** | **-2.24** ** | -1.05 | -1 | -1.65 | -1.6 |

*** p<0.001, ** p<0.01 and * p<0.
(This Table is based on data with all correct exclusions)

## Appendix E

Hospital-level InterClass Correlation (ICC), Spearman Brown Correlation (n=300) and Reliability

| | Linear Scoring | | | Topbox Scoring | | |
|---|---|---|---|---|---|---|
| **Measures** | **ICC** | **Spearman-Brown correlation at n=300** | **Reliability** | **ICC** | **Spearman-Brown correlation at n=300** | **Reliability** |
| Coordination of Care Composite | 0.023 | **0.88** | 0.76 | 0.017 | **0.84** | 0.69 |
| Nurse communication Composite | 0.019 | **0.85** | 0.73 | 0.017 | **0.84** | 0.71 |
| Doctor communication Composite | 0.016 | **0.83** | 0.69 | 0.014 | **0.81** | 0.66 |
| Responsiveness of hospital staff Composite | 0.026 | **0.89** | 0.77 | 0.015 | **0.82** | 0.66 |
| Pain management Composite | 0.010 | **0.75** | 0.49 | 0.008 | **0.71** | 0.45 |
| Communication about medicines Composite | 0.015 | **0.82** | 0.55 | 0.011 | **0.77** | 0.47 |
| Discharge information Composite | 0.018 | **0.85** | 0.70 | | | |
| Quiet | 0.033 | **0.91** | 0.82 | 0.026 | **0.89** | 0.78 |
| Clean | 0.020 | **0.86** | 0.74 | 0.015 | **0.82** | 0.67 |
| Rate hospital | 0.021 | **0.87** | 0.75 | 0.022 | **0.87** | 0.75 |
| Recommend hospital | 0.039 | **0.92** | 0.85 | 0.039 | **0.92** | 0.85 |

Appendix F.1

Patient-Mix Adjusted Means Scores for Linearly Scored Measures

| PROVID | CARE_1 | CARE_2 | CARE_3 | CARE_4 |
|---|---|---|---|---|
| 010024 | 80.01 | 80.02 | 80.05 | 80.05 |
| 030037 | 75.36 | 75.24 | 75.38 | 75.27 |
| 030122 | 79.82 | 79.63 | 79.87 | 79.69 |
| 040014 | 78.34 | 78.29 | 78.37 | 78.32 |
| 040027 | 79.71 | 79.61 | 79.98 | 79.89 |
| 050069 | 79.28 | 79.29 | 79.46 | 79.47 |
| 050104 | 78.63 | 78.7 | 78.87 | 78.93 |
| 050438 | 84.81 | 84.72 | 84.72 | 84.64 |
| 050455 | 78.56 | 78.51 | 78.65 | 78.61 |
| 050506 | 80 | 79.93 | 80.16 | 80.1 |
| 050746 | 74.93 | 75.06 | 74.94 | 75.06 |
| 060030 | 83.94 | 83.86 | 83.89 | 83.82 |
| 100113 | 81.67 | 81.52 | 81.78 | 81.65 |
| 100135 | 79.9 | 79.79 | 80.04 | 79.94 |
| 100187 | 65.07 | 65.06 | 64.87 | 64.86 |
| 100189 | 76.46 | 76.69 | 76.53 | 76.75 |
| 110075 | 78.88 | 78.89 | 78.72 | 78.73 |
| 110198 | 71.71 | 71.9 | 71.69 | 71.87 |
| 120006 | 85.18 | 85.46 | 85.55 | 85.81 |
| 150012 | 81.24 | 81.17 | 81.31 | 81.25 |
| 150150 | 80.45 | 80.15 | 80.47 | 80.18 |
| 190046 | 79.31 | 79.3 | 79.32 | 79.3 |
| 210019 | 79.69 | 79.62 | 79.41 | 79.35 |
| 210040 | 76.71 | 76.83 | 76.92 | 77.03 |
| 230002 | 78.68 | 78.7 | 78.52 | 78.54 |
| 230070 | 84.43 | 84.5 | 84.43 | 84.49 |
| 230236 | 82.17 | 82.29 | 81.92 | 82.03 |
| 240053 | 79.11 | 79.02 | 79.12 | 79.04 |
| 260027 | 76.23 | 76.11 | 76.54 | 76.43 |
| 260094 | 78.16 | 78.43 | 78.19 | 78.45 |
| 290022 | 68.45 | 68.71 | 68.39 | 68.63 |
| 290041 | 75.07 | 75.1 | 75.02 | 75.05 |
| 310081 | 79.42 | 79.53 | 79.08 | 79.19 |
| 360012 | 81.63 | 81.6 | 81.63 | 81.59 |
| 360155 | 81.8 | 81.82 | 81.65 | 81.67 |
| 370008 | 77.49 | 77.55 | 77.51 | 77.57 |
| 370149 | 81.52 | 81.66 | 81.86 | 81.99 |
| 390211 | 79.47 | 79.47 | 79.17 | 79.18 |
| 440034 | 80.53 | 80.58 | 80.64 | 80.69 |
| 440091 | 83.15 | 82.96 | 83.13 | 82.95 |
| 450056 | 80.47 | 80.42 | 80.56 | 80.51 |
| 450424 | 78.96 | 79.09 | 78.58 | 78.71 |

| | | | | |
|---|---|---|---|---|
| 450647 | 80.46 | 80.35 | 80.52 | 80.42 |
| 450675 | 77.99 | 78.06 | 78.21 | 78.28 |
| 450697 | 73.43 | 73.42 | 72.89 | 72.89 |
| 450742 | 76.27 | 76.27 | 76.35 | 76.34 |
| 490075 | 77.4 | 77.4 | 77.22 | 77.23 |

Note: Model 1 is composed of the standard patient-mix adjustor; Model 2 adds to Model 1 the indicator for ER admission; Model 3 adds to Model 1 linear MHP; Model 4 adds to Model 1 the indicator for ER admission and linear MHP.

| PROVID | CARE_tb_1 | CARE_tb_2 | CARE_tb_3 | CARE_tb_4 |
|---|---|---|---|---|
| 010024 | 46.38 | 46.39 | 46.47 | 46.48 |
| 030037 | 37.52 | 37.36 | 37.56 | 37.43 |
| 030122 | 50.78 | 50.54 | 50.92 | 50.7 |
| 040014 | 47.53 | 47.47 | 47.61 | 47.55 |
| 040027 | 47.33 | 47.2 | 48.02 | 47.9 |
| 050069 | 48.84 | 48.86 | 49.3 | 49.31 |
| 050104 | 43.2 | 43.29 | 43.8 | 43.88 |
| 050438 | 57.78 | 57.67 | 57.56 | 57.46 |
| 050455 | 46.46 | 46.4 | 46.71 | 46.66 |
| 050506 | 47.79 | 47.7 | 48.21 | 48.13 |
| 050746 | 40.95 | 41.12 | 40.97 | 41.12 |
| 060030 | 55.47 | 55.37 | 55.35 | 55.26 |
| 100113 | 51.85 | 51.67 | 52.15 | 51.98 |
| 100135 | 48.75 | 48.62 | 49.12 | 49 |
| 100187 | 37.87 | 37.86 | 37.36 | 37.35 |
| 100189 | 40.32 | 40.61 | 40.5 | 40.76 |
| 110075 | 44.69 | 44.7 | 44.29 | 44.29 |
| 110198 | 29.14 | 29.38 | 29.08 | 29.29 |
| 120006 | 57.96 | 58.33 | 58.9 | 59.22 |
| 150012 | 51.63 | 51.54 | 51.82 | 51.74 |
| 150150 | 47.98 | 47.59 | 48.03 | 47.68 |
| 190046 | 49.57 | 49.55 | 49.58 | 49.56 |
| 210019 | 47.46 | 47.38 | 46.75 | 46.68 |
| 210040 | 42.02 | 42.18 | 42.55 | 42.69 |
| 230002 | 44.03 | 44.06 | 43.63 | 43.66 |
| 230070 | 57.91 | 58 | 57.91 | 57.99 |
| 230236 | 54.27 | 54.43 | 53.63 | 53.77 |
| 240053 | 45.32 | 45.21 | 45.35 | 45.25 |
| 260027 | 40.74 | 40.59 | 41.52 | 41.38 |
| 260094 | 46.97 | 47.32 | 47.04 | 47.36 |
| 290022 | 30.67 | 31 | 30.52 | 30.81 |
| 290041 | 40.43 | 40.48 | 40.32 | 40.36 |
| 310081 | 47.42 | 47.57 | 46.57 | 46.7 |
| 360012 | 52.63 | 52.59 | 52.62 | 52.58 |
| 360155 | 54.7 | 54.72 | 54.32 | 54.34 |
| 370008 | 41.45 | 41.53 | 41.51 | 41.59 |
| 370149 | 50.89 | 51.07 | 51.73 | 51.89 |
| 390211 | 44.29 | 44.3 | 43.54 | 43.55 |
| 440034 | 51.02 | 51.09 | 51.31 | 51.38 |
| 440091 | 53.87 | 53.63 | 53.82 | 53.6 |
| 450056 | 49.45 | 49.38 | 49.66 | 49.6 |
| 450424 | 45.87 | 46.03 | 44.91 | 45.06 |
| 450647 | 48.61 | 48.47 | 48.76 | 48.63 |
| 450675 | 44.64 | 44.73 | 45.21 | 45.29 |

| | | | | |
|---|---|---|---|---|
| 450697 | 37.17 | 37.15 | 35.8 | 35.79 |
| 450742 | 41.82 | 41.81 | 42.01 | 41.99 |
| 490075 | 43.97 | 43.98 | 43.53 | 43.54 |

Note: Model 1 is composed of the standard patient-mix adjustor; Model 2 adds to Model 1 the indicator for ER admission; Model 3 adds to Model 1 linear MHP; Model 4 adds to Model 1 the indicator for ER admission and linear MHP.

Appendix F.2

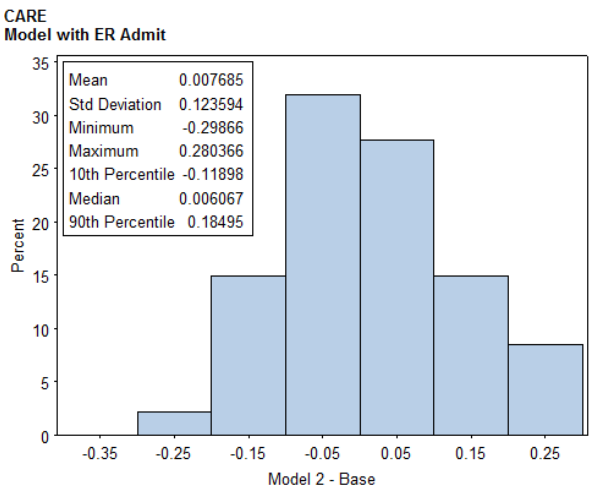
Correlation and Informativeness (1 - $R^2$) of Adjusted Means from Model 1 with Each of the Three Alternative Models.

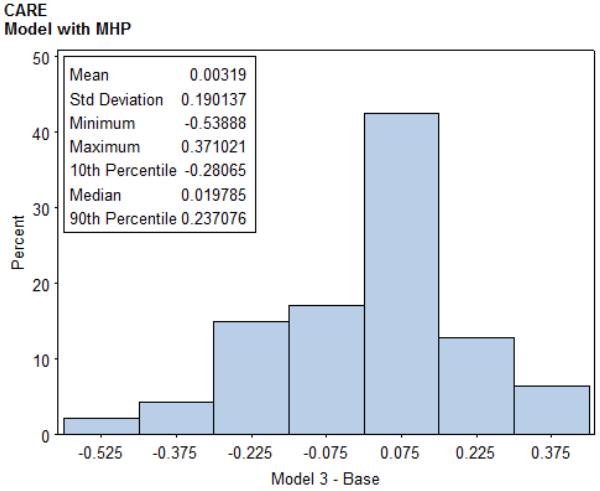
| | Correlation | | | 1 - $R^2$ | | |
|---|---|---|---|---|---|---|
| | Model 1 & 2 | Model 1 & 3 | Model 1 & 4 | Model 1 & 2 | Model 1 & 3 | Model 1 & 4 |
| Linear | | | | | | |
| Nurse communication Composite | 1.000 | 0.999 | 0.999 | 0.000 | 0.001 | 0.001 |
| Doctor communication Composite | 0.997 | 0.998 | 0.995 | 0.007 | 0.003 | 0.010 |
| Responsiveness of hospital staff Composite | 1.000 | 1.000 | 1.000 | 0.000 | 0.000 | 0.001 |
| Pain management Composite | 1.000 | 0.999 | 0.999 | 0.000 | 0.002 | 0.002 |
| Communication about medicines Composite | 1.000 | 0.999 | 0.999 | 0.000 | 0.002 | 0.002 |
| Discharge information Composite | 0.999 | 1.000 | 0.999 | 0.002 | 0.000 | 0.002 |
| Quiet | 1.000 | 1.000 | 1.000 | 0.000 | 0.000 | 0.001 |
| Clean | 1.000 | 1.000 | 1.000 | 0.000 | 0.000 | 0.000 |
| Rate hospital | 1.000 | 1.000 | 1.000 | 0.000 | 0.000 | 0.001 |
| Recommend hospital | 1.000 | 1.000 | 1.000 | 0.000 | 0.000 | 0.000 |
| Coordination of Care Composite | 0.999 | 0.999 | 0.998 | 0.001 | 0.002 | 0.003 |
| Top-Box | | | | | | |
| Nurse communication | 1.000 | 0.999 | 0.999 | 0.000 | 0.003 | 0.003 |
| Doctor communication Composite | 0.996 | 0.998 | 0.995 | 0.007 | 0.004 | 0.010 |
| Responsiveness of hospital staff Composite | 1.000 | 0.999 | 0.999 | 0.000 | 0.001 | 0.001 |
| Pain management Composite | 1.000 | 0.999 | 0.999 | 0.000 | 0.002 | 0.003 |
| Communication about medicines Composite | 1.000 | 0.998 | 0.999 | 0.000 | 0.003 | 0.003 |
| Discharge information Composite | 0.999 | 1.000 | 0.999 | 0.002 | 0.000 | 0.002 |
| Quiet | 1.000 | 1.000 | 1.000 | 0.000 | 0.001 | 0.001 |
| Clean | 1.000 | 1.000 | 1.000 | 0.000 | 0.001 | 0.001 |
| Rate hospital | 1.000 | 1.000 | 0.999 | 0.000 | 0.001 | 0.001 |
| Recommend hospital | 1.000 | 1.000 | 1.000 | 0.000 | 0.001 | 0.001 |
| Coordination of Care Composite | 1.000 | 0.997 | 0.997 | 0.001 | 0.005 | 0.006 |

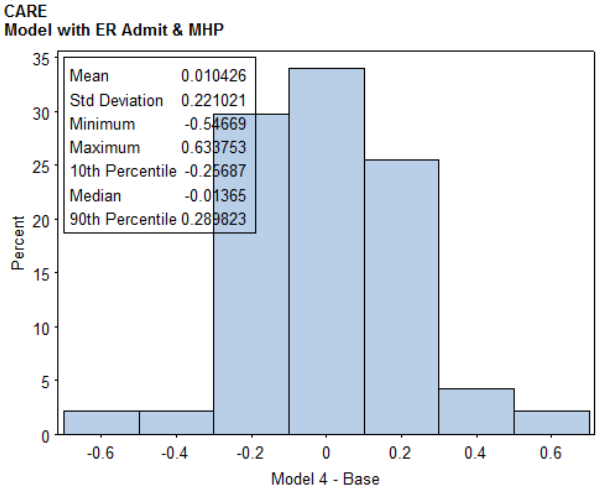
Note: Model 1 is composed of the standard patient-mix adjustor; Model 2 adds to Model 1 the indicator for ER admission; Model 3 adds to Model 1 linear MHP; Model 4 adds to Model 1 the indicator for ER admission and linear MHP.

## Appendix G

Difference in adjusted mean scores from standard PMA Model (Base Model) and each of the alternate Models 2, 3 and 4.




DUPONT HOSPITAL LLC (Gain: -0.299)
BANNER GATEWAY MEDICAL CENTER (Gain: -0.19)
MEMORIAL HOSPITAL, CHATTANOOGA, TN (Gain: -0.187)
SHANDS HOSPITAL AT THE UNIVERSITY OF FLORIDA (Gain: -0.143)
RESEARCH MEDICAL CENTER (Gain: -0.119)

NORTH FULTON REGIONAL HOSPITAL (Loss: 0.185)
NORTHWEST MEDICAL CENTER (Loss: 0.227)
DESERT SPRINGS HOSPITAL CENTER (Loss: 0.254)
SKAGGS COMMUNITY HEALTH CENTER (Loss: 0.272)
CASTLE MEDICAL CENTER (Loss: 0.28)

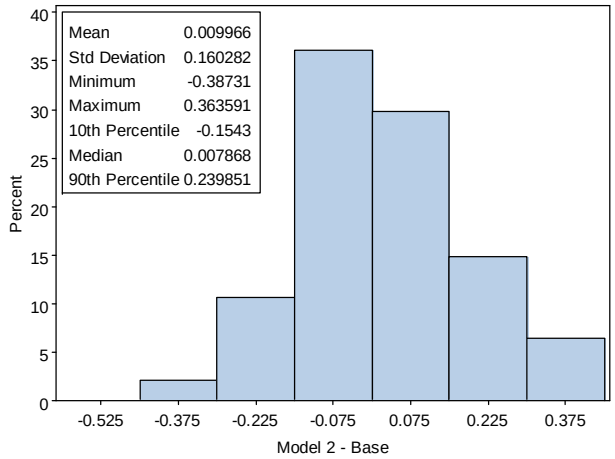
SOUTHWEST GENERAL HOSPITAL (Gain: -0.539)
SAN JACINTO METHODIST HOSPITAL (Gain: -0.379)
UNDERWOOD - MEMORIAL HOSPITAL (Gain: -0.336)
SHARON REGIONAL HEALTH SYSTEM (Gain: -0.299)
PENINSULA REGIONAL MEDICAL CENTER (Gain: -0.281)

SAINT FRANCIS MEDICAL CENTER (Loss: 0.237)
BAXTER REGIONAL MEDICAL CENTER (Loss: 0.274)
RESEARCH MEDICAL CENTER (Loss: 0.307)
UNITY HEALTH CENTER (Loss: 0.336)
CASTLE MEDICAL CENTER (Loss: 0.371)

SOUTHWEST GENERAL HOSPITAL (Gain: -0.547)
PENINSULA REGIONAL MEDICAL CENTER (Gain: -0.339)
SHARON REGIONAL HEALTH SYSTEM (Gain: -0.29)
DUPONT HOSPITAL LLC (Gain: -0.262)
SAN JACINTO METHODIST HOSPITAL (Gain: -0.257)

MEDICAL CENTER OF ARLINGTON (Loss: 0.29)
SAINT FRANCIS MEDICAL CENTER (Loss: 0.297)
NORTHWEST HOSPITAL CENTER (Loss: 0.325)
UNITY HEALTH CENTER (Loss: 0.466)
CASTLE MEDICAL CENTER (Loss: 0.634)

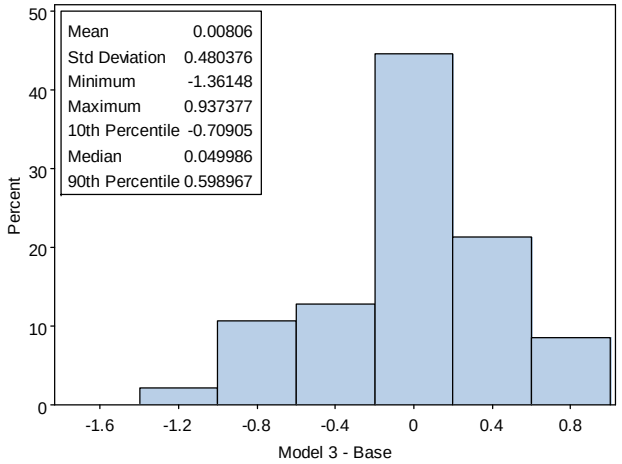
**CARE (top-box)**
**Model with ER Admit**




DUPONT HOSPITAL LLC (Gain: -0.387)
BANNER GATEWAY MEDICAL CENTER (Gain: -0.246)
MEMORIAL HOSPITAL, CHATTANOOGA, TN (Gain: -0.243)
SHANDS HOSPITAL AT THE UNIVERSITY OF FLORIDA (Gain: -0.186)
RESEARCH MEDICAL CENTER (Gain: -0.154)

NORTH FULTON REGIONAL HOSPITAL (Loss: 0.24)
NORTHWEST MEDICAL CENTER (Loss: 0.294)
DESERT SPRINGS HOSPITAL CENTER (Loss: 0.329)
SKAGGS COMMUNITY HEALTH CENTER (Loss: 0.352)
CASTLE MEDICAL CENTER (Loss: 0.364)

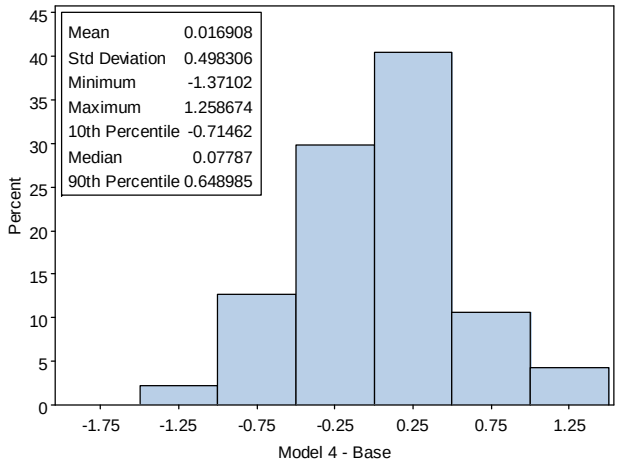
**CARE (top-box)**
**Model with MHP**




SOUTHWEST GENERAL HOSPITAL (Gain: -1.361)
SAN JACINTO METHODIST HOSPITAL (Gain: -0.957)
UNDERWOOD - MEMORIAL HOSPITAL (Gain: -0.849)
SHARON REGIONAL HEALTH SYSTEM (Gain: -0.755)
PENINSULA REGIONAL MEDICAL CENTER (Gain: -0.709)

SAINT FRANCIS MEDICAL CENTER (Loss: 0.599)
BAXTER REGIONAL MEDICAL CENTER (Loss: 0.692)
RESEARCH MEDICAL CENTER (Loss: 0.776)
UNITY HEALTH CENTER (Loss: 0.848)
CASTLE MEDICAL CENTER (Loss: 0.937)

**CARE (top-box)**
**Model with ER Admit & MHP**




SOUTHWEST GENERAL HOSPITAL (Gain: -1.371)
SAN JACINTO METHODIST HOSPITAL (Gain: -0.808)
PENINSULA REGIONAL MEDICAL CENTER (Gain: -0.78)
SHARON REGIONAL HEALTH SYSTEM (Gain: -0.744)
UNDERWOOD - MEMORIAL HOSPITAL (Gain: -0.715)

MEDICAL CENTER OF ARLINGTON (Loss: 0.649)
NORTHWEST HOSPITAL CENTER (Loss: 0.671)
SAINT FRANCIS MEDICAL CENTER (Loss: 0.672)
UNITY HEALTH CENTER (Loss: 1.007)
CASTLE MEDICAL CENTER (Loss: 1.259)

## Appendix H

Mode Effects with and without PMA adjustment.

| | | LINEAR SCORING | | | TOP-BOX SCORING | | |
|---|---|---|---|---|---|---|---|
| | | **CATI** | **IVR** | **MIXED** | **CATI** | **IVR** | **MIXED** |
| CARE | Without PMA | 2.25 ** | -1.53 | 0.89 | 3.50 * | 0.12 | 2.53 |
| | With PMA | 2.10 ** | -1.97 * | 0.88 | 3.13 * | -0.77 | 2.45 |

## Appendix I

Mixed effect models with mode and standard PMA as fixed effects, and hospital and hospital by mode as random effects.

| | CARE | | |
|---|---|---|---|
| RANDOM EFFECTS: | SE | VAR | |
| PROVID | 2.65 | 7.01 | ** |
| CATI*PROVID | 0.00 | 0.00 | |
| MIXED*PROVID | 0.60 | 0.36 | |
| IVR*PROVID | 4.07 | 16.54 | * |
| Residual | 19.06 | 363.4 | *** |