NATIONAL QUALITY FORUM

National Voluntary Consensus Standards for Patient Outcomes
Measure Summary

Measure number: OT1-017-09

Measure name: 30-Day post-hospital heart failure (HF) discharge care transition composite measure

Description: This measure scores a hospital on the incidence among its patients during the month following discharge from an inpatient stay having a primary diagnosis of heart failure for three types of events: readmissions, ED visits, and evaluation and management (E&M) services.

These events are relatively common, measurable using readily available administrative data, and associated with effective coordination of care after discharge. The input for this score is the result of measures for each of these three events that are being submitted concurrently under the Patient Outcomes Measures Phase I project's call for measures (ED and E&M) or is already approved by NQF (readmissions). Each of these individual measures is a risk-adjusted, standardized rate together with a percentile ranking. This composite measure is a weighted average of the deviations of the three risk-adjusted, standardized rates from the population mean for the measure across all patients in all hospitals. Again, the composite measure is accompanied by a percentile ranking to help with its interpretation.

Numerator statement: The numerator is the weighted sum of the three deviations from their expected values for the individual measures comprising the component measure. The question of appropriate weights on the deviations is difficult and would probably lead to a wide variation in opinion. The weights of -4, -2, and 1 are selected to represent order of magnitude differences in seriousness of the three outcomes, which most would agree to (that is to say: readmission is more important than ED which is more important in a negative way than E&M service is in a positive way). The idea of not using weights was also considered, but this was noted to be itself a de facto weight scheme (with all weights the same), and as such, a weight scheme that was less appropriate than the one chosen.

Denominator statement: The composite measure is the weighted sum of three individual measures. Thus, the denominator is one.

Level of Analysis: Population: national

Type of Measure: Outcome

Data Source: Electronic adminstrative data/claims

Measure developer: Brandeis University/CMS

Type of Endorsement (full or time-limited): Recommended for endorsement (Steering Committee— March 24, 2010 [Recommend composite measure— 9; Do not recommend— 6; Abstain— 1])

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Summary Table of TAP Ratings of Subcriteria and Comments:

IMPORTANCE TO MEASURE AND REPORT		
1d. Quality construct	High	No direct method for measuring transitions— idea of a composite is appealing; are all three components needed? What is the contribution of each component to the overall score? Including the E&M measure that is "bidirectional, "i.e., both positive and negative, is conceptually difficult; Measure developer clarification— for a hospital/system to do better on the composite they could either reduce readmissions or increase E&M visits.
1e. Conceptual construct	Medium	
SCIENTIFIC ACCEPTABILTY		
2a. Specs	High	2a—Specifications—complete. 2b and c—Reliability testing good; validity of the composite—would be nice to compare to another data set like the NCDR. 2f— Meaningful differences—testing data shows a reasonable spread in results. 2h—Disparities known but not addressed. 2i—Component justification—correlations: ED and readmission negatively correlated to E&M visit. 2k—Weightings are arbitrary—it seems empirically reasonable and with experience can be adjusted.
2b. Reliability	High	
2c. Validity	High	
2d. Exclusions	High	
2e. Risk adjustment	High	
2f. Meaningful differences	High	
2g. Comparability	High	
2h. Disparities	Not at all	
2i. Component justification	High	
2j. Component variability	High	
2k. Differential weighting	Medium/low	
2l. Missing scores	High	
USEABILITY		
3a. Distinctive	Low	Unsure how to interpret results? 3a—How would you assign quintiles or stars? Is this structured in the best manner? 3c—Distinctive from individual measures but does it convey meaningful summary information? Would need much "merchandizing." Concept has good potential—not sure it was realized. Would the results provide important information for patient choice?
3b. Harmonization	High	
3c. Added value	Medium	
3d. Decomposition	High	
3e. State purpose	High	
FEASIBILITY		
4a. Data a byproduct of care	High	Scores high on feasibility.

4b. Electronic	High	
4c. Exclusions	High	
4d. Inaccuracies/errors	High	
4e. Implementation	High	

Measure Developer Responses:

Topic, Measure # and Title	Follow-Up Issues
Topic Area: AMI **Measure#** OT1-017-09 **Title:** 30-Day post-hospital heart failure (HF) discharge care transition composite measure	**Questions/Conditions for Measure Developer:** 1. Address and clarify why these measures did not address measuring disparities. 2. To better understand how the components and composite relate, could you make a table listing the results of each component and the composite for a sample of hospitals in each quintile of the composite results (ranked highest to lowest), such as: We think this table for both composite measures would be extremely helpful in understanding how everything relates together and in responding to the question about the added value for each component. **Response from Measure Developer:** 1. This measure had not been evaluated prior to submission. Our recent evaluation of the proposed measure has demonstrated that performance on the composite measure is not systematically related to race (i.e., Black, White, Hispanic) among Medicare beneficiaries. 2. We prepared a table and a document (attached) as suggested, describing the impact of individual measures on the overall composite scores. The attached table (Sample of Composite Scores With Associated Component Scores.pdf) illustrates the relative importance of each component within the HF composite for a sample of hospitals using color-coding. All hospitals were ranked by composite score initially and a sample of hospitals was then selected by taking hospital number 25 and every 50th hospital thereafter. The cells of the highest quintile scores are dark green, and the next highest quintile cells are light green. The cells of the lowest quintile scores are dark red and the next to the bottom quintile cells are light red. Within the quintile rank for the composite score we observe some differences in rank for the individual component measures.

	N	Readmission	ED Visit	E/M Visit	Composite
Hospital A					
Hospital B					

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Topic, Measure # and Title	Follow-Up Issues
	The attached document (Change in Rates Sufficient to Move Hospitals.doc) simulates the impact of changes in individual component scores on the overall composite score for a selected sample of five hospitals. Each hospital's composite score and quintile category are functions of all individual measures and not overly dependent on any single measure. As a result of differential measure weighting, a relatively small change in readmission rate (0.4 to 1.0 percent) would move a hospital into a higher or lower quintile. A larger change in the ED rate (0.8 to 2.0 percent) would be required for a hospital to move quintiles and an even larger change in the E&M rate (1.7 to 4.0 percent) would be required.

Summary table of SC ratings of sub criteria and comments:

IMPORTANCE TO MEASURE AND REPORT	
The developer advised that the weightings were determined by the developers and their expert panel. While arbitrary, the weightings reflect the value of the desirable care trajectory for patients after hospitalization. Some Committee members felt that only the readmission and ED visit measures would be a better composite.	SC Vote on Importance Yes—16 No—0
SCIENTIFIC ACCEPTABILITY	
N/A	SC Vote on Scientific Acceptability Completely—4 Partially—11 Minimally—1 Not at all—0
USABILITY	
N/A	SC Vote on Usability Completely—6

	Partially—9 Minimally—1 Not at all—0
FEASIBILITY	
N/A	SC Vote on Feasibility Completely—8 Partially—8 Minimally—0 Not at all—0

THE NATIONAL QUALITY FORUM

COMPOSITE MEASURE SUBMISSION FORM
Version 4.0 August 2009

This form will be used by stewards to submit **composite** measures and by reviewers to evaluate the measures.

Measure Stewards: Complete all non-shaded areas of the form. All requested information should be entered directly into this form. The information requested is directly related to NQF's composite measure evaluation criteria and will be used by reviewers to determine if the evaluation criteria have been met. The specific relevant subcriteria language is provided in a Word comment within the form and will appear if your cursor is over the highlighted area.

The measure steward has the opportunity to identify and present the information that demonstrates the measure meets the criteria. Additional materials will only be considered supplemental. Do not rely solely on materials provided at URLs or in attached documents to provide measure specifications or to demonstrate meeting the criteria. If supplemental materials are provided, be sure to indicate specific page numbers/ web page locations for the relevant information (web page links preferred).

For questions about this form, contact the project director at 202-783-1300. Please email this form to the appropriate contact listed in the corresponding call for measures.

Reviewers: Complete all yellow highlighted areas of the form. Evaluate the extent to which each subcriterion is met and then overall, the extent to which each major criterion is met. Provide the rationale for your rating.

Evaluation ratings of the extent to which the criteria are met
H=High (unquestionably demonstrated to meet the criterion)
M=Moderate (demonstrated to moderately meet the criterion)
L=Low (addressed BUT demonstrated to only minimally meet the criterion)
N=No (NOT addressed; OR incorrectly addressed; OR demonstrated to NOT meet the criterion)
NA=Not applicable (only an option for a few subcriteria as indicated)

(for NQF staff use) **NQF Review #:** OT1-017-09 **NQF Project:** Patient Outcome Measures Phase I
Title of Measure: 30-day Post-Hospital Heart Failure (HF) Discharge Care Transition Composite Measure
Brief description of measure (*including type of score, measure focus, target population, time, e.g., Percentage of adult patients aged 18-75 years receiving one or more HbA1c tests per year*): This measure scores a hospital on the incidence among its patients during the month following discharge from an inpatient stay having a primary diagnosis of heart failure for three types of events: readmissions, ED visits and evaluation and management (E&M) services. These events are relatively common, measurable using readily available administrative data, and associated with effective coordination of care after discharge. The input for this score is the result of measures for each of these three events that are being submitted concurrently under the Patient Outcomes Measures Phase I project's call for measures (ED and E&M) or is already approved by NQF (readmissions). Each of these individual measures is a risk-adjusted, standardized rate together with a percentile ranking. This composite measure is a weighted average of the deviations of the three risk-adjusted, standardized rates from the population mean for the measure across all patients in all hospitals. Again, the composite measure is accompanied by a percentile ranking to help with its interpretation.
►**Type of Measure:** ☒ Composite
Select the most relevant priority area(s), quality domain(s), and consumer need(s). ►**National Priority Partners Priority Area** ☐ patient and family engagement ☐ population health ☐ safety ☒ care coordination ☐ palliative and end of life care ☐ overuse ►**IOM Quality Domain** ☐ effectiveness ☒ efficiency ☐ equity ☐ patient-centered ☐ safety ☐

timeliness

►**Consumer Care Need** ☐ Getting Better ☒ Living With Illness ☐ Staying Healthy

CONDITIONS FOR CONSIDERATION BY NQF	
Four conditions must be met before proposed measures may be considered and evaluated for suitability as voluntary consensus standards:	**NQF Staff**
A. The measure is in the public domain or an intellectual property agreement (measure steward agreement) is signed. *Public domain only applies to governmental organizations. All non-government organizations must sign a measure steward agreement even if measures are made publicly and freely available.* ►**Do you attest that the measure steward holds intellectual property rights to the measure and the right to use any aspects of the measure owned by another entity (e.g., component measures, risk model, code set)?** ☒ Yes ►**Measure Steward Agreement** ☐ Signed and Submitted **OR** ☒ Government entity–public domain (If measure steward agreement not signed for non-government entities, do not submit) ►**Please check if either of the following apply:** ☐ Proprietary Measure ☐ Proprietary Complex Measure w/fees	**A** **Y**☒ **N**☐
B. The measure owner/steward verifies there is an identified responsible entity and process to maintain and update the measure on a schedule that is commensurate with the rate of clinical innovation, but at least every 3 years. ☒ Yes (If no, do not submit)	**B** **Y**☒ **N**☐
C. The intended use of the measure includes both public reporting and quality improvement. ►**Purpose:** ☒ Public reporting ☒ Internal quality improvement ☐ Accountability ☐ Accreditation ☐ Payment incentive ☐ Other, describe: (If not intended for both public reporting and quality improvement, do not submit)	**C** **Y**☒ **N**☐
D. The requested measure submission information is complete. Generally, measures should be fully developed and tested so that all the evaluation criteria have been addressed and information needed to evaluate the measure is provided. Measures that have not been tested are only potentially eligible for a time-limited endorsement and in that case, measure owners must verify that testing will be completed within 24 months of endorsement. ►**Testing:** ☐ Fully developed and tested ☒ Testing will be completed within 24 months (If not tested and no plans for testing within 24 months, do not submit) **Component Measures** (*All components of the composite must be either NQF-endorsed or submitted for consideration for NQF endorsement*) ☐ All component measures are NQF-endorsed measures ☒ Some or all component measures are not NQF-endorsed and have been submitted using the online measure submission tool ►**Have NQF-endorsed measures been reviewed to identify if there are similar or related measures?** ☒ Yes (If no, do not submit) *If there are similar or related measures, be sure to address items 3b and 3c with specific information.* ►**Is all requested information entered into this form?** ☒ Yes (If no, do not submit)	**D** **Y**☒ **N**☐
(for NQF staff use) **Have all conditions for consideration been met?** **Staff Notes (if submission returned):**	**Met** **Y**☒ **N**☐

1. IMPORTANCE TO MEASURE AND REPORT	
Extent to which the specific measure focus is important to making significant gains in health care quality	**Eval**

(safety, timeliness, effectiveness, efficiency, equity, patient-centeredness) and improving health outcomes for a specific high impact aspect of healthcare where there is variation in or overall poor performance. *Measures must be judged to be important to measure and report in order to be evaluated against the remaining criteria.* (composite measure evaluation criteria)

If the component measures are determined to meet the importance criteria 1a, 1b, and 1c, then the composite would meet 1a, 1b, and 1c.

(for NQF staff use) **Specific** **NPP goal**: Care Coordination: All healthcare organizations and their staff will work collaboratively with patients to reduce 30-day readmission rates.

1d. Purpose/objective of the Composite

►**Describe the purpose/objective of the composite measure:** Measurement that extends a hospital's performance from its inpatient setting to requisite outpatient delivery systems facilitates acknowledgement of shared accountability in achieving optimal patient outcomes and results in the active transfer of accountability for the patients' treatment. This application extends the precedent set by 30-day time intervals (for readmission rates) to include other important indicators or criteria for inferring better versus worse care coordination. NQF has identified transitions or "hand-offs" as the fifth domain in their definition and framework for measuring care coordination (NQF, 2006). Transitions between care settings involve multiple providers and patients with complex needs, resulting in care that is often unsafe, disconnected, and uncoordinated. Furthermore, pilot programs and evaluations of efforts to improve care transitions often use service utilization as signals or indicators or performance, and criteria for whether the intended improvements are realized (Brown et al., 2006; Coleman & Berenson, 2004; Coleman, Parry, Chalmers, & Min, 2006; DeJonge, Taler, & Boling, 2009; Naylor, 2004; Naylor et al, 2004; Peikes, Chen, Schore, & Brown, 2009; Moore et al, 2003; Dudas et al, 2001; Forester et al, 2003) .

Hospital readmissions are recognized as system failures at least in part (Jencks, 2009). Ultimately, a composite measure examining the care trajectories of Medicare beneficiaries with heart failure for the 30-days following hospital discharge would provide a more comprehensive picture of care provision during this critical window of time. Therefore, we examine the outcome of non-prescriptive, system-individualized and patient/family needs-based collaborative efforts to intervene appropriately with these high-risk patient cohorts at the lowest possible level of resource intensity. A hospital performance measure of E & M follow-up on Medicare beneficiaries discharged with HF may encourage hospitals to develop discharge risk scores for specific cohorts that inform the most appropriate time frame for scheduled outpatient follow-up (Coleman & Williams, 2007). Clearly clinical practice guidelines for both conditions address the importance of follow-up after discharge althought are silent regarding specific time frame.

►**Describe the quality construct used in developing the composite:** Having derived hospital-level risk-adjusted expected rates for E & M services, ED visits and readmissions following index hospitalizations for heart failure patients, we propose to combine these three measures into a weighted, post-hospital discharge care transition composite measure. If timely care transition is facilitated by the discharge hospital, one would expect to avoid preventable Emergency Department visits or readmissions to the hospital. As the E & M service is the link that presumably transfers physician accountability for treatment back to the primary care physician or specialist in the outpatient setting, the E & M service should be the first event observed following hospital discharge, and our proposed composite measure credits and weights positively such E & M services. Conversely, hospital readmissions and outpatient ED visits are considered negative events and weighted accordingly, as described below.

Due to their implicit seriousness as well as high level of resource use, any readmission within 30 days following a hospital heart failure stay, identified by NQF-endorsed criteria, contributes negatively to our composite measure. An ED visit contributes, again negatively, if it occurs within 30 days and prior to any readmission. An E & M service contributes, but positively, if the E & M service is the first service received following the index hospitalization during the time period. Risk adjusted predicted rates for E & M services, ED visits and hospitalizations are calculated for each hospital and compared with risk-adjusted expected rates (designated as 'popavg' in our formulas). Deviations in readmission rate, ED visit rate and E & M service rate, derived by subtracting risk-adjusted expected rate (popavg) from risk standardized rate (RSR) are combined into a composite rate using the weights of -4, -2, and 1 respectively to reflect the presumed relative seriousness of the three events. That is:

Post-discharge care composite measure = -4*(RSR_RE - popaverage_RE) - 2*(RSR_ED - popaverage_ED) +

1d
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N☐

1*(RSR_EM-popaverage_EM). In addition, to help interpret the resulting measure values, the hospitals are also percentile ranked.	
1e. Conceptual construct for quality ►**Describe how the component measures are consistent with and representative of the quality construct:** The outcomes making up the composite measure, E&M service, ED visits and hospital readmissions, represent increasing levels of resouce use to medically manage HF post-hospital discharge. These measures do not measure care transitions themselves or care coordination, but instead they represent the expectant result from improvement in such processes as evidenced by the numerous intervention programs and studies that utilize these measures as evidence of program/process effectiveness. If this composite is measured and reported, hospitals would be more motivated to develop the system-specific, needs-based processes unique to their inpatient-outpatient networks to provide the appropriate level of medical care at the right time and in the right setting. The proposed composite measure builds upon the previously endorsed measure for 30-day All-Cause Readmission following hospialization for HF by incorporating two additional measures to differentiate hospital performance on the outcome of transitional care efforts.	**1e** H☐ M☒ L☐ N☐
Staff Notes to Reviewers: TAP comments on strengths and weaknesses: 1d. Parallel to AMI composite measure; weighted measure 1e. Difficult to understand results; Composite is a good concept -- not sure these are the right components; would like to see a composite of readmission and E&M only; difficulties again in interpreting the components of the composite and understanding how each of them contribute to the overall quality construct, but the conceptual process is clear enough.	
Reviewer: Was the threshold criterion, Importance to Measure and Report, met? **Rationale:** • The developer advised that the weightings were determined by the developers and their expert panel. While arbitrary, the weightings reflect the value of the desirable care trajectory for patients after hospitalization. • Some Committee members felt that only the readmission and ED visit measures would be a better composite.	**1** Y☒ N☐
2. SCIENTIFIC ACCEPTABILITY OF MEASURE PROPERTIES	
Extent to which the measure, as specified, produces consistent (reliable) and credible (valid) results about the quality of care when implemented. (composite measure evaluation criteria)	**Eval**
2a. MEASURE SPECIFICATIONS	
In the future, NQF will require measure stewards to provide a URL link to a web page where current detailed specifications can be obtained? ►Do you have a web page where current detailed measure specifications can be obtained? ►If yes, provide web page URL: None 2a. Precisely Specified **Components of the Composite** (*List the components, i.e., domains/sub-composites and individual measures*) ►**List components:** (*If component measures NQF-endorsed, include NQF measure number*; if not NQF-endorsed, provide date of submission to NQF) 30-day Post-Hospital HF discharge evaluation and management measure, submitted to NQF on 9/18/2009; 30-day Post-Hospital HF discharge ED measure, submitted to NQF on 9/18/2009; and, 30-Day All-Cause Risk Standardized Readmission Rate Following Heart Failure Hospitalization (risk adjusted) (NQF # 0330; endorsed 5/15/2008).	**2a-specs** H☒ M☐ L☐ N☐

Composite Numerator Statement: The numerator is the weighted sum of the three deviations from their expected values for the individual measures comprising the component measure. The question of appropriate weights on the deviations is difficult and would probably lead to a wide variation in opinion. The weights of -4, -2, and 1 are selected to represent order of magnitude differences in seriousness of the three outcomes, which most would agree to (that is to say: readmission is more important than ED which is more important in a negative way than E & M service is in a positive way). The idea of not using weights was also considered, but this was noted to be itself a de facto weight scheme (with all weights the same), and as such, a weight scheme that was less appropriate than the one chosen. **Numerator Time Window:** Each of the individual measures in the composite is computed annually (January through December), as a three year rolling average. **Numerator Details:** The details on each individual measure comprising the component measure are provided in their submission for NQF approval.	
Composite Denominator Statement: N/A The composite measure is the weighted sum of three individual measures. Thus, the denominator is one. **Denominator Time Window:** N/A **Denominator Details**: N/A	
Composite Denominator Exclusions: N/A **Denominator Exclusion Details:** N/A	

►**Type of Score:** Weighted score/comosite/scale ► If "Other", please describe:

►**Interpretation of Score** (*Classifies interpretation of score according to whether better quality is associated with a higher score, a lower score, a score falling within a defined interval, or a passing score*) Better quality = Higher score ► If "Other", please describe:

Method of Scoring/Aggregation: other **If "other" scoring method, describe:** Weighted sum of components, where each component is a deviation from an expected value.

Missing Component Scores (*Indicate how missing component scores are handled*): NA

Weighting: ☐ **Equal** ☒ **Differential** **If differential weighting, describe:** Readmission measure = -4* (RSR-popaverage); ED measure = -2*(RSR-popaverage); E&M measure = 1*(RSR-popaverage)

►**Calculation Algorithm** (*Describe the calculation of the measure as a flowchart or series of steps*)**:** Calculation Algorithm for 30-day Hospital Discharge HF Care Transition Composite measure:

Step 1: Claims for all beneficiaries (regardless of clinical condition) from 2003-2007 Medicare Inpatient files were combined and cleaned to create a claims file with one claim per inpatient per provider stay. Next, a single-stay claims file for all beneficiaries (regardless of clinical condition) in which transfer claims are combined into a single inpatient stay record was created. This process is described in the "Input File Processing for 2009 CMS 30-day Mortality and Readmission Measures" documentation.

Step 2: Each stay in the five year period is then defined as either an index admission or a 30-day readmission. A single stay cannot count as both an index admission and a readmission for another index admission. Thus, additional admissions within 30-days of an index admission are not counted as index admissions. Index admissions with a qualifying primary discharge diagnosis from beneficiaries meeting the inclusion criteria were included in this measure. This process is described in the Hospital 30-Day PNA Readmission Measure Methodology submitted by YNHH-CORE, the Hospital 30-Day Acute Myocardial Infarction Readmission Measure Methodology submitted by YNHH-CORE, and the Hospital 30-Day Heart Failure Readmission Measure Methodology submitted by YNHH-CORE.

Step 3: For each qualifying index admission, the beneficiary's inpatient and outpatient claims in the 12-months prior to the hospitalization are examined. All diagnoses from non-DME, non-diagnostic testing claims are used to construct flags for 184 clinical Condition Categories (CCs). Secondary diagnoses (excluding diagnoses associated with potential complications) from the index admission are used also to assign the 184 CCs. The process for creating the CC flags is described in the RiskSmart Stand Alone Users Guide, v2.2. These flags are used for risk adjustment.

Step 4: The following three flags (0/1 indicators) are then set for each index admission.
- Readmission=1 if a subsequent readmission occurs within 30 days of discharge from the qualifying index admission
- ED visit=1 if an ED visit occurs in the 30 days after discharge from the index admission, and the ED visit is not associated with or after the first readmission.
- E&M service=1 if an E&M service occurs in the 30 days after discharge from the index admission, and the E&M service is not after the first readmission, and is not after the first ED visit.

Step 5:
- Calculate separately (a) the ratio of E&M service=1 events, (b) the ratio of ED visit=1 events, and (c) the ratio of Readmission=1 events over the total number of qualifying index admissions to get unadjusted E&M, ED visit, and Readmission rates, respectively. These ratios are for descriptive purposes only.

Step 6:
- Estimate separately risk adjustment regression models on (a) the E&M service indicator, (b) the ED visit indicator, and (c) the readmission indicator using the methodology developed for the CMS 30-day all cause readmission measure.

Step 7: Applying the CMS 30-day readmission measure methodology, compute separately the P/E ratio and corresponding risk standardized rates (the RSR is defined as P/E times overall population mean) for E&M service, ED visit, and readmission.It must be understood that the RSR for E&M services greater than expected (popavg) indicates better than anticipated performance, while RSR for ED visits and readmissions greater than expected indicates lower than anticipated performance. This explains why weights for E&M service deviation is positive (+1), while weights for ED visits and readmissions components are negative (-2

►**Describe the method for discriminating performance** *(e.g., significance testing)***:**
Over the next few months we will explore this issue further, but as there are meaningful differences in each of its components, we assume we'll be able to construct categories from the composite that reflect meaningful differences as well. As part of this analysis we'll examine two approaches: one grouping hospitals together based on significance - for example, three categories for 1) hospitals significantly lower than mean, 2) hospitals with no significant difference from mean, and 3) hospitals significantly higher than mean) and a second approach based on percentile ranks, for example, using quintiles as categories. The final selection will maximize the amount of variation in hospital categorization (i.e., many hospitals in each category), as well as the amount of significant differences among hospitals of different categories (i.e., hopefully, categories can be constructed to have significant differences among their means).

►**Sampling (Survey) Methodology** *If measure is based on a sample (or survey), provide instructions for obtaining the sample, conducting the survey and guidance on minimum sample size (response rate)*:
N/A

►**Stratification Details/Variables (***All information required to stratify the measure including the stratification variables, all codes, logic, and definitions***):**
N/A

►**Data Source** *Check all the source(s) used in the component measures.*

- ☒ Electronic administrative data/ claims
- ☐ Electronic Health/Medical Record
- ☐ Electronic Clinical Data *(e.g., MDS)*
- ☐ Registry data (or database)
- ☐ Lab data
- ☐ Pharmacy data
- ☐ Paper Medical Record/flowsheet
- ☐ Survey-patient *(e.g., CAHPS)*
- ☐ Survey-provider
- ☐ Documentation of original self-assessment *(e.g., SF-36)*
- ☐ Management data
- ☐ Public health data/vital statistics
- ☐ Special or unique data, specify:

►**Level of Measurement/Analysis** (*For what entity will the scores be computed?*)
Check the level(s) for which the measure is specified and tested.

Clinician: ☐ Individual ☐ Group ☐ Other
- ☐ Facility/Agency (e.g., hospital, nursing home)
- ☐ Multi-site/corporate chain
- ☐ Integrated delivery system
- ☐ Health plan
- ☐ Prescription drug plan

Program: ☐ Disease management ☐ QIO
- ☐ Other

Population: ☒ National ☐ Regional/network
- ☐ State ☐ Counties/Cities
- ☐ Other (*Please describe*):
- ☐ All levels

►**Applicable Care Settings**
Check the setting(s) for which the measure is specified and tested.
Ambulatory Care: ☐ Amb Surgery Center ☐ Office ☐ Clinic ☐ Emergency Dept ☐ Hospital Outpatient

- ☐ Assisted Living
- ☐ Behavioral health/psychiatric unit
- ☐ Dialysis Facility
- ☐ Emergency medical services/ambulance
- ☐ Group Home
- ☐ Home
- ☐ Hospice
- ☒ Hospital
- ☐ Long term acute care hospital
- ☐ Nursing home/ Skilled Nursing Facility (SNF)
- ☐ Rehabilitation Facility
- ☐ Other (*Please describe*):
- ☐ Unspecified or "not applicable"
- ☐ All settings

TESTING/ANALYSIS

2i. Component item/measure analysis to justify inclusion in composite

Data/sample: The testing analyses described in this section use data from the Dartmouth Atlas 20% sample of Medicare Carrier Claim files for 2003-2007. Analysis used only AMI index admissions to the 2,505 hospitals having 10 or more AMI index admissions in 2006. This sub-sample has 77,743 AMI index admissions for 2006 and 246,421 for the three year period 2004-2006.

Analytic Method: Calculate correlation between the positive subgroup and the reverse of the negative subgroups of measures

2i
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M☒
L☐
N☐

Testing Results: We found that the Pearson correlation coefficient between component for E&M service within 30 days and the sum of the components for readmission and ambulatory ED visit was approximately 0.288 to 0.352 (p<.001), depending on method of formulating the individual components (e.g., one-year versus three-year). This implied that the positive component (E&M service) and the reverse of the negative components (formed by combining ED visits with readmissions) can be used together to form a useful composite.	
2j. Component item/measure analysis of contribution to variability in composite score **Data/sample:** The testing analyses described in this section use data from the Dartmouth Atlas 20% sample of Medicare Carrier Claim files for 2003-2007. Analysis used only AMI index admissions to the 2,505 hospitals having 10 or more AMI index admissions in 2006. This sub-sample has 77,743 AMI index admissions for 2006 and 246,421 for the three year period 2004-2006. **Analytic Method:** Correlation of each of the three component measures with the composite measure. **Testing Results:** Correlations between each component and the overall composite measure were very strong (p<.001). For the predicted over expected composite measure based on three year rolling average, the correlations .763 with the readmission component, .369 with the ED visit component, and .718 with the E&M service component. For the one year composite measure (based on 2007 data), it was similarly strong – readmission component correlated at .593, ED visit correlated at .539, and E&M service component correlated at .764.	**2j** H☐ M☒ L☐ N☐
2k. Analysis to support differential weighting of component scores **Data/sample:** N/A **Analytic Method:** N/A **Testing Results:** N/A **Describe how the method of scoring/aggregation achieves the stated purpose and represents the quality construct:** The question of appropriate weights on the deviations is difficult and would probably lead to a wide variation in opinion. The weights of -4, -2, and 1 are selected to represent order of magnitude differences in seriousness of the three outcomes, which most would agree to (that is to say: readmission is more important than ED which is more important in a negative way than E & M service is in a positive way). **Indicate if any alternative scoring/aggregation methods were tested and why not chosen:** The idea of not using weights was also considered, but this was noted to be itself a de facto weight scheme (with all weights the same), and as such, a weight scheme that was less appropriate than the one chosen.	**2k** H☐ M☒ L☐ N☐
2l. Analysis of missing component scores **Data/sample:** The testing analyses described in this section use data from the Dartmouth Atlas 20% sample of Medicare Carrier Claim files for 2003-2007. Analysis used only AMI index admissions to the 2,505 hospitals having 10 or more AMI index admissions in 2006. This sub-sample has 77,743 AMI index admissions for 2006 and 246,421 for the three year period 2004-2006. **Analytic Method:** search of data summaries for components with zero or low number of HF admissions **Testing Results:** Components are present or absent uniformly for all hospitals in our HF dataset.	**2l** H☒ M☐ L☐ N☐
2b. Reliability testing of composite score ►**Data/sample** *(description of data/sample and size)*: The testing analyses described in this section use data from the Dartmouth Atlas 20% sample of Medicare Carrier Claim files for 2003-2007. Analysis used only AMI index admissions to the 2,505 hospitals having 10 or more AMI index admissions in 2006. This sub-sample has 77,743 AMI index admissions for 2006 and 246,421 for the three year period 2004-2006.	**2b** H☐ M☒ L☐ N☐

►**Analytic Method** *(type of reliability & rationale, method for testing)*: Reliability was examined two ways: through correlation of measure with its one year incremental change, and through division into quintiles and calculating weighted kappa statistics. Both Pearson and Spearman (rank) correlations were computed between 2007 and average of first three years (2004 through 2006). This is a more stringent test than the straightforward test of correlating 2007 measures (based on three year rolling averages from 2005-2007) with 2006 measures (based on three year rolling averages from 2004-2006). The latter would share 2/3 of the data and have an inflated correlation as a result.

►**Testing Results** *(reliability statistics, assessment of adequacy in the context of norms for the test conducted)*: All tested correlations were significant at the .001 level. The Pearson correlation between 2007 and three year averages (using 2004- 2006) for predicted over expected was 0.220. For comparison purposes, the observed over expected composites had a 0.145 correlation. The Spearman correlation (which are less sensitive to outliers) was similar: 0.195 for predicted over expected and 0.120 for corresponding observed over expected composites. Weighted kappas measuring agreement within quintiles showed a similar pattern of reliability. Weighted kappa was 0.115 for 2007 predicted over expected compared with prior composite measure based on three year rolling average. The 95% CI for this weighted kappa was (0.087, 0.143).

2c. Validity testing of composite score

►**Data/sample** *(description of data/sample and size)*: The testing analyses described in this section use data from the Dartmouth Atlas 20% sample of Medicare Carrier Claim files for 2003-2007. Analysis used only AMI index admissions to the 2,505 hospitals having 10 or more AMI index admissions in 2006. This sub-sample has 77,743 AMI index admissions for 2006 and 246,421 for the three year period 2004-2006.

►**Analytic Method** *(type of validity & rationale, method for testing)*: N/A yet

►**Testing Results** *(statistical results, assessment of adequacy in the context of norms for the test conducted)*: As a weighted sum of three measures, the validity of this composite depends greatly on the validity of the three components. We hope to further test this validity through construct validation, predictive validation, and other analyses as follow-up to this submission.

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2f. Identification of Meaningful Differences in Performance

►**Data/sample from Testing or Current Use** *(description of data/sample and size)*: The testing analyses described in this section use data from the Dartmouth Atlas 20% sample of Medicare Carrier Claim files for 2003-2007. Analysis used only AMI index admissions to the 2,505 hospitals having 10 or more AMI index admissions in 2006. This sub-sample has 77,743 AMI index admissions for 2006 and 246,421 for the three year period 2004-2006.

►**Methods to identify statistically significant and practically/meaningfully differences in performance** *(type of analysis & rationale)*: For more appropriate interpretation, the composite measure, which is a weighted sum, can be standardized by dividing by 7 (the sum of the weights). This standardization implies that when all component measure deviations are equal (e.g. 1%), the resulting standardized composite score will have this same common value (e.g., again 1%).

This composite is not yet used. We are submitting it for provisional acceptance with the plan over the next few months tol explore this issue further. As there are meaningful differences in each of its components, we assume we'll be able to construct categories from the composite that reflect meaningful differences as well. As part of this analysis we'll examine two approaches: one grouping hospitals together based on significance - for example, three categories for 1) hospitals significantly lower than mean, 2) hospitals with no significant difference from mean, and 3) hospitals significantly higher than mean) and a second approach based on percentile ranks, for example, using quintiles as categories. The final selection will maximize the amount of variation in hospital categorization (i.e., many hospitals in each category), as well as the amount of significant differences among hospitals of different categories (i.e., hopefully, categories can be constructed to have significant differences among their means).

► **Provide Measure Scores from Testing or Current Use** *(description of scores, e.g., distribution by quartile, mean, median, SD, etc.; identification of statistically significant and meaningfully differences in performance)* : With scaling as described above, the composite's 5th percentile is -2.2% (indicating each

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deviation of these lowest performing hospitals averages -2.2%) and the 95th percentile is 2.1% (indicating each deviation of these highest performing hospitals averages 2.1%). Under the same scaling, the inter-quartile range for the composite is -0.8% to 0.9%, or 1.7 percentage points. By way of context, the inter-quartile range of the readmission rate component calculated for this analysis (see Table 7 (page 17) in Attachemt B of the supporting document) is 2 percentage points.	
2h. Disparities in Care ►**If measure is stratified, provide stratified results** *(scores by stratified categories/cohorts)*: N/A ►**If disparities have been reported/identified, but measure is not specified to detect disparities, provide follow-up plans:** We are currently examining hospital quality measures related to disparities for CMS and we can add these measures to see how they break out by race/ethnicity, SES, etc. We had intended the further exploration of measure performance as related to special populations.	**2h** **H**☐ **M**☐ **L**☒ **N**☐ **NA**☐
Staff Notes to Reviewers: TAP comments on strengths and weaknesses: 2a. specifications - complete; 2b and c - internal consistency testing of correlation of the components though relatively low kappa values; 2f - meaningful differences - testing data shows a reasonable spead in results 2h - disparities known but not addressed; 2i - component justification -- correlations presented: 2k - weightings are arbitrary and not validated; if somebody has an ED visit ten days post-discharge and they are not admitted and then they come back two weeks after that and they end up getting admitted. - only one ED visit and readmission count in the composite score 2l.disparities not addressed	
Reviewers: Overall, to what extent was the criterion, *Scientific Acceptability of Measure Properties*, **met?** **Rationale:**	**2** **H**☐ **M**☒ **L**☐ **N**☐
3. USABILITY	
Extent to which intended audiences (e.g., consumers, purchasers, providers, policy makers) can understand the results of the measure and are likely to find them useful for decision making. (composite measure evaluation criteria)	**Eval**
3a. Meaningful, Understandable, and Useful Information **Current Use:** ☐ In use ☐ Not in use, but testing completed ☒ Testing not yet completed **If used in a public reporting initiative, Name of initiative(s), locations, Web page URL(s):** N/A **If used in other programs/initiatives (e.g., quality improvement), Name of initiative(s), locations, web page URL(s):** N/A **Testing of Interpretability** (*Testing that demonstrates the results are understood by the potential users for public reporting and quality improvement*) ►**Data/sample** *(description of data/sample and size)*: Measure has not yet been tested; requesting provisional approval to continue the formal testing including consumer interpretation of the 30-day Post-hospital AMI Discharge Evaluation and Management Service measure. ►**Methods** *(methods, e.g., focus group, survey, QI project)*: N/A ►**Results** *(qualitative and/or quantitative results and conclusions)*: N/A	**3a** **H**☐ **M**☒ **L**☐ **N**☐
3b/3c. Relation to other NQF-endorsed measures *Identify similar or related NQF-endorsed measures* (available at *www.qualityforum.org under Core Documents)*	

☐ Other measures for same target population ☒ Other measures on same topic ☐ No similar measures **NQF # and Title of similar or related measures:** 30-Day All-Cause Risk Standardized Readmission Rate Following Heart Failure Hospitalization (risk adjusted) (NQF # 0330; endorsed 5/15/2008). **Describe the distinctive or additive value this measure provides to existing NQF-endorsed measures:** Adds two additional components to an exisiting readmission rate measure in building a composite measure of transitional care post-hospital discharge	
3b. Harmonization ►**Are the component measure specifications harmonized, or if not, why?** yes; employed the diagnositic coding specification for population cohorts and the risk-adjustment methodology of the currently NQF-endorsed hospital 30-day PNA, Heart Failure and AMI readmission rates (developed by Yale researchers)	**3b** H☒ M☐ L☐ N☐ NA☐
3c. Distinctive or Additive Value ►**Describe the distinctive, improved, or additive value this measure provides to existing NQF-endorsed measures:** It builds upon the foundation of the NQF-endorsed 30-day PNA, Heart Failure, and AMI readmission rates providing a more comprehensive picture of transitional care and resource use immediately post-discharge for a frequent and high-cost condition in the Medicare population.	**3c** H☐ M☒ L☐ N☐ NA☐
3d. Decomposition of Composite ►**Describe the information from decomposing the composite into its components that is available:** 1) 30-Day All-Cause Risk Standardized Readmission Rate Following Heart Failure Hospitalization (risk adjusted) (NQF # 0330; endorsed 5/15/2008). 2) 30-day Post-hospital Heart Failure discharge ED visit rate 3) 30-day Post-hospital Heart Failure discharge evaluation and management service rate	**3d** H☒ M☐ L☐ N☐
3e. Achieved stated purpose **Describe how the results reported above demonstrate that the composite achieves the stated purpose:** Ideal care following hospitalization for HF is evidence of an evaluation and management (E & M)services visit that presumably links the inpatient care back to the outpatient setting thereby transferring physician accountability for treatment from the hospitalist or hospital physician to the primary care physician or specialist. If the discharged patient required an Emergency Department visit or readmission prior to this E & M it can be inferred that optimal care transition did not occur.	**3e** H☐ M☒ L☐ N☐
Staff Notes to Reviewers (including additions/changes to related or similar measures): TAP comments on strengths and weaknesses:unclear what the score means; need to understand the relationship among the components; What is the value above the individual measures? Would argue for parsimony among the group of related measures. want to understand how it could be used nationally as well as in individual institutions - how it translates is really dependent on how the information is presented.	
Steering Committee/TAP: Overall, to what extent was the criterion, *Usability*, met? **Rationale:**	**3** H☐ M☒ L☐ N☐
4. FEASIBILITY	
Extent to which the required data are readily available, retrievable without undue burden, and can be implemented for performance measurement. (composite measure evaluation criteria)	**Eval**
4a. Data Generated as a Byproduct of Care Processes **How are <u>all</u> the data elements that are needed to compute measure scores generated?** *Check all that apply* ☐ Data are generated as a byproduct of care processes during care delivery (*Data are generated and used*	**4a** H☒ M☐ L☐ N☐

by healthcare personnel during the provision of care, e.g., blood pressure, lab value, medical condition) ☒ Coding/abstraction performed by someone other than person obtaining original information *(e.g., DRG, ICD-9 codes on claims; chart abstraction for quality measure, registry)* ☐ Other *(e.g., patient experience of care surveys, provider surveys, observation)*, *Please describe*:	**NA**☐
4b. Electronic Sources ►**Are <u>all</u> the data elements available electronically?** (*elements that are needed to compute measure scores are in defined, computer-readable fields, e.g., electronic health record, electronic claims*) ☒ Yes ☐ No ►**If no, specify the near-term path to achieve electronic capture by most providers.** *Note: Measure stewards will be asked to specify the data elements for electronic health records at a later date*	**4b** **H**☒ **M**☐ **L**☐ **N**☐
4d. Susceptibility to Inaccuracies, Errors, or Unintended Consequences ►**Identify susceptibility to inaccuracies, errors, or unintended consequences of the measure and describe how these potential problems could be audited. If audited, provide results.** Our measure as specified is not susceptible to inaccuracies.	**4d** **H**☒ **M**☐ **L**☐ **N**☐
4e. Data Collection Strategy/Implementation ►**Describe what you have learned/modified as a result of testing and/or operational use of the composite/component measures regarding data collection, availability of data/missing data, timing/frequency of data collection, patient confidentiality, time/cost of data collection, other feasibility/ implementation issues:** As a completely claims-based measure once measure specification has been coded it is not difficult to derive. ►**Costs to implement the measure** (*costs of data collection, fees associated with proprietary measures*)**:** NA-this is an administrative claims-based measure that does not add data collection burden to hospitals or providers ►**Evidence for costs:** N/A ►**Business case documentation:** N/A	**4e** **H**☒ **M**☐ **L**☐ **N**☐
Staff Notes to Reviewers: TAP comment: scores high on feasibility	
Reviewers: Overall, to what extent was the criterion, Feasibility, met? **Rationale:**	**4** **H**☐ **M**☒ **L**☐ **N**☐
Reviewers: Overall, to what extent were all the criteria met? **Rationale:**	**H**☐ **M**☐ **L**☐
Steering Committee only **Recommendation:** ☒ **Endorsement** ☐ **Time-limited endorsement** ☐ **Do not recommend** **Conditions:** ☒ **No** ☐ **Yes, Specify:**	
CONTACT INFORMATION	
Measure Steward (Intellectual Property Owner) **Organization:** Centers for Medicare and Medicaid Services **Street Address:** **City:** Washington D.C. **State:** **ZIP:** 21244	

Point of Contact: First Name: Shaheen **MI:** **Last Name:** Halim **Credentials (MD, MPH, etc.):** Ph.D.
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Measure Developer If different from Measure Steward
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Street Address: 415 South Street **City:** Waltham **State:** MA **ZIP:** 02454-9110

Point of Contact: First Name: Christopher **MI:** **Last Name:** Tompkins **Credentials (MD, MPH, etc.):** Ph.D.
Email: tompkins@brandeis.edu. **Telephone:** 781-736-3913 ext:

Submitter If different from Measure Steward Point of Contact
First Name: Christopher **MI:** **Last Name:** Tompkins **Credentials (MD, MPH, etc.):** Ph.D.
Email: tompkins@brandeis.edu **Telephone:** 781-736-3913 ext:
Organization: ☐ Measure Steward ☒ Measure Developer

Additional Measure Developer Organizations:

ADDITIONAL INFORMATION

Workgroup/Expert Panel involved in measure development
►Provide a list of sponsoring organizations and workgroup/panel members' names and organizations.
►Describe the members' role in measure development.

Technical Expert Panel (TEP):
Lisa Latts, MD, MBA -WellPoint
Julie Bynum, MD, MPH -Dartmouth Medical School
Joanne Lynn, MD -DC Department of Health – Chronic Disease and Cancer Community Health Administration
Anthony Armada, MHA, MBA -Henry Ford Hospital

TEP Role:
The Technical Expert Panel assisted our workgroup developing measures by providing input to:
- Supplement, and provide texture, to the knowledge gathered through the literature review prior to measure development;
- Discussing existing measures and providing input as to next steps for CMS to adopt, adapt, and/or develop measures of care coordination relevant to the hospital setting; and
- Reviewing and providing input on draft measures and measure development testing.

Workgroup

Kristine Martin Anderson, MBA -Booz Allen Hamilton
Sandra Lesikar, PhD-Booz Allen Hamilton
Arlene Ash, PhD-Boston University
James Burgess, PhD-Boston University
Gary Young, MD-Boston University
Christopher Tompkins, PhD-Brandeis University
John Chapman, PhD-Brandeis University
Timothy Martin, PhD-Brandeis University
Grant RItter, PhD-Brandeis University
Sue Lee, MS-Brandeis University
Marian Ryan, Ph.D.Candidate-Brandeis University

Workgroup Role:
The workgroup participated in development of measures, review of interim results during development, and the review of NQF submission forms. Listed members participated on the CMS project team working on the development of measures under a hospital VBP program.

►**If adapted, provide name of original measure:** 30-day Post-hospital HF Discharge Care Transition Measure
►**If adapted, provide original specifications** ☐ **attachment or web page URL:**

Measure Developer/Steward Updates and Ongoing Maintenance
►Year the measure was first released:
►Month and Year of most recent revision:

►What is the frequency for review/update of this measure? ►When is the next scheduled review/update for this measure?
Copyright statement/disclaimers: NA
Additional Information web page URL:
I have checked that the submission is complete and all the information needed to evaluate the measure is provided in the form; any blank fields indicate that no information is provided. ☒
Date of Submission (*MM/DD/YY*)**:** 9/18/2009

Heart Failure 30-Day Post-Hospital Discharge Care Transition Composite Measure

Supporting Material for Scientific Acceptability

Brandeis University

1. Introduction

This document elaborates and supports the statements on scientific acceptability in Brandeis University's November 10, 2009 revision of its September 18, 2009 submission of a measure titled "30-Day Post-Hospital Heart Failure Discharge Care Transition Composite Measure" to the National Quality Forum's Consensus Development Project on Proposed Patient Outcomes Measures (Phase I) in response to its call for candidate standards.

1.1. Data Sample

All data used for the analyses described in this document are from the Dartmouth Atlas 20% sample of Medicare Carrier Claim files for 2003-2007. Data from 2003 are used only for pre-admission information about patients admitted during 2004, and are not included directly in any of the analysis presented. December 2007 is used only for information about the 30-day post-discharge period; there are no December 2007 index admissions in the results presented here. These data were processed in accordance with the measure definitions described in the submission. All resulting index admissions were used in the model for testing and estimation and are reflected in the individual level expected and predicted values used in computing the component measures. However, composite measure scores were analyzed only for hospitals having 10 or more index admissions in 2006. These are the same hospitals used for the analysis presented in support of the accompanying submissions for the ED visit and E&M service measures used for this composite.

More information about the ED visit and E&M service component scores used for this analysis can be found in the submissions for those measures. Similar information about the readmission component data and scores used for this analysis is presented in Appendix B.

1.2. Measure Methods

The component measures of this composite use three years of data, updated annually (i.e., rolling average), borrowing power longitudinally in order to increase the signal-to-noise ratio relative to simple annual calculations. This supporting analysis provides one-year and three-year computations to show what is gained in exchange for the loss of 'currentness' resulting from the three-year approach.

Analysis considered observed-to-expected (O/E) ratios as well as the proposed predicted-to-expected (P/E) ratios. Results of both approaches are documented below. The O/E rate for three years is a weighted average of three one-year rates, with weights of 0.5 for the most recent year, 0.3 for the prior year and 0.2 for the first year. The P/E rate for three years is computed using the results of the HGLM model estimated for three years. Other weighting approaches will be investigated during the provisional period.

2. Component item/measure analysis to justify inclusion in composite (Measure evaluation criterion 2i)

   Table 1 displays coefficients of correlation among the three component measures, for each of the method and time period combinations. All are significant at $p<0.0001$. There is substantial consistency among the method and period combinations, with the three-year and P/E variations having slightly larger values.

Table 1: Heart Failure 30-Day Care Transition Composite – Correlation Among Component Measures

	Pearson Coefficient		Spearman Coefficient	
Measure, Method and Period	**Readmission**	**ED Visit**	**Readmission**	**ED Visit**
One-Year Using O/E				
• ED Visit	-0.071	.	-0.079	.
• E & M Service	0.189	0.219	0.180	0.195
One-Year Using P/E				
• ED Visit	-0.089	.	-0.088	.
• E & M Service	0.168	0.230	0.175	0.222
Three-Years Using O/E				
• ED Visit	-0.084	.	-0.101	.
• E & M Service	0.194	0.237	0.183	0.221
Three-Years Using P/E				
• ED Visit	-0.112	.	-0.105	.
• E & M Service	0.207	0.266	0.210	0.267

Note: For clarity of presentation, the directions of the measures were aligned before computing the correlation coefficients.

We present correlation coefficients because reviewers and users may find them of interest. They were not the basis for our decision to include these measures in the composite. Rather, as articulated in our submissions for NQF endorsement of these measures, we believe that each is an intrinsically valid indicator of the outcome of care coordination and hence belongs in the care transition composite measure.

Interpretation of the negative correlation between the readmission and ambulatory ED visit measures is warranted. In many cases the independent components of a

composite are intended to measure imperfectly the same underlying construct, these are called reflective measures. In such cases, the correlations between components will be positive. In other cases, some components of a composite will note events which somewhat substitute for each other or are uncorrelated with each other, and it is reasonable to add the measures together to make what is called a formative measure even though some of the underlying constructs are negatively correlated. This is the situation for our readmissions and ambulatory ED visit components. Both measure a lack of care coordination, but since the same patient can not be readmitted and have an ambulatory ED visit during the same trip to the hospital, the correlation between them can be negative.

Checking further, we find that the Pearson correlation coefficient between the E&M service within 30 days rate and the sum of the readmission and ambulatory ED visit components is approximately 0.288 to 0.352, depending on composite formulation. This correlation is higher than between any two individual components and provides justification for combining the three components. The Cronbach alphas for the three components (standardized) are in the range of 0.256 to 0.291, again reflecting agreement among them.

3. Component item/measure analysis of contribution to variability in composite score (Measure evaluation criterion 2j)

   Each of the three component measures is substantially correlated with the composite. These coefficients are in Table 2. There is little variation by method or time period.

Table 2: Heart Failure 30-Day Care Transition Composite – Correlation With Component Measures

Period and Method	Readmission	ED Visit	E&M Service
One Year – Using O/E			
• Pearson	-0.904	-0.289	0.482
• Spearman	-0.888	-0.258	0.459
One Year – Using P/E			
• Pearson	-0.593	-0.539	0.764
• Spearman	-0.575	-0.509	0.749
Three Years – Using O/E			
• Pearson	-0.895	-0.285	-0.513
• Spearman	-0.874	-0.250	0.496
Three Years – Using P/E			
• Pearson	-0.763	-0.369	0.718
• Spearman	-0.742	-0.350	0.707

4. Identification of Meaningful Differences in Performance (Measure evaluation criterion 2f)

Table 3 summarizes the distribution of the composite scores using each of the methods and time periods for the 2,505 hospitals having 10 or more index admissions in 2006 Table 4 breaks these rates down by hospital heart failure volume (quartile of index admissions in 2006). These data are illustrated by histograms in Appendix A.

Table 3: Heart Failure 30-Day Care Transition Composite -- Distribution Among Hospitals, by Estimation Period

	P5	P25	Median	P75	P95
One-Year Composite Scores					
• **Using O/E**	-.803	-.249	0.017	0.274	0.654
• **Using P/E**	-.093	-.033	0.002	0.034	0.083
Three-Year					
• **Using O/E**	-.557	-.175	0.017	0.180	0.441
• **Using P/E**	-.153	-.055	0.006	0.063	0.145

For more appropriate interpretation, the composite measure, which is a weighted sum, can be standardized by dividing by 7 (the sum of the weights). This standardization implies that when all component measure deviations are equal (e.g. 1%), the resulting standardized composite score will have this same common value (e.g., again 1%). With such scaling, the composite's 5^{th} percentile is -2.2% (indicating each deviation of these lowest performing hospitals averages -2.2%) and the 95^{th} percentile is 2.1% (indicating each deviation of these highest performing hospitals averages 2.1%). Under the same scaling, the inter-quartile range for the composite is -0.8% to 0.9%.

Table 4: Heart Failure 30-Day Care Transition Composite -- Distribution Among Hospitals, By Volume Quartile

		P5	P25	Median	P75	P95
Composite Score - O/E	**Vol. Quartile**					
	Q1: 10 - 15	-1.09	-.424	-.005	0.379	0.858
	Q2: 16 - 23	-.895	-.330	-.001	0.291	0.647
	Q3: 24 - 38	-.638	-.238	0.019	0.273	0.609
	Q4: 39 - 232	-.386	-.112	0.039	0.204	0.454
Composite Score - P/E	**Vol. Quartile**					
	Q1: 10 - 15	-.086	-.034	-.002	0.022	0.057
	Q2: 16 - 23	-.097	-.037	-.005	0.027	0.064
	Q3: 24 - 38	-.094	-.032	0.007	0.040	0.090
	Q4: 39 - 232	-.100	-.027	0.012	0.057	0.109
Composite Score - O/E 3-yr Wtd.	**Vol. Quartile**					
	Q1: 10 - 15	-.822	-.297	-.038	0.246	0.545
	Q2: 16 - 23	-.561	-.240	-.008	0.177	0.423
	Q3: 24 - 38	-.445	-.135	0.024	0.182	0.425
	Q4: 39 - 232	-.278	-.081	0.043	0.159	0.335
Composite Score - P/E 3-yr	**Vol. Quartile**					
	Q1: 10 - 15	-.168	-.067	-.010	0.041	0.103
	Q2: 16 - 23	-.153	-.064	-.005	0.049	0.119
	Q3: 24 - 38	-.154	-.045	0.017	0.075	0.147
	Q4: 39 - 232	-.141	-.044	0.024	0.095	0.180

5. Reliability Testing (Measure evaluation criterion 2b)

Reliability was assessed by correlating the one-year scores for 2007 with both the one-year scores for 2006 and the three-year scores for 2006. In each case, both Pearson and Spearman correlations were calculated, the latter being less susceptible to outliers. As an additional assessment, scores were grouped in quintiles and weighted kappa statistics were computed. These results are all in Table 9, with each value being statistically significant ($p<.001$). Correlation statistics between the three-year average ending in 2007 and the three-year average ending in 2006 are not calculated because the two scores share two years of data in common.

Table 5: Heart Failure 30-Day Care Transition Composite -- Reliability When Comparing Across Years

Statistic	One Year (2006)		Three Years (2004-6)	
	Obs./Exp. Ratio	Pred./Exp. Ratio	Obs./Exp. Ratio	Pred./Exp. Ratio
Correlation Coefficients				
• **Pearson**	0.106	0.160	.0145	.0220
• **Spearman**	0.088	0.133	0.120	0.195
Kappa Statistic				
• **Weighted Kappa**	0.067	0.080	0.082	0.115
• **95% CI – Lower**	0.039	0.052	0.054	0.087
• **95% CI -- Upper**	0.096	0.108	0.110	0.143

Appendix A

Figure 1: Distribution of Hospital 30-Day Heart Failure Discharge Care Transition Composite Rates (O/E Method -- One Year – 2006)

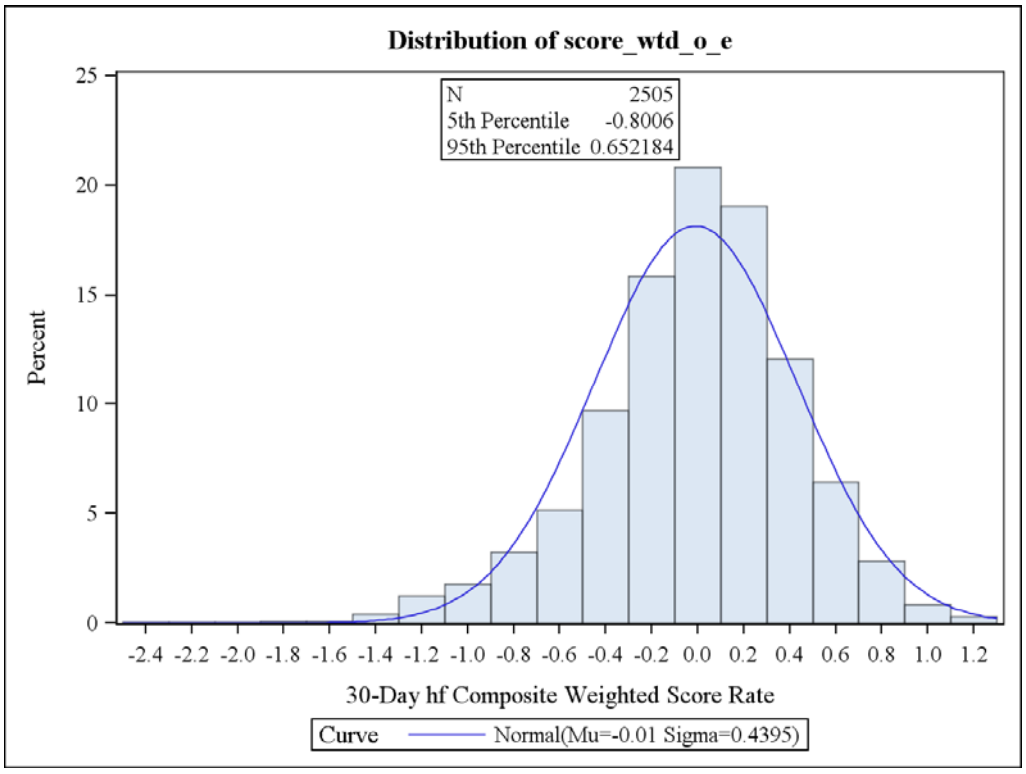


Figure 2: Distribution of Hospital 30-Day Heart Failure Discharge Care Transition Composite Rates (O/E Method -- One Year – 2006), By Volume Quartile

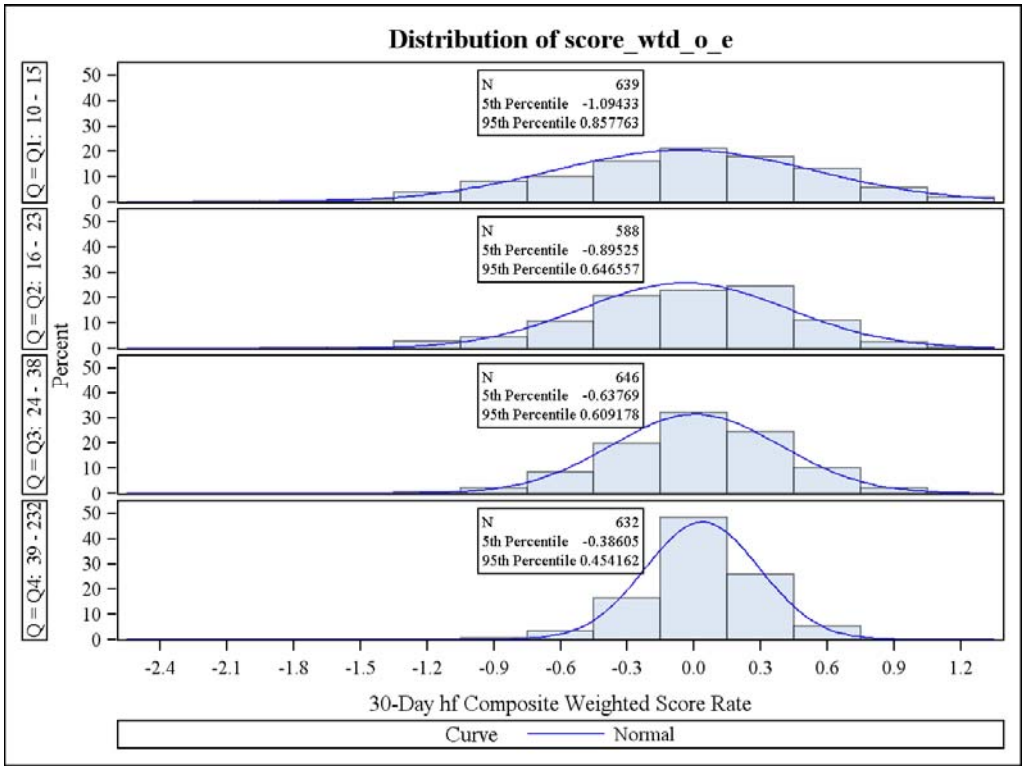


Figure 3: Distribution of Hospital 30-Day Heart Failure Discharge Care Transition Composite Rates (P/E Method -- One Year – 2006)

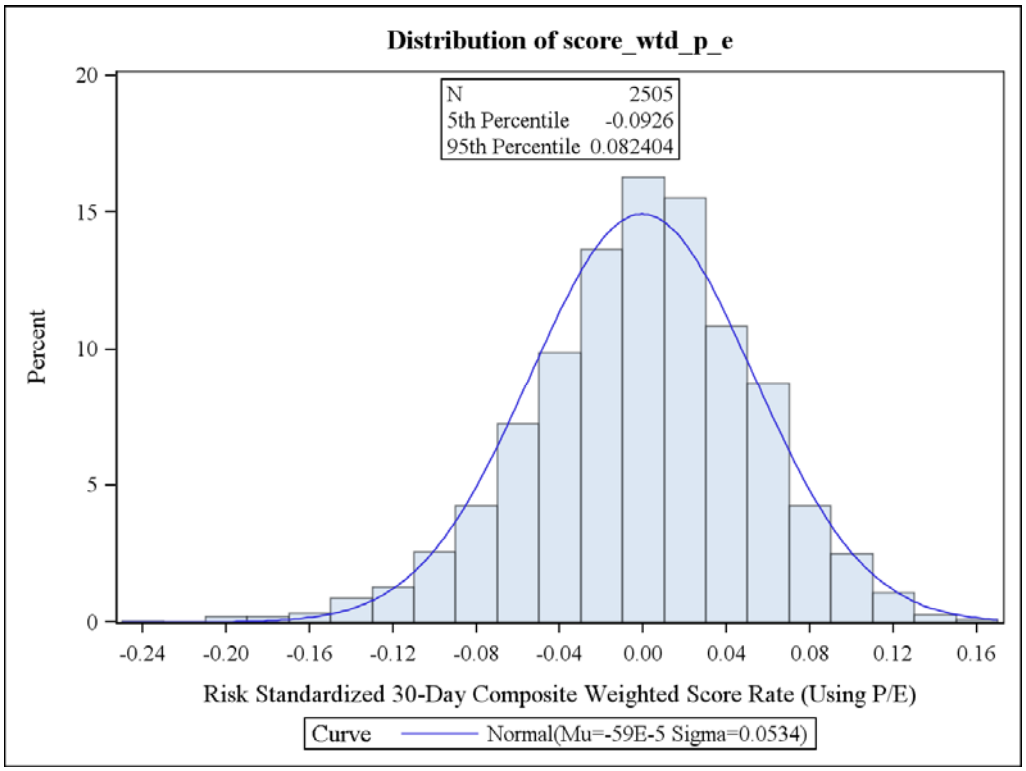


Figure 4: Distribution of Hospital 30-Day Heart Failure Discharge Care Transition Composite Rates (O/E Method -- One Year – 2006), By Volume Quartile

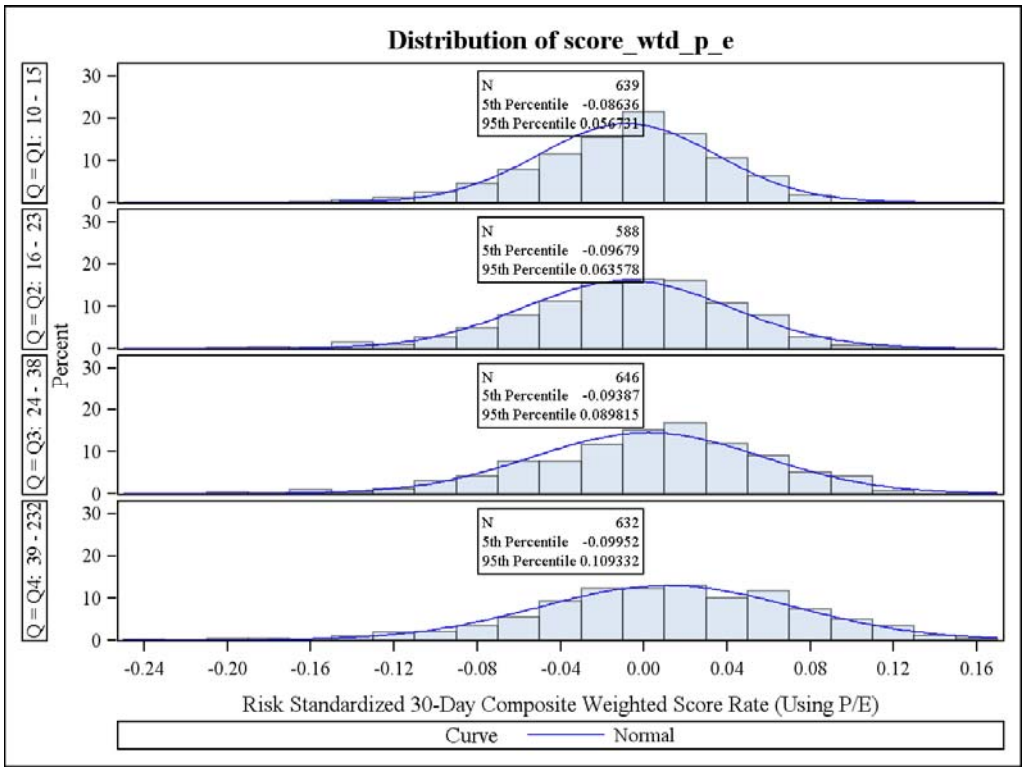


Figure 5: Distribution of Hospital 30-Day Heart Failure Discharge Care Transition Composite Rates (O/E Method -- Three Years – 2004-6)

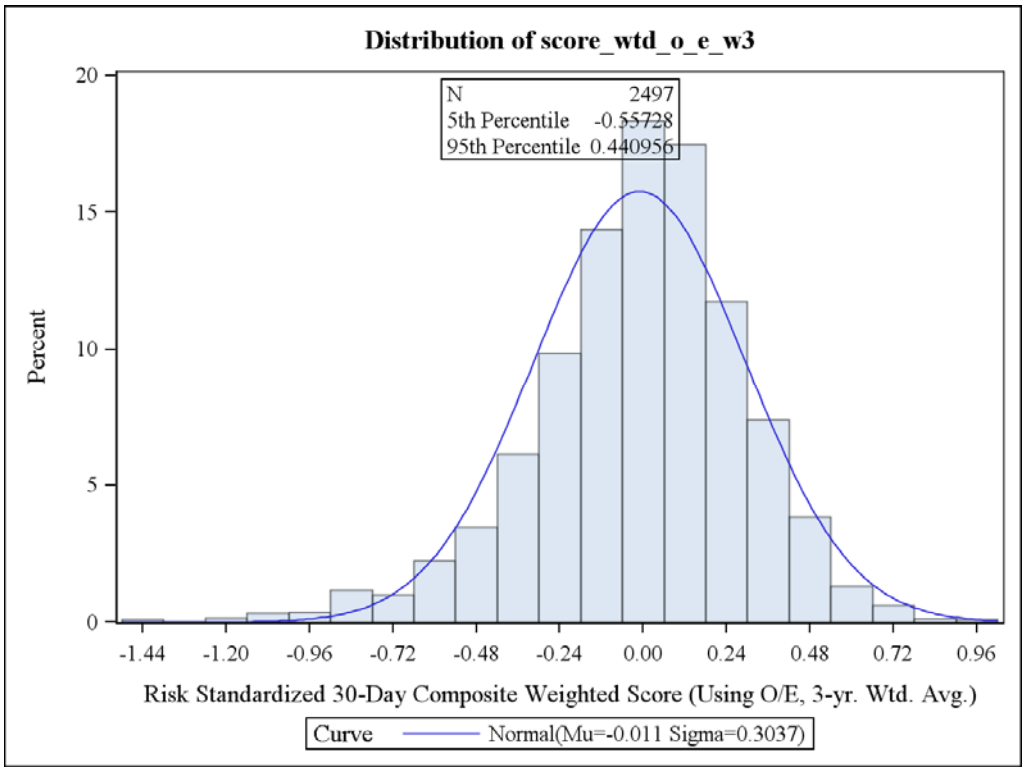


Figure 6: Distribution of Hospital 30-Day Heart Failure Discharge Care Transition Composite Rates (O/E Method -- Three Years – 2004-6), By Volume Quartile

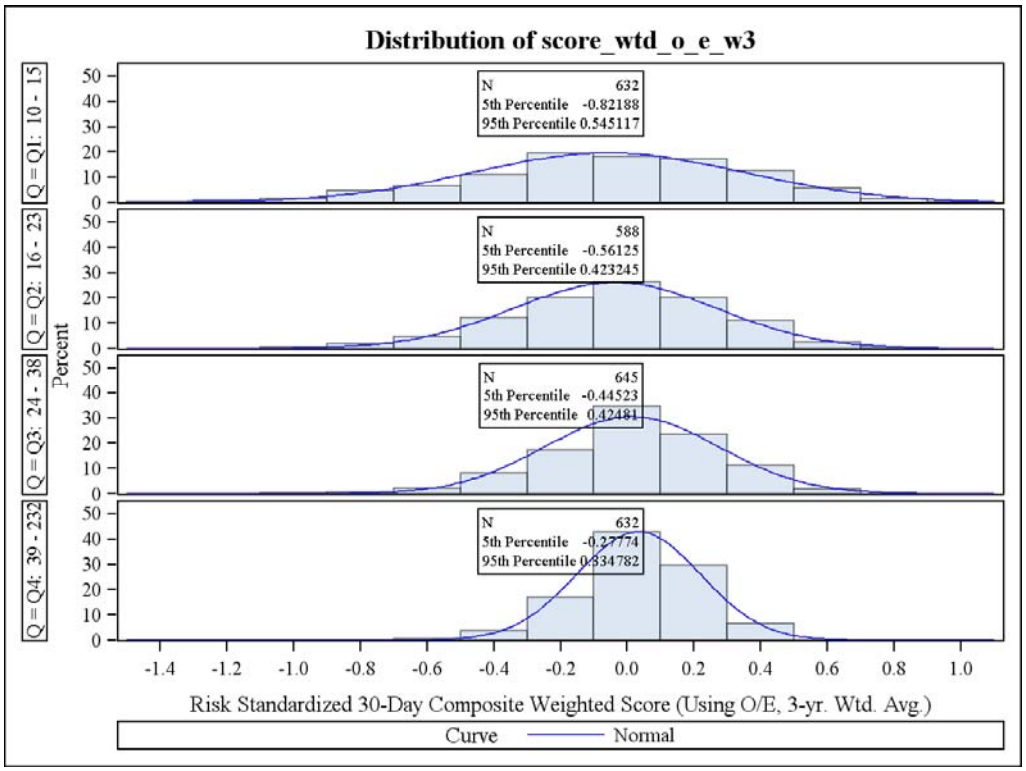


Figure 7: Distribution of Hospital 30-Day Heart Failure Discharge Care Transition Composite Rates (P/E Method -- Three Years – 2004-6)

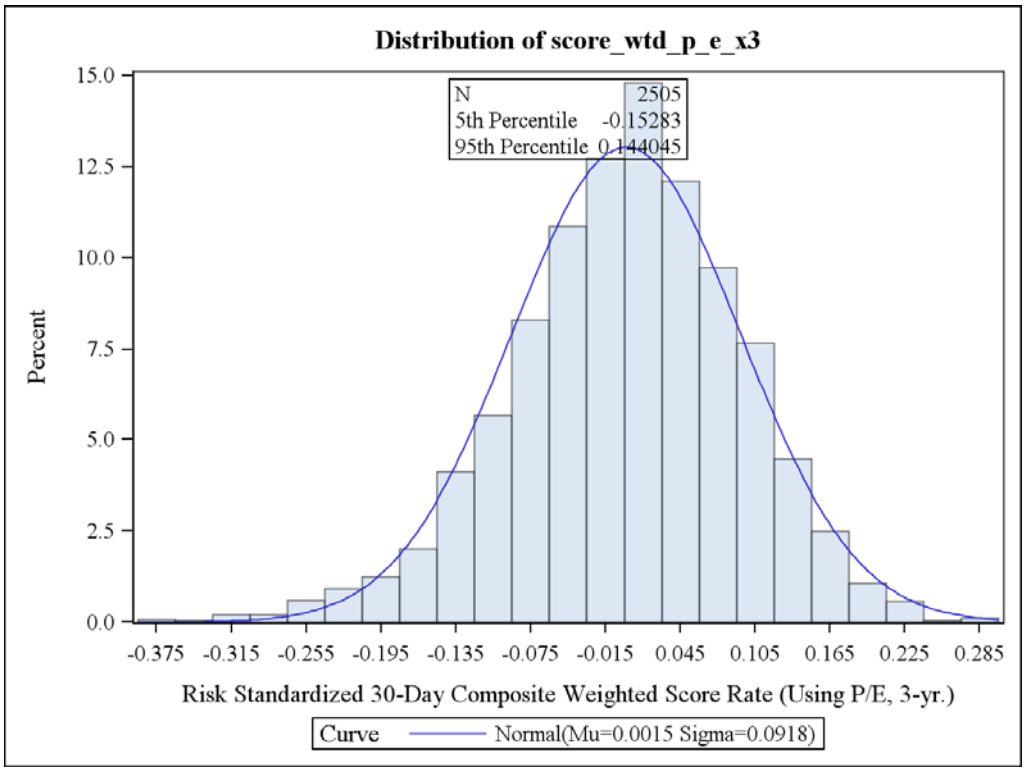
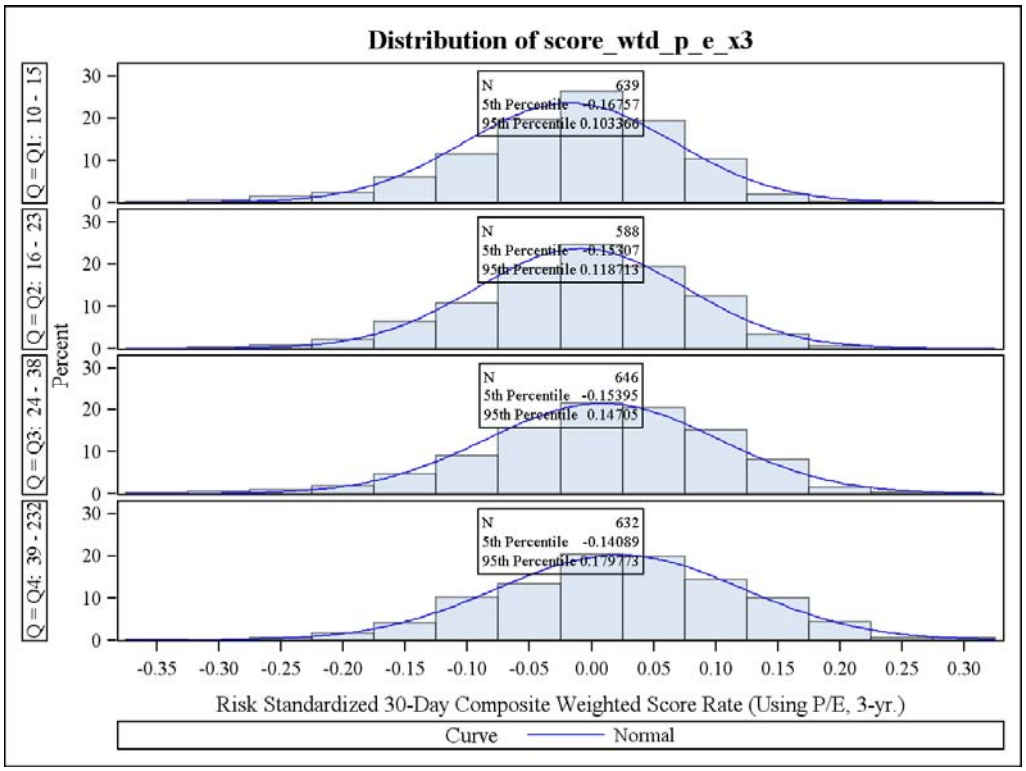


Figure 8: Distribution of Hospital 30-Day Heart Failure Discharge Care Transition Composite Rates (P/E Method -- Three Years – 2004-6), By Volume Quartile



Appendix B

30-Day Post-Hospital Heart Failure Discharge Readmission Measure Scores Used for Composite Measure Assessment

1. Introduction

This appendix describes and assesses the 30-day post-hospital heart failure readmission rates used for the analyses of the proposed 30-Day Post-Hospital Heart Failure Discharge Care Transition Composite Measure.

1.1. Data Sample

All data used for the analyses described in this document are from the Dartmouth Atlas 20% sample of Medicare Carrier Claim files for 2003-2007. Data from 2003 are used only for pre-admission information about patients admitted during 2004, and are not included directly in any of the analysis presented. December 2007 is used only for information about the 30-day post-discharge period; there are no December 2007 index admissions in the results presented here. These data were processed in accordance with the measure definitions described in the submission. All resulting index admissions were used in the model for testing and estimation and are reflected in the results presented in section 2 on Risk Adjustment. Scores and their analysis discussed in sections 3 and 4 were analyzed only for hospitals having 10 or more index admissions in 2006. Table 1 summarizes the number of resulting hospitals and index admissions with a primary diagnosis of heart failure, and the rate of a 30-day post-discharge readmission following these admissions.

1.2. Summary of Sample by Year

The proposed composite measure uses three years of data, updated annually (i.e., rolling average) in order to increase the signal-to-noise ratio relative to simple annual calculations. This supporting analysis provides one-year and three-year computations to show what is gained in exchange for the loss of 'currentness' resulting from the three-year approach.

Table 6: Count of Heart Failure Index Admissions and 30-Day Readmission Rate, By Year

	All Hospitals			Hospitals With 10+ Index Admissions in 2006		
	Number of Index Admissions	30-Day Readmission Rate	Number of Hospitals	Number of Index Admissions	30-Day Readmission Rate	Number of Hospitals
Year						
2004	98,137	0.219	4,589	85,464	0.219	2,466
2005	94,443	0.221	4,541	83,214	0.221	2,497
2006	85,882	0.220	4,410	77,743	0.221	2,505
2007	71,128	0.221	4,317	63,520	0.221	2,497

Analysis to-date has considered observed-to-expected (O/E) ratios as well as predicted-to-expected (P/E) ratios. Results of both approaches are documented below. The O/E rate for three years is a weighted average of three one year rates, with weights of 0.5 for the most recent year, 0.3 for the prior year and 0.2 for the first year. The P/E rate for three years is computed using the results of the HGLM model estimated for three years. Other approaches will be investigated during the provisional period.

2. Risk Adjustment

2.1. Method

The risk adjustment strategy is one of indirect adjustment, with predicted and expected 30-day post-discharge readmission rates calculated for each hospital using a hierarchical logistic regression model. The statistical model is that of the Hospital 30-Day Heart Failure Readmission Measure Methodology prepared for CMS by the Yale University/Yale-New Haven Hospital Center for Outcomes Research and Evaluation (YNHH-CORE, 2008), with the level 1 demographic and condition covariates from that methodology and each hospital in our data as a level 2 unit. We are using the fixed covariates selected by YNHH-CORE for readmission following a heart failure stay.

2.2. Analysis

YNHH-CORE tested and validated their selected covariates using a generalized linear model (GLM) with a logistic link function. We assessed the application of that model to our data for 2004-6. Results are summarized in Table 2

Table 2: Heart Failure 30-Day Readmission Rate -- GLM Model (covariates only) Performance (2004-6)

Statistic		Value
Actual Rate		0.220
Max. Re-scaled R^2		0.013
Predictive Ability (Lowest Decile, Highest Decile) [1]		0.165 – 0.291
c-statistic		0.563
Residuals Lack of Fit (Pearson Residual Fall %)	<-2 [-2, 0) [0, 2) [2+	- 78.0 15.6 6.4
Model Wald chi-squared (number of covariates)		2,309 (37)
[1] Average actual rate within indicated decile when ranked by estimated probability.		

Table 3 lists the covariates with their incidence among the heart failure index admissions for 2004-6 and results of the GLM logistic estimates using those admissions.

2.2.1. The composite measure is specified to be computed annually, using the most recent three years of data. Analysis was done with both one year of data, and three. Table 4 gives parameter estimates for the fixed covariates in the HGLM model using data for one year, 2006, and table 5 for three years, 2004-6.

Table 3: Heart Failure 30-Day Readmission Rate -- GLM (2004-6) -- Proposed Covariates and Statistics

Effect	Mean, Std. Dev., or Proportion	Estimate	Standard Error	Std. Est.	Odds Ratio Estimate	OR 95% CI
Intercept	.	-1.620	0.018	_	.	
Age-65 (years above 65, continuous)	15.5392	-0.001	0.001	-0.0065	0.999	0.997 - 1.000
Age - Std. Dev.	7.9536	.	.	.	.	
Sex (Male)	0.4329	-0.013	0.005	_	0.974	0.955 - 0.993
History of CABG	0.1727	0.039	0.013	0.0080	1.039	1.013 - 1.066
CC 80 Congestive heart failure	0.3756	-0.011	0.010	-0.0029	0.989	0.970 - 1.008
CC 81, 82 Acute coronary syndrome	0.0476	0.134	0.021	0.0159	1.144	1.098 - 1.191
CC 92, 93 Arrhythmias	0.4886	0.046	0.009	0.0128	1.048	1.028 - 1.067
CC 79 Cardio-respiratory failure and shock	0.0731	0.027	0.019	0.0037	1.028	0.991 - 1.066
CC 86 Valvular and rheumatic heart disease	0.2349	0.059	0.011	0.0138	1.061	1.038 - 1.084
CC 104-106 Vascular or circulatory disease	0.1289	0.106	0.013	0.0196	1.112	1.083 - 1.142
CC 83, 84 Chronic atherosclerosis	0.4920	0.067	0.010	0.0185	1.070	1.049 - 1.091
CC 94 Other and unspecified heart disease	0.0239	-0.062	0.031	-0.0052	0.940	0.884 - 0.999
CC 67-69, 100-102, 177, 178 Hemiplegia, paraplegia, paralysis, functional disability	0.0148	0.088	0.037	0.0059	1.092	1.015 - 1.174
CC 95, 96 Stroke	0.0042	0.005	0.070	0.0002	1.005	0.875 - 1.153
CC 131 Renal failure	0.2445	0.309	0.011	0.0705	1.362	1.333 - 1.392
CC 108 COPD	0.3195	0.206	0.010	0.0530	1.229	1.205 - 1.253
CC 15-20, 119, 120 Diabetes and DM complications	0.3476	0.102	0.010	0.0270	1.108	1.086 - 1.130
CC 22, 23 Disorders of fluid/electrolyte/acid-base	0.1995	0.112	0.012	0.0246	1.119	1.094 - 1.144
CC 136 Other urinary tract disorders	0.1088	0.159	0.014	0.0285	1.173	1.141 - 1.205
CC 148, 149 Decubitus ulcer or chronic skin ulcer	0.0318	0.249	0.025	0.0240	1.283	1.222 - 1.347
CC 36 Other gastrointestinal disorders	0.1363	0.040	0.014	0.0076	1.041	1.013 - 1.069
CC 34 Peptic ulcer, hemorrhage, other specified gastrointestinal disorders	0.0310	0.141	0.026	0.0136	1.152	1.096 - 1.211
CC 44 Severe hematological disorders	0.0111	0.208	0.041	0.0121	1.232	1.136 - 1.336
CC 132 Nephritis	0.0135	0.060	0.037	0.0039	1.061	0.987 - 1.142
CC 49, 50 Dementia and senility	0.0821	-0.004	0.018	-0.0006	0.996	0.962 - 1.031
CC 7 Metastatic cancer and acute leukemia	0.0085	0.062	0.052	0.0030	1.064	0.961 - 1.179
CC 8-12 Cancer	0.0376	0.166	0.024	0.0175	1.181	1.127 - 1.238
CC 25-30 Liver and biliary disease	0.0165	0.154	0.035	0.0108	1.167	1.090 - 1.249
CC 129, 130 End-stage renal disease or dialysis	0.0157	0.234	0.035	0.0157	1.264	1.180 - 1.354
CC 110 Asthma	0.0182	0.088	0.035	0.0065	1.092	1.020 - 1.169
CC 47 Iron deficiency and other/unspecified anemias and blood disease	0.1874	0.079	0.012	0.0171	1.083	1.058 - 1.108
CC 111-113 Pneumonia	0.0997	0.016	0.016	0.0025	1.016	0.985 - 1.048
CC 51-53 Drug/alcohol abuse/dependence/psychosis	0.0382	-0.056	0.025	-0.0059	0.946	0.901 - 0.993
CC 54-56 Major pysch disorders	0.0114	0.135	0.042	0.0079	1.145	1.054 - 1.244
CC 58 Depression	0.0436	0.013	0.023	0.0014	1.013	0.969 - 1.059
CC 60 Other psychiatric disorders	0.0197	0.097	0.033	0.0075	1.102	1.033 - 1.176
CC 109 Fibrosis of lung and other chronic lung disorders	0.0267	0.040	0.028	0.0036	1.041	0.985 - 1.101
CC 21 Protein-calorie malnutrition	0.0182	0.127	0.034	0.0092	1.135	1.062 - 1.212

Table 4: Heart Failure 30-Day Readmission Rate -- HGLM Parameter Estimates, 2006

Effect	Estimate	Standard Error	t Value	Pr > |t|
Intercept	-1.622	0.033	-48.79	<.0001
Sex (Male)	-0.053	0.017	-3.03	0.0025
Age-65 (years above 65, continuous)	-0.002	0.001	-2.10	0.0355
History of CABG	0.095	0.023	4.11	<.0001
CC 80 Congestive heart failure	-0.003	0.018	-0.18	0.8534
CC 81, 82 Acute coronary syndrome	0.143	0.038	3.76	0.0002
CC 92, 93 Arrhythmias	0.046	0.017	2.70	0.0068
CC 79 Cardio-respiratory failure and shock	0.042	0.031	1.35	0.1781
CC 86 Valvular and rheumatic heart disease	0.043	0.020	2.18	0.0295
CC 104-106 Vascular or circulatory disease	0.110	0.024	4.50	<.0001
CC 83, 84 Chronic atherosclerosis	0.046	0.018	2.53	0.0113
CC 94 Other and unspecified heart disease	-0.075	0.058	-1.30	0.1952
CC 67-69, 100-102, 177, 178 Hemiplegia, paraplegia, paralysis, functional disability	0.108	0.071	1.53	0.1259
CC 95, 96 Stroke	0.043	0.125	0.34	0.7306
CC 131 Renal failure	0.354	0.018	19.33	<.0001
CC 108 COPD	0.221	0.018	12.41	<.0001
CC 15-20, 119, 120 Diabetes and DM complications	0.074	0.018	4.04	<.0001
CC 22, 23 Disorders of fluid/electrolyte/acid-base	0.093	0.021	4.52	<.0001
CC 136 Other urinary tract disorders	0.173	0.031	5.61	<.0001
CC 148, 149 Decubitus ulcer or chronic skin ulcer	0.256	0.044	5.81	<.0001
CC 36 Other gastrointestinal disorders	0.043	0.025	1.73	0.0841
CC 34 Peptic ulcer, hemorrhage, other specified gastrointestinal disorders	0.149	0.046	3.23	0.0012
CC 44 Severe hematological disorders	0.190	0.075	2.54	0.0109
CC 132 Nephritis	0.120	0.072	1.67	0.0957
CC 49, 50 Dementia and senility	0.072	0.031	2.31	0.0210
CC 7 Metastatic cancer and acute leukemia	-0.077	0.098	-0.78	0.4351
CC 8-12 Cancer	0.219	0.043	5.12	<.0001
CC 25-30 Liver and biliary disease	0.151	0.063	2.40	0.0165
CC 129, 130 End-stage renal disease or dialysis	0.248	0.058	4.25	<.0001
CC 110 Asthma	0.133	0.062	2.15	0.0313
CC 47 Iron deficiency and other/unspecified anemias and blood disease	0.086	0.021	4.02	<.0001
CC 111-113 Pneumonia	-0.006	0.026	-0.22	0.8255
CC 51-53 Drug/alcohol abuse/dependence/psychosis	-0.011	0.044	-0.24	0.8102
CC 54-56 Major pysch disorders	0.062	0.078	0.80	0.4210
CC 58 Depression	0.001	0.042	0.03	0.9787
CC 60 Other psychiatric disorders	0.063	0.061	1.04	0.3003
CC 109 Fibrosis of lung and other chronic lung disorders	0.065	0.050	1.30	0.1943
CC 21 Protein-calorie malnutrition	0.170	0.058	2.91	0.0036

Table 5: Heart Failure 30-Day Readmission Rate -- HGLM Parameter Estimates, 2004 - 2006

Effect	Estimate	Standard Error	t Value	Pr > |t|
Intercept	-1.617	0.018	-87.85	<.0001
Sex (Male)	-0.022	0.010	-2.30	0.0212
Age-65 (years above 65, continuous)	-0.002	0.001	-2.64	0.0082
History of CABG	0.036	0.013	2.76	0.0057
CC 80 Congestive heart failure	-0.007	0.010	-0.68	0.4986
CC 81, 82 Acute coronary syndrome	0.136	0.021	6.56	<.0001
CC 92, 93 Arrhythmias	0.055	0.010	5.83	<.0001
CC 79 Cardio-respiratory failure and shock	0.033	0.019	1.80	0.0716
CC 86 Valvular and rheumatic heart disease	0.071	0.011	6.39	<.0001
CC 104-106 Vascular or circulatory disease	0.109	0.013	8.05	<.0001
CC 83, 84 Chronic atherosclerosis	0.070	0.010	7.01	<.0001
CC 94 Other and unspecified heart disease	-0.059	0.031	-1.88	0.0598
CC 67-69, 100-102, 177, 178 Hemiplegia, paraplegia, paralysis, functional disability	0.084	0.037	2.25	0.0244
CC 95, 96 Stroke	0.012	0.070	0.17	0.8669
CC 131 Renal failure	0.313	0.011	27.89	<.0001
CC 108 COPD	0.206	0.010	20.59	<.0001
CC 15-20, 119, 120 Diabetes and DM complications	0.101	0.010	9.95	<.0001
CC 22, 23 Disorders of fluid/electrolyte/acid-base	0.115	0.012	9.94	<.0001
CC 136 Other urinary tract disorders	0.165	0.014	11.75	<.0001
CC 148, 149 Decubitus ulcer or chronic skin ulcer	0.248	0.025	10.01	<.0001
CC 36 Other gastrointestinal disorders	0.042	0.014	3.10	0.0020
CC 34 Peptic ulcer, hemorrhage, other specified gastrointestinal disorders	0.141	0.025	5.53	<.0001
CC 44 Severe hematological disorders	0.212	0.041	5.14	<.0001
CC 132 Nephritis	0.064	0.037	1.71	0.0873
CC 49, 50 Dementia and senility	-0.003	0.018	-0.18	0.8566
CC 7 Metastatic cancer and acute leukemia	0.066	0.052	1.27	0.2031
CC 8-12 Cancer	0.166	0.024	6.89	<.0001
CC 25-30 Liver and biliary disease	0.152	0.035	4.38	<.0001
CC 129, 130 End-stage renal disease or dialysis	0.235	0.035	6.68	<.0001
CC 110 Asthma	0.085	0.035	2.45	0.0143
CC 47 Iron deficiency and other/unspecified anemias and blood disease	0.081	0.012	6.81	<.0001
CC 111-113 Pneumonia	0.016	0.016	0.98	0.3281
CC 51-53 Drug/alcohol abuse/dependence/psychosis	-0.052	0.025	-2.09	0.0366
CC 54-56 Major pysch disorders	0.129	0.042	3.05	0.0023
CC 58 Depression	0.016	0.023	0.68	0.4943
CC 60 Other psychiatric disorders	0.100	0.033	3.05	0.0023
CC 109 Fibrosis of lung and other chronic lung disorders	0.043	0.028	1.51	0.1319
CC 21 Protein-calorie malnutrition	0.129	0.034	3.83	0.0001

3. Differences in Performance

The between-hospital variance and intra-class correlation coefficients from both the one- and three-year versions of the HGLM indicate the existence of significant, though small, differences among hospitals in the rate at which their heart failure patients receive at least one readmission within the month following discharge. Table 6 summarizes these statistics for 2006. Results using data from other years were consistent.

Table 6: Heart Failure 30-Day Readmission Rate -- Variation Among Hospitals

Statistic	One-Year (2006)	Three-Year (2004-6)
Between-Hospital Variance (SE)	0.020 (0.006)	0.029 (0.003)
Residual Variance (SE)	0.991	0.991 (0.003)
Intra-Class Correlation	.020	.028

For purposes of analysis, risk standardized rates were computed using (a) observed-to-expected (O/E) rates and (b) predicted-to-expected (P/E) rates, each for one-year and three-year time periods. The O/E rate for three years is a weighted average of three one-year rates, with weights of 0.5 for the most recent year, 0.3 for the prior year and 0.2 for the first year. The P/E rate for three years is computed using the results of the HGLM model estimated for three years. Table 7 summarizes the distribution of the underlying actual, predicted and respective risk-standardized rates computed using each of the time periods. The distribution is of hospital-level rates, for the 2,505 hospitals having 10 or more index admissions in 2006 Table 8 breaks these rates down by hospital heart failure volume (quartile of index admissions in 2006). These data are illustrated by histograms in Appendix B-1.

Table 7: Heart Failure 30-Day Readmission Rate -- Distribution Among Hospitals of Actual and Risk-Standardized Rates, by Estimation Period

	Mean	P5	P25	Median	P75	P95
One-Year						
• **Actual**	0.220	0.077	0.160	0.214	0.273	0.385
• **Risk-Standardized Rate (Using O/E)**	0.221	0.078	0.159	0.214	0.274	0.388
• **Predicted**	0.219	0.196	0.210	0.219	0.229	0.243
• **Risk-Standardized Rate (Using P/E)**	0.220	0.209	0.215	0.220	0.224	0.232
Three-Year						
• **Actual**	0.221	0.120	0.180	0.217	0.257	0.332
• **Risk-Standardized Rate (Using O/E)**	0.221	0.121	0.181	0.217	0.258	0.334
• **Predicted**	0.220	0.193	0.208	0.219	0.231	0.251
• **Risk-Standardized Rate (Using P/E)**	0.220	0.196	0.210	0.219	0.230	0.249

Table 8: Heart Failure 30-Day Readmission Rate -- Distribution of Hospital-Level Actual and Risk-Standardized Rates, By Volume Quartile

		Mean	P5	P25	Median	P75	P95
One-Year Actual	**Vol. Quartile**						
	Q1: 10 - 15	0.216	0.000	0.100	0.200	0.300	0.455
	Q2: 16 - 23	0.221	0.059	0.146	0.211	0.290	0.389
	Q3: 24 - 38	0.224	0.086	0.162	0.219	0.276	0.371
	Q4: 39 - 232	0.219	0.125	0.182	0.218	0.256	0.315
One-Year Risk Standardized Rate (Using O/E)	**Vol. Quartile**						
	Q1: 10 - 15	0.222	0.000	0.109	0.209	0.304	0.455
	Q2: 16 - 23	0.224	0.062	0.146	0.209	0.289	0.404
	Q3: 24 - 38	0.222	0.087	0.163	0.218	0.273	0.362
	Q4: 39 - 232	0.217	0.121	0.181	0.217	0.253	0.310
One-Year Predicted	**Vol. Quartile**						
	Q1: 10 - 15	0.215	0.191	0.205	0.215	0.225	0.243
	Q2: 16 - 23	0.219	0.196	0.208	0.219	0.228	0.243
	Q3: 24 - 38	0.222	0.202	0.214	0.222	0.231	0.245
	Q4: 39 - 232	0.222	0.203	0.213	0.221	0.230	0.242
One-Year Risk-Standardized Rate (Using P/E)	**Vol. Quartile**						
	Q1: 10 - 15	0.220	0.213	0.216	0.220	0.223	0.229
	Q2: 16 - 23	0.220	0.211	0.216	0.219	0.224	0.231
	Q3: 24 - 38	0.220	0.208	0.215	0.220	0.225	0.234
	Q4: 39 - 232	0.220	0.205	0.214	0.220	0.225	0.235
Three-Year Actual	**Vol. Quartile**						
	Q1: 10 - 15	0.220	0.087	0.162	0.213	0.271	0.377
	Q2: 16 - 23	0.222	0.124	0.173	0.220	0.267	0.333
	Q3: 24 - 38	0.222	0.128	0.186	0.217	0.258	0.320
	Q4: 39 - 232	0.220	0.153	0.191	0.218	0.245	0.293
Three-Year Risk-Standardized Rate (Using O/E)	**Vol. Quartile**						
	Q1: 10 - 15	0.223	0.088	0.163	0.216	0.274	0.386
	Q2: 16 - 23	0.224	0.123	0.175	0.220	0.269	0.337
	Q3: 24 - 38	0.221	0.128	0.185	0.217	0.255	0.319
	Q4: 39 - 232	0.218	0.152	0.189	0.217	0.245	0.289
Three-Year Predicted	**Vol. Quartile**						
	Q1: 10 - 15	0.217	0.191	0.207	0.216	0.227	0.245
	Q2: 16 - 23	0.220	0.196	0.208	0.219	0.230	0.247
	Q3: 24 - 38	0.222	0.192	0.209	0.220	0.234	0.253
	Q4: 39 - 232	0.221	0.192	0.207	0.220	0.234	0.254
Three-Year Risk-Standardized Rate (Using P/E)	**Vol. Quartile**						
	Q1: 10 - 15	0.221	0.201	0.212	0.220	0.228	0.246
	Q2: 16 - 23	0.221	0.199	0.211	0.220	0.230	0.245
	Q3: 24 - 38	0.221	0.194	0.209	0.220	0.231	0.249
	Q4: 39 - 232	0.219	0.190	0.205	0.217	0.232	0.253

4. Reliability Testing

Reliability was assessed by correlating the one-year measures for 2007 with both the one-year measures for 2006 and the three-year measures ending with 2006. In each case, both Pearson and Spearman correlations were calculated, the latter being less susceptible to outliers. As an additional assessment, measures were grouped in quintiles and weighted kappa statistics were computed. The results are in Table 9. All values are significant ($p<.001$). Correlation statistics between the three-year average ending in 2007 and the three-year average ending in 2006 are not calculated because the two measures share two years of data in common.

Table 9: Heart Failure 30-Day Readmission Rate -- Reliability When Comparing Across Years

Statistic	One-Year (2006)		Three-Year (2004-6)	
	Obs./Exp. Ratio	Pred./Exp. Ratio	Obs./Exp. Ratio	Pred./Exp. Ratio
Correlation Coefficients				
• **Pearson**	0.104	0.120	0.118	0.166
• **Spearman**	0.100	0.107	0.127	0.147
Kappa Statistic				
• **Weighted Kappa**	0.079	0.070	0.091	0.090
• **95% CI – Lower**	0.051	0.042	0.063	0.063
• **95% CI -- Upper**	0.108	0.098	0.120	0.118

Reference

Yale University/Yale-New Haven Hospital Center for Outcomes Research and Evaluation (YNHH-CORE). “Hospital 30-Day Heart Failure Readmission Measure Methodology”. Prepared for Centers for Medicare & Medicaid Services (CMS), April 23, 2008.

Appendix B-1
Histograms of Hospital 30-Day Heart Failure Readmission Rate Distributions

Figure 1: Distribution of Hospital Actual (unadjusted) 30-Day Heart Failure Readmission Rates (One Year – 2006)

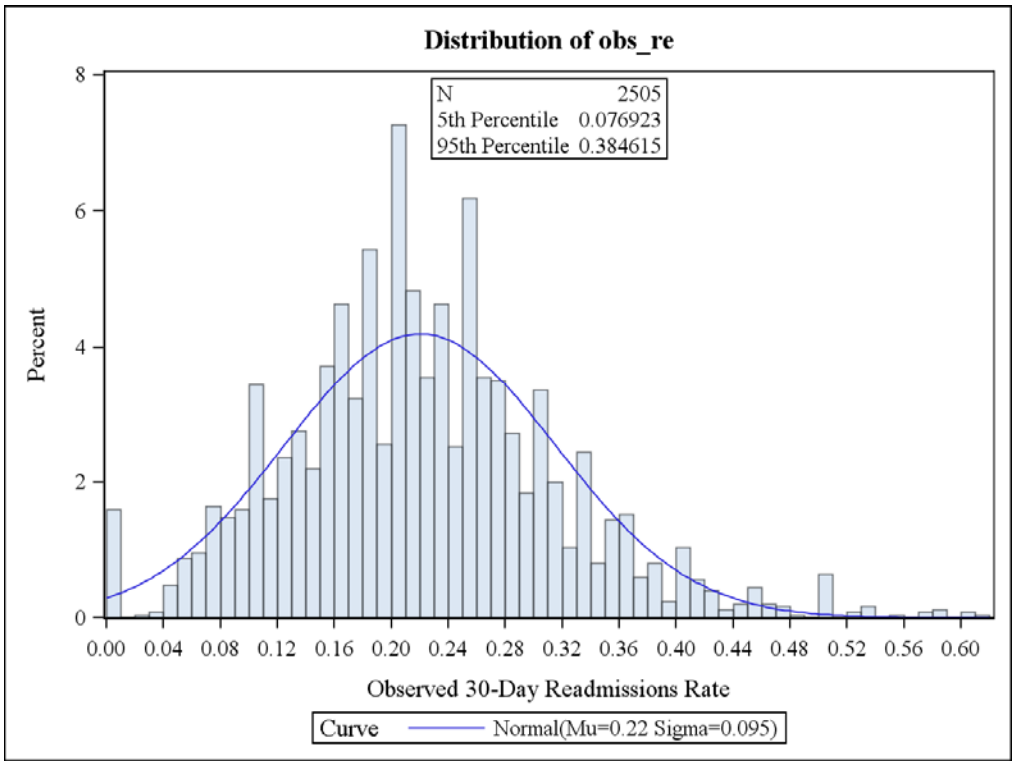


Figure2: Distribution of Hospital Actual (unadjusted) 30-Day Heart Failure Readmission Rates (One Year – 2006) -- By Hospital HF Volume Quartile

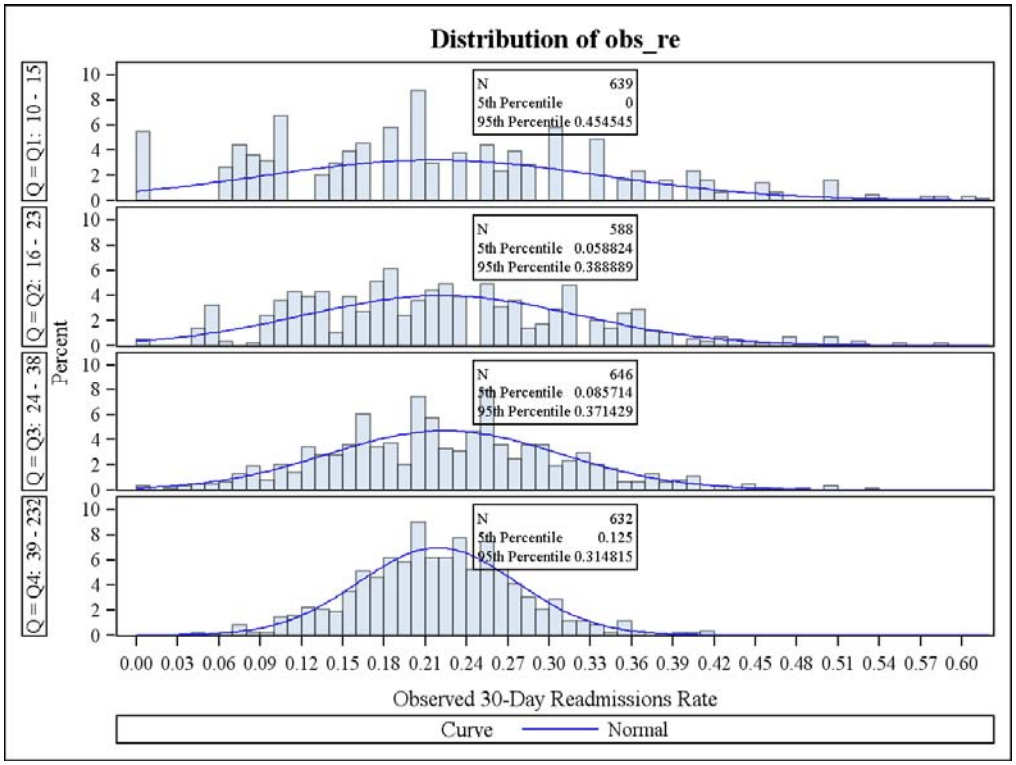


Figure 3: Distribution of Hospital Risk Adjusted 30-Day Heart Failure Readmission Rates (Using P/E Method, One Year – 2006)

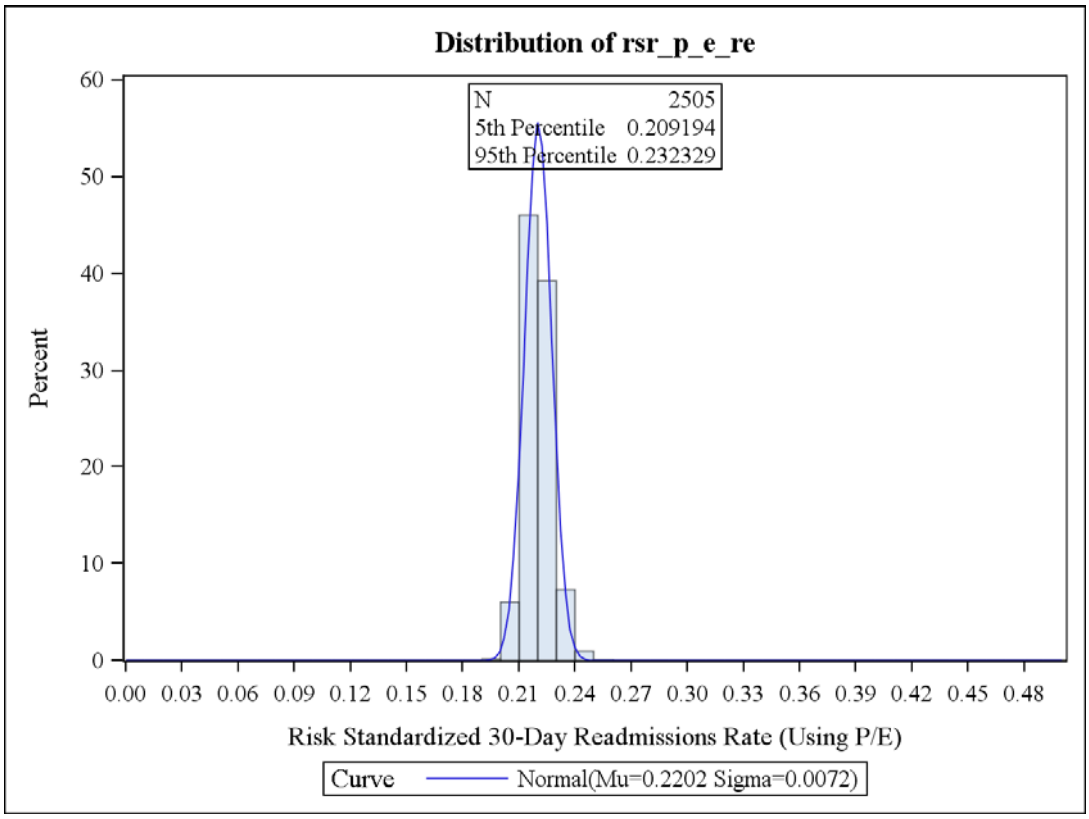


Figure 4: : Distribution of Hospital Risk Adjusted 30-Day Heart Failure Readmission Rates (Using P/E Method, One Year – 2006) -- By Hospital HF Volume Quartile

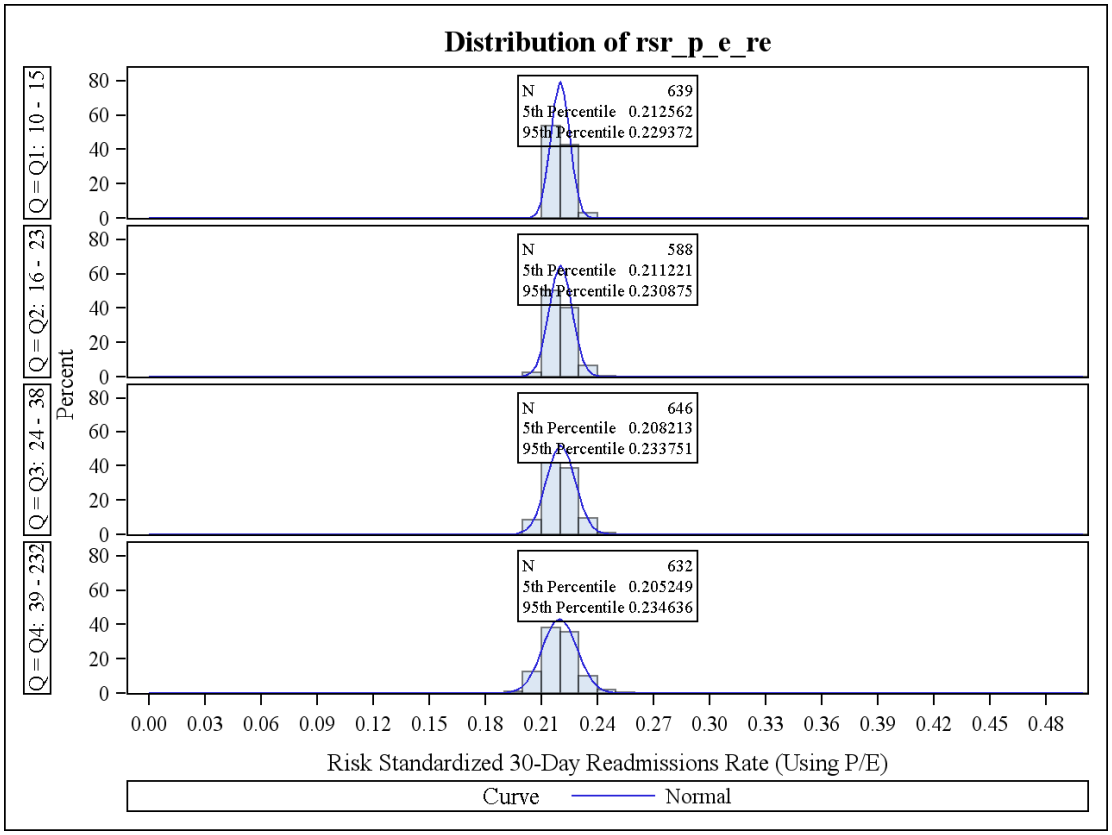


Figure 5: Distribution of Hospital Risk Adjusted 30-Day Heart Failure Readmission Rates (Using O/E Method, Three-Year – 2004-6)

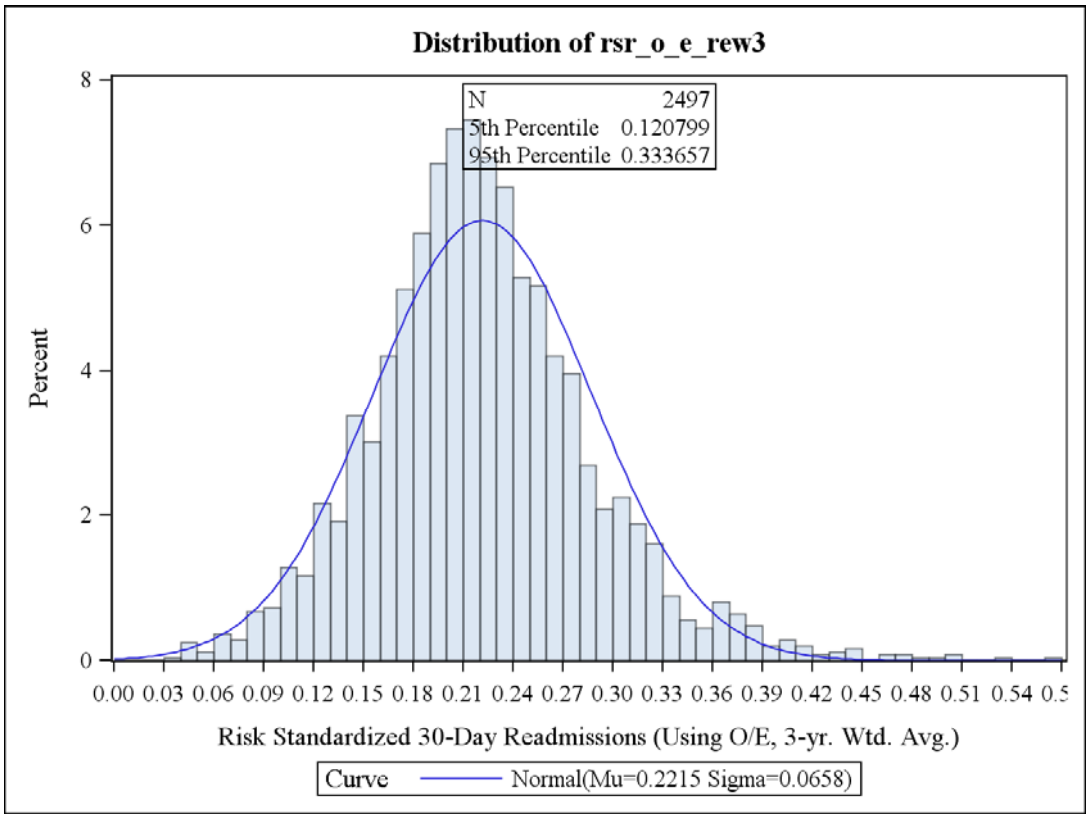


Figure 6: : Distribution of Hospital Risk Adjusted 30-Day Heart Failure Readmission Rates (Using O/E Method, Three-Year – 2004-6) -- By Hospital HF Volume Quartile

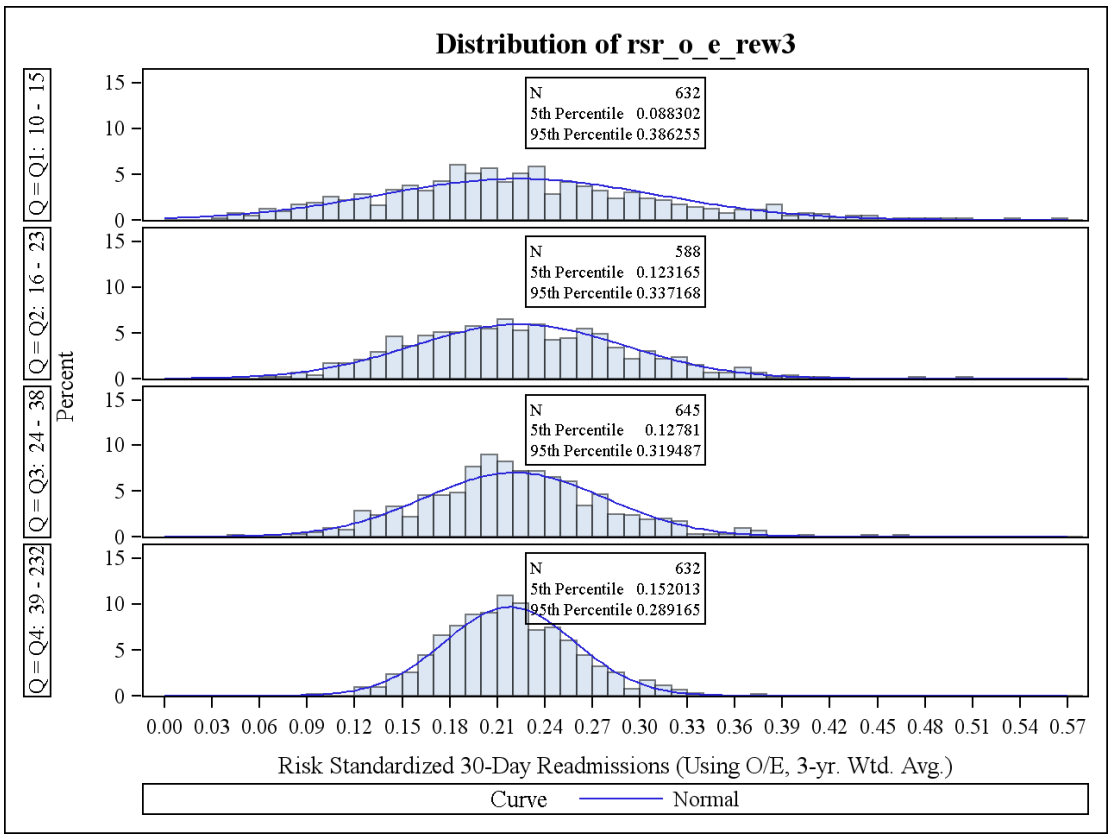


Figure 7: Distribution of Hospital Risk Adjusted 30-Day Heart Failure Readmission Rates (Using P/E Method, Three-Year – 2004-6)

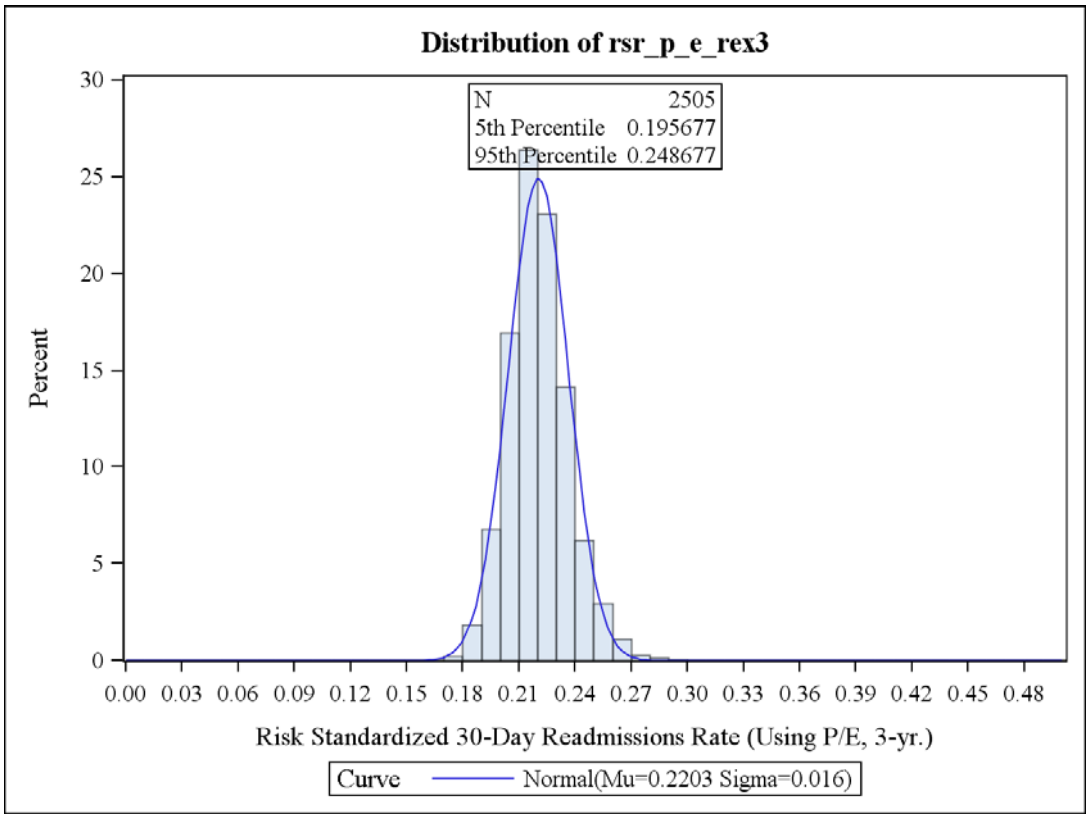
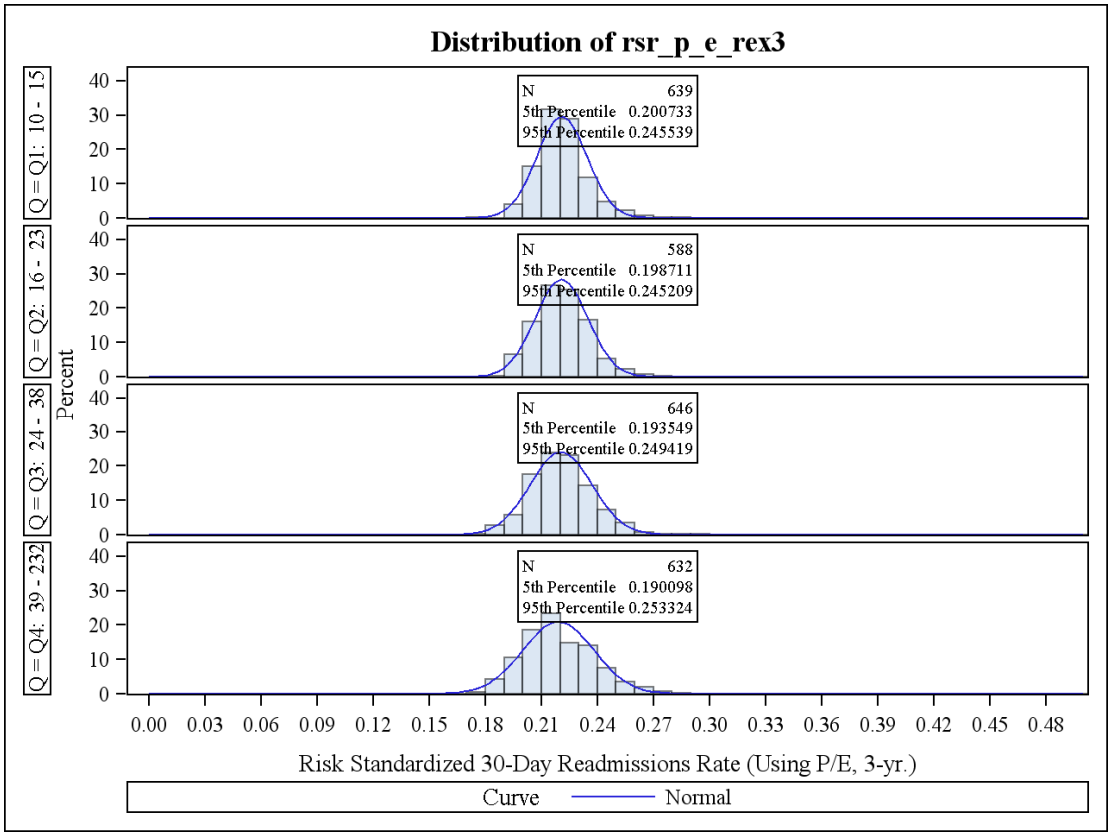


Figure 8: Distribution of Hospital Risk Adjusted 30-Day Heart Failure Readmission Rates (Using P/E Method, Three-Year – 2004-6) -- By Hospital HF Volume Quartile



AMI post-30 OP ED Primary Dx (5-digit)

Year	dgns_cd1	Dx1_Desc	Freq	Pct	Cum Freq	Cum Pct
2004	78650	CHEST PAIN NOS	263	7.15	263	7.15
2004	4280	CHF NOS	189	5.14	452	12.29
2004	78659	CHEST PAIN NEC	150	4.08	602	16.37
2004	4275	CARDIAC ARREST	128	3.48	730	19.85
2004	5990	URIN TRACT INFECTION NOS	88	2.39	818	22.24
2004	7802	SYNCOPE AND COLLAPSE	75	2.04	893	24.28
2004	7847	EPISTAXIS	62	1.69	955	25.97
2004	78609	RESPIRATORY ABNORM NEC	62	1.69	1,017	27.65
2004	7804	DIZZINESS AND GIDDINESS	57	1.55	1,074	29.20
2004	78820	RETENTION URINE NOS	55	1.50	1,129	30.70
2004	78079	MALAISE AND FATIGUE NEC	49	1.33	1,178	32.03
2004	41401	CRNRY ATHRSCL NATVE VSSL	48	1.31	1,226	33.33
2004	7295	PAIN IN LIMB	44	1.20	1,270	34.53
2004	486	PNEUMONIA, ORGANISM NOS	42	1.14	1,312	35.67
2004	4019	HYPERTENSION NOS	42	1.14	1,354	36.81
2004	25080	DMII OTH NT ST UNCNTRLD	41	1.11	1,395	37.93
2004	78652	PAINFUL RESPIRATION	41	1.11	1,436	39.04
2004	4139	ANGINA PECTORIS NEC/NOS	37	1.01	1,473	40.05
2004	2765	HYPOVOLEMIA	36	0.98	1,509	41.03
2004	41400	COR ATH UNSP VSL NTV/GFT	36	0.98	1,545	42.01
2004	42789	CARDIAC DYSRHYTHMIAS NEC	31	0.84	1,576	42.85
2004	78605	SHORTNESS OF BREATH	31	0.84	1,607	43.69
2004	42731	ATRIAL FIBRILLATION	29	0.79	1,636	44.48
2004	78900	ABDMNAL PAIN UNSPCF SITE	29	0.79	1,665	45.27
2004	920	CONTUSION FACE/SCALP/NCK	28	0.76	1,693	46.03
2004	7851	PALPITATIONS	28	0.76	1,721	46.79
2004	78701	NAUSEA WITH VOMITING	28	0.76	1,749	47.55
2004	4111	INTERMED CORONARY SYND	27	0.73	1,776	48.29
2004	49121	OBS CHR BRONC W(AC) EXAC	26	0.71	1,802	48.99
2004	56400	CONSTIPATION NOS	25	0.68	1,827	49.67
2004	5589	NONINF GASTROENTERIT NEC	24	0.65	1,851	50.33

AMI post-30 OP ED Primary Dx (5-digit)

Year	dgns_cd1	Dx1_Desc	Freq	Pct	Cum Freq	Cum Pct
2005	78650	CHEST PAIN NOS	264	7.50	264	7.50
2005	4280	CHF NOS	178	5.06	442	12.56
2005	78659	CHEST PAIN NEC	155	4.40	597	16.96
2005	4275	CARDIAC ARREST	116	3.30	713	20.26
2005	5990	URIN TRACT INFECTION NOS	75	2.13	788	22.39
2005	7847	EPISTAXIS	72	2.05	860	24.43
2005	78609	RESPIRATORY ABNORM NEC	64	1.82	924	26.25
2005	7802	SYNCOPE AND COLLAPSE	63	1.79	987	28.04
2005	25080	DMII OTH NT ST UNCNTRLD	57	1.62	1,044	29.66
2005	7295	PAIN IN LIMB	56	1.59	1,100	31.25
2005	7804	DIZZINESS AND GIDDINESS	54	1.53	1,154	32.78
2005	4139	ANGINA PECTORIS NEC/NOS	49	1.39	1,203	34.18
2005	78079	MALAISE AND FATIGUE NEC	49	1.39	1,252	35.57
2005	78605	SHORTNESS OF BREATH	44	1.25	1,296	36.82
2005	78820	RETENTION URINE NOS	41	1.16	1,337	37.98
2005	41401	CRNRY ATHRSCL NATVE VSSL	39	1.11	1,376	39.09
2005	486	PNEUMONIA, ORGANISM NOS	38	1.08	1,414	40.17
2005	56400	CONSTIPATION NOS	38	1.08	1,452	41.25
2005	41400	COR ATH UNSP VSL NTV/GFT	37	1.05	1,489	42.30
2005	78652	PAINFUL RESPIRATION	35	0.99	1,524	43.30
2005	4019	HYPERTENSION NOS	34	0.97	1,558	44.26
2005	4111	INTERMED CORONARY SYND	34	0.97	1,592	45.23
2005	42731	ATRIAL FIBRILLATION	31	0.88	1,623	46.11
2005	42789	CARDIAC DYSRHYTHMIAS NEC	31	0.88	1,654	46.99
2005	2765	HYPOVOLEMIA	28	0.80	1,682	47.78
2005	78900	ABDMNAL PAIN UNSPCF SITE	25	0.71	1,707	48.49
2005	4359	TRANS CEREB ISCHEMIA NOS	24	0.68	1,731	49.18
2005	4589	HYPOTENSION NOS	24	0.68	1,755	49.86
2005	5997	HEMATURIA	24	0.68	1,779	50.54

AMI post-30 OP ED Primary Dx (5-digit)

Year	dgns_cd1	Dx1_Desc	Freq	Pct	Cum Freq	Cum Pct
2006	78650	CHEST PAIN NOS	229	7.38	229	7.38
2006	78659	CHEST PAIN NEC	156	5.03	385	12.40
2006	4280	CHF NOS	138	4.45	523	16.85
2006	4275	CARDIAC ARREST	100	3.22	623	20.07
2006	7847	EPISTAXIS	72	2.32	695	22.39
2006	5990	URIN TRACT INFECTION NOS	67	2.16	762	24.55
2006	7802	SYNCOPE AND COLLAPSE	66	2.13	828	26.68
2006	78079	MALAISE AND FATIGUE NEC	65	2.09	893	28.77
2006	78609	RESPIRATORY ABNORM NEC	50	1.61	943	30.38
2006	4139	ANGINA PECTORIS NEC/NOS	42	1.35	985	31.73
2006	78820	RETENTION URINE NOS	42	1.35	1,027	33.09
2006	25080	DMII OTH NT ST UNCNTRLD	39	1.26	1,066	34.34
2006	56400	CONSTIPATION NOS	39	1.26	1,105	35.60
2006	78605	SHORTNESS OF BREATH	38	1.22	1,143	36.82
2006	4019	HYPERTENSION NOS	37	1.19	1,180	38.02
2006	41401	CRNRY ATHRSCL NATVE VSSL	37	1.19	1,217	39.21
2006	7804	DIZZINESS AND GIDDINESS	33	1.06	1,250	40.27
2006	78652	PAINFUL RESPIRATION	33	1.06	1,283	41.33
2006	7295	PAIN IN LIMB	31	1.00	1,314	42.33
2006	27651	DEHYDRATION	31	1.00	1,345	43.33
2006	78900	ABDMNAL PAIN UNSPCF SITE	29	0.93	1,374	44.27
2006	99812	HEMATOMA COMPLIC PROC	28	0.90	1,402	45.17
2006	7851	PALPITATIONS	27	0.87	1,429	46.04
2006	42731	ATRIAL FIBRILLATION	27	0.87	1,456	46.91
2006	486	PNEUMONIA, ORGANISM NOS	24	0.77	1,480	47.68
2006	7823	EDEMA	24	0.77	1,504	48.45
2006	5997	HEMATURIA	22	0.71	1,526	49.16
2006	4111	INTERMED CORONARY SYND	21	0.68	1,547	49.84
2006	5589	NONINF GASTROENTERIT NEC	21	0.68	1,568	50.52

AMI post-30 OP ED Primary Dx (5-digit)

Year	dgns_cd1	Dx1_Desc	Freq	Pct	Cum Freq	Cum Pct
2007	78650	CHEST PAIN NOS	218	7.59	218	7.59
2007	78659	CHEST PAIN NEC	138	4.81	356	12.40
2007	4280	CHF NOS	122	4.25	478	16.64
2007	4275	CARDIAC ARREST	89	3.10	567	19.74
2007	5990	URIN TRACT INFECTION NOS	65	2.26	632	22.01
2007	7847	EPISTAXIS	63	2.19	695	24.20
2007	78079	MALAISE AND FATIGUE NEC	60	2.09	755	26.29
2007	7802	SYNCOPE AND COLLAPSE	59	2.05	814	28.34
2007	78609	RESPIRATORY ABNORM NEC	53	1.85	867	30.19
2007	25080	DMII OTH NT ST UNCNTRLD	49	1.71	916	31.89
2007	4019	HYPERTENSION NOS	44	1.53	960	33.43
2007	7804	DIZZINESS AND GIDDINESS	41	1.43	1,001	34.85
2007	41401	CRNRY ATHRSCL NATVE VSSL	37	1.29	1,038	36.14
2007	78820	RETENTION URINE NOS	37	1.29	1,075	37.43
2007	7295	PAIN IN LIMB	35	1.22	1,110	38.65
2007	78605	SHORTNESS OF BREATH	31	1.08	1,141	39.73
2007	78652	PAINFUL RESPIRATION	31	1.08	1,172	40.81
2007	4589	HYPOTENSION NOS	30	1.04	1,202	41.85
2007	4139	ANGINA PECTORIS NEC/NOS	28	0.97	1,230	42.83
2007	56400	CONSTIPATION NOS	27	0.94	1,257	43.77
2007	42731	ATRIAL FIBRILLATION	26	0.91	1,283	44.67
2007	49121	OBS CHR BRONC W(AC) EXAC	26	0.91	1,309	45.58
2007	486	PNEUMONIA, ORGANISM NOS	25	0.87	1,334	46.45
2007	5997	HEMATURIA	24	0.84	1,358	47.28
2007	7851	PALPITATIONS	22	0.77	1,380	48.05
2007	920	CONTUSION FACE/SCALP/NCK	21	0.73	1,401	48.78
2007	41400	COR ATH UNSP VSL NTV/GFT	21	0.73	1,422	49.51
2007	78900	ABDMNAL PAIN UNSPCF SITE	21	0.73	1,443	50.24

HF post-30 OP ED Primary Dx (5-digit)

Year	dgns_cd1	Dx1_Desc	Freq	Pct	Cum Freq	Cum Pct
2004	4280	CHF NOS	978	12.67	978	12.67
2004	78650	CHEST PAIN NOS	225	2.91	1,203	15.58
2004	78609	RESPIRATORY ABNORM NEC	216	2.80	1,419	18.38
2004	4275	CARDIAC ARREST	204	2.64	1,623	21.03
2004	5990	URIN TRACT INFECTION NOS	173	2.24	1,796	23.27
2004	78079	MALAISE AND FATIGUE NEC	148	1.92	1,944	25.18
2004	78605	SHORTNESS OF BREATH	148	1.92	2,092	27.10
2004	7847	EPISTAXIS	147	1.90	2,239	29.01
2004	78659	CHEST PAIN NEC	141	1.83	2,380	30.83
2004	7802	SYNCOPE AND COLLAPSE	133	1.72	2,513	32.56
2004	49121	OBS CHR BRONC W(AC) EXAC	129	1.67	2,642	34.23
2004	25080	DMII OTH NT ST UNCNTRLD	104	1.35	2,746	35.57
2004	2765	HYPOVOLEMIA	102	1.32	2,848	36.90
2004	78820	RETENTION URINE NOS	95	1.23	2,943	38.13
2004	56400	CONSTIPATION NOS	94	1.22	3,037	39.34
2004	42731	ATRIAL FIBRILLATION	92	1.19	3,129	40.54
2004	7804	DIZZINESS AND GIDDINESS	90	1.17	3,219	41.70
2004	920	CONTUSION FACE/SCALP/NCK	87	1.13	3,306	42.83
2004	78900	ABDMNAL PAIN UNSPCF SITE	80	1.04	3,386	43.87
2004	486	PNEUMONIA, ORGANISM NOS	67	0.87	3,453	44.73
2004	7823	EDEMA	67	0.87	3,520	45.60
2004	4019	HYPERTENSION NOS	60	0.78	3,580	46.38
2004	78652	PAINFUL RESPIRATION	56	0.73	3,636	47.10
2004	5997	HEMATURIA	53	0.69	3,689	47.79
2004	496	CHR AIRWAY OBSTRUCT NEC	52	0.67	3,741	48.46
2004	7295	PAIN IN LIMB	51	0.66	3,792	49.13
2004	7242	LUMBAGO	46	0.60	3,838	49.72
2004	4589	HYPOTENSION NOS	45	0.58	3,883	50.30

HF post-30 OP ED Primary Dx (5-digit)

Year	dgns_cd1	Dx1_Desc	Freq	Pct	Cum Freq	Cum Pct
2005	4280	CHF NOS	868	11.15	868	11.15
2005	78650	CHEST PAIN NOS	244	3.13	1,112	14.29
2005	78609	RESPIRATORY ABNORM NEC	209	2.68	1,321	16.97
2005	4275	CARDIAC ARREST	207	2.66	1,528	19.63
2005	5990	URIN TRACT INFECTION NOS	199	2.56	1,727	22.19
2005	7847	EPISTAXIS	161	2.07	1,888	24.25
2005	78605	SHORTNESS OF BREATH	156	2.00	2,044	26.26
2005	78079	MALAISE AND FATIGUE NEC	149	1.91	2,193	28.17
2005	25080	DMII OTH NT ST UNCNTRLD	139	1.79	2,332	29.96
2005	7802	SYNCOPE AND COLLAPSE	133	1.71	2,465	31.67
2005	49121	OBS CHR BRONC W(AC) EXAC	126	1.62	2,591	33.29
2005	78659	CHEST PAIN NEC	126	1.62	2,717	34.90
2005	56400	CONSTIPATION NOS	101	1.30	2,818	36.20
2005	2765	HYPOVOLEMIA	92	1.18	2,910	37.38
2005	920	CONTUSION FACE/SCALP/NCK	91	1.17	3,001	38.55
2005	42731	ATRIAL FIBRILLATION	91	1.17	3,092	39.72
2005	78820	RETENTION URINE NOS	91	1.17	3,183	40.89
2005	486	PNEUMONIA, ORGANISM NOS	89	1.14	3,272	42.03
2005	7804	DIZZINESS AND GIDDINESS	88	1.13	3,360	43.17
2005	78900	ABDMNAL PAIN UNSPCF SITE	82	1.05	3,442	44.22
2005	4019	HYPERTENSION NOS	79	1.01	3,521	45.23
2005	4589	HYPOTENSION NOS	70	0.90	3,591	46.13
2005	7295	PAIN IN LIMB	65	0.84	3,656	46.97
2005	7823	EDEMA	63	0.81	3,719	47.78
2005	496	CHR AIRWAY OBSTRUCT NEC	61	0.78	3,780	48.56
2005	4660	ACUTE BRONCHITIS	59	0.76	3,839	49.32
2005	8730	OPEN WOUND OF SCALP	56	0.72	3,895	50.04

HF post-30 OP ED Primary Dx (5-digit)

Year	dgns_cd1	Dx1_Desc	Freq	Pct	Cum Freq	Cum Pct
2006	4280	CHF NOS	834	11.93	834	11.93
2006	78650	CHEST PAIN NOS	224	3.20	1,058	15.14
2006	4275	CARDIAC ARREST	211	3.02	1,269	18.15
2006	78609	RESPIRATORY ABNORM NEC	208	2.98	1,477	21.13
2006	5990	URIN TRACT INFECTION NOS	187	2.68	1,664	23.81
2006	25080	DMII OTH NT ST UNCNTRLD	144	2.06	1,808	25.87
2006	7847	EPISTAXIS	140	2.00	1,948	27.87
2006	7802	SYNCOPE AND COLLAPSE	131	1.87	2,079	29.74
2006	78079	MALAISE AND FATIGUE NEC	127	1.82	2,206	31.56
2006	78605	SHORTNESS OF BREATH	113	1.62	2,319	33.18
2006	78659	CHEST PAIN NEC	111	1.59	2,430	34.76
2006	78820	RETENTION URINE NOS	96	1.37	2,526	36.14
2006	49121	OBS CHR BRONC W(AC) EXAC	93	1.33	2,619	37.47
2006	27651	DEHYDRATION	88	1.26	2,707	38.73
2006	56400	CONSTIPATION NOS	81	1.16	2,788	39.89
2006	7804	DIZZINESS AND GIDDINESS	80	1.14	2,868	41.03
2006	920	CONTUSION FACE/SCALP/NCK	76	1.09	2,944	42.12
2006	78900	ABDMNAL PAIN UNSPCF SITE	74	1.06	3,018	43.18
2006	42731	ATRIAL FIBRILLATION	69	0.99	3,087	44.16
2006	7823	EDEMA	68	0.97	3,155	45.14
2006	486	PNEUMONIA, ORGANISM NOS	67	0.96	3,222	46.09
2006	4019	HYPERTENSION NOS	57	0.82	3,279	46.91
2006	7295	PAIN IN LIMB	56	0.80	3,335	47.71
2006	5589	NONINF GASTROENTERIT NEC	51	0.73	3,386	48.44
2006	95901	HEAD INJURY NOS	48	0.69	3,434	49.13
2006	496	CHR AIRWAY OBSTRUCT NEC	47	0.67	3,481	49.80
2006	4589	HYPOTENSION NOS	46	0.66	3,527	50.46

HF post-30 OP ED Primary Dx (5-digit)

Year	dgns_cd1	Dx1_Desc	Freq	Pct	Cum Freq	Cum Pct
2007	4280	CHF NOS	675	11.22	675	11.22
2007	78650	CHEST PAIN NOS	183	3.04	858	14.26
2007	78609	RESPIRATORY ABNORM NEC	173	2.88	1,031	17.14
2007	5990	URIN TRACT INFECTION NOS	165	2.74	1,196	19.88
2007	4275	CARDIAC ARREST	153	2.54	1,349	22.43
2007	25080	DMII OTH NT ST UNCNTRLD	125	2.08	1,474	24.51
2007	7847	EPISTAXIS	121	2.01	1,595	26.52
2007	78605	SHORTNESS OF BREATH	111	1.85	1,706	28.36
2007	78079	MALAISE AND FATIGUE NEC	109	1.81	1,815	30.17
2007	78659	CHEST PAIN NEC	94	1.56	1,909	31.74
2007	7802	SYNCOPE AND COLLAPSE	80	1.33	1,989	33.07
2007	42731	ATRIAL FIBRILLATION	80	1.33	2,069	34.40
2007	49121	OBS CHR BRONC W(AC) EXAC	79	1.31	2,148	35.71
2007	27651	DEHYDRATION	78	1.30	2,226	37.01
2007	920	CONTUSION FACE/SCALP/NCK	75	1.25	2,301	38.25
2007	78820	RETENTION URINE NOS	74	1.23	2,375	39.48
2007	7804	DIZZINESS AND GIDDINESS	69	1.15	2,444	40.63
2007	78900	ABDMNAL PAIN UNSPCF SITE	68	1.13	2,512	41.76
2007	56400	CONSTIPATION NOS	66	1.10	2,578	42.86
2007	486	PNEUMONIA, ORGANISM NOS	62	1.03	2,640	43.89
2007	7823	EDEMA	58	0.96	2,698	44.85
2007	7295	PAIN IN LIMB	55	0.91	2,753	45.77
2007	4019	HYPERTENSION NOS	53	0.88	2,806	46.65
2007	95901	HEAD INJURY NOS	52	0.86	2,858	47.51
2007	496	CHR AIRWAY OBSTRUCT NEC	43	0.71	2,901	48.23
2007	4589	HYPOTENSION NOS	43	0.71	2,944	48.94
2007	78097	ALTERED MENTAL STATUS	43	0.71	2,987	49.66
2007	78652	PAINFUL RESPIRATION	40	0.67	3,027	50.32

Selected providers having 2006 AMI Index Admissions with a post-30 OP ED Visit

Year=2006 Provider A

dgns_cd1	Dx1_Description	Freq	Pct	Cum Freq	Cum Pct
2141	LIPOMA SKIN NEC	1	7.69	1	7.69
4139	ANGINA PECTORIS NEC/NOS	1	7.69	2	15.38
41401	CRNRY ATHRSCL NATVE VSSL	1	7.69	3	23.08
4280	CHF NOS	1	7.69	4	30.77
4619	ACUTE SINUSITIS NOS	1	7.69	5	38.46
490	BRONCHITIS NOS	1	7.69	6	46.15
7840	HEADACHE	1	7.69	7	53.85
78650	CHEST PAIN NOS	1	7.69	8	61.54
78900	ABDMNAL PAIN UNSPCF SITE	1	7.69	9	69.23
78902	ABDMNAL PAIN LFT UP QUAD	1	7.69	10	76.92
99674	COMP-OTH VASC DEV/GRAFT	1	7.69	11	84.62
99811	HEMORRHAGE COMPLIC PROC	1	7.69	12	92.31
V583	ATTEN-SURG DRESSNG/SUTUR	1	7.69	13	100

Year=2006 Provider B

dgns_cd1	Dx1_Description	Freq	Pct	Cum Freq	Cum Pct
78650	CHEST PAIN NOS	3	25	3	25
4280	CHF NOS	2	16.67	5	41.67
4239	PERICARDIAL DISEASE NOS	1	8.33	6	50
4589	HYPOTENSION NOS	1	8.33	7	58.33
53081	ESOPHAGEAL REFLUX	1	8.33	8	66.67
6823	CELLULITIS OF ARM	1	8.33	9	75
78609	RESPIRATORY ABNORM NEC	1	8.33	10	83.33
78652	PAINFUL RESPIRATION	1	8.33	11	91.67
78659	CHEST PAIN NEC	1	8.33	12	100

Year=2006 Provider C

dgns_cd1	Dx1_Description	Freq	Pct	Cum Freq	Cum Pct
41401	CRNRY ATHRSCL NATVE VSSL	2	16.67	2	16.67
78650	CHEST PAIN NOS	2	16.67	4	33.33
78659	CHEST PAIN NEC	2	16.67	6	50
3698	VISUAL LOSS, ONE EYE NOS	1	8.33	7	58.33
41091	AMI NOS, INITIAL	1	8.33	8	66.67
4280	CHF NOS	1	8.33	9	75
4359	TRANS CEREB ISCHEMIA NOS	1	8.33	10	83.33
5119	PLEURAL EFFUSION NOS	1	8.33	11	91.67
7820	SKIN SENSATION DISTURB	1	8.33	12	100

Selected providers having 2006 HF Index Admissions with a post-30 OP ED Visit

Year=2006 Provider D

dgns_cd1	Dx1_Description	Freq	Pct	Cum Freq	Cum Pct
4280	CHF NOS	3	17.65	3	17.65
4275	CARDIAC ARREST	2	11.76	5	29.41
78609	RESPIRATORY ABNORM NEC	2	11.76	7	41.18
486	PNEUMONIA, ORGANISM NOS	1	5.88	8	47.06
5990	URIN TRACT INFECTION NOS	1	5.88	9	52.94
7802	SYNCOPE AND COLLAPSE	1	5.88	10	58.82
7804	DIZZINESS AND GIDDINESS	1	5.88	11	64.71
7821	NONSPECIF SKIN ERUPT NEC	1	5.88	12	70.59
87342	OPEN WOUND OF FOREHEAD	1	5.88	13	76.47
920	CONTUSION FACE/SCALP/NCK	1	5.88	14	82.35
92231	BACK CONTUSION	1	5.88	15	88.24
9248	MULTIPLE CONTUSIONS NEC	1	5.88	16	94.12
9778	POISON-MEDICINAL AGT NEC	1	5.88	17	100

Year=2006 Provider E

dgns_cd1	Dx1_Description	Frequency	Percent	Cum Freq	Cum Pct
4280	CHF NOS	3	20	3	20
4241	AORTIC VALVE DISORDER	1	6.67	4	26.67
4254	PRIM CARDIOMYOPATHY NEC	1	6.67	5	33.33
4580	ORTHOSTATIC HYPOTENSION	1	6.67	6	40
4659	ACUTE URI NOS	1	6.67	7	46.67
5990	URIN TRACT INFECTION NOS	1	6.67	8	53.33
71941	JOINT PAIN-SHLDER	1	6.67	9	60
78099	OTHER GENERAL SYMPTOMS	1	6.67	10	66.67
78609	RESPIRATORY ABNORM NEC	1	6.67	11	73.33
78650	CHEST PAIN NOS	1	6.67	12	80
78652	PAINFUL RESPIRATION	1	6.67	13	86.67
99672	COMP-OTH CARDIAC DEVICE	1	6.67	14	93.33
V5881	FIT/ADJ VASCULAR CATHETR	1	6.67	15	100

Year=2006 Provider F

dgns_cd1	Dx1_Description	Freq	Pct	Cum Freq	Cum Pct
25080	DMII OTH NT ST UNCNTRLD	2	14.29	2	14.29
4280	CHF NOS	2	14.29	4	28.57
49121	OBS CHR BRONC W(AC) EXAC	2	14.29	6	42.86
25000	DMII WO CMP NT ST UNCNTR	1	7.14	7	50
5990	URIN TRACT INFECTION NOS	1	7.14	8	57.14
78820	RETENTION URINE NOS	1	7.14	9	64.29
81221	FX HUMERUS SHAFT-CLOSED	1	7.14	10	71.43
8470	SPRAIN OF NECK	1	7.14	11	78.57
9221	CONTUSION OF CHEST WALL	1	7.14	12	85.71
95901	HEAD INJURY NOS	1	7.14	13	92.86
99673	COMP-REN DIALYS DEV/GRFT	1	7.14	14	100

Mean AMI and HF Hospital Measure Scores by Race Quartile													
	Mean Readmission			Mean ED			Mean E&M			Mean Composite		
Race Quartile	**White**	**Black**	**Other***	**White**	**Black**	**Other**	**White**	**Black**	**Other**	**White**	**Black**	**Other**
AMI												
First	0.21	0.20	0.20	0.08	0.09	0.08	0.82	0.81	0.80	0.00	0.00	-0.02
Second	0.20	0.20	0.20	0.08	0.08	0.08	0.82	0.82	0.82	0.01	0.01	0.00
Third	0.20	0.21	0.20	0.08	0.08	0.08	0.82	0.82	0.82	0.00	0.01	0.01
Fourth	0.20	0.21	0.21	0.09	0.08	0.08	0.81	0.81	0.83	0.00	-0.01	0.01
HF												
First	0.22	0.22	0.22	0.08	0.08	0.08	0.80	0.81	0.80	-0.02	0.01	-0.02
Second	0.22	0.22	0.22	0.08	0.08	0.08	0.82	0.82	0.81	0.00	0.01	0.01
Third	0.22	0.22	0.22	0.08	0.08	0.08	0.82	0.82	0.82	0.02	0.01	0.01
Fourth	0.22	0.22	0.22	0.08	0.08	0.08	0.81	0.80	0.82	0.01	-0.02	0.01
* Other = 1 - (White + Black)												
Race Quartile is the ranking of hospitals for each measure by the cross-tab, the first is the lowest quartile and fourth is the highest. The reported rate is the mean within quartile for each race.												

Composite Scores, With Component Scores
Heart Failure
Representative Sample of Hospitals

	Risk Standardized Rates			Contribution to Composite Score			
Composite Score	Readmissions (Pop. Mean: 0.220)	ED Visits (Pop. Mean: 0.081)	E&M Services (Pop. Mean: 0.765)	Readmissions	ED Visits	E&M Services	Number of Index Admissions
0.199	0.190	0.051	0.782	0.120	0.061	0.017	189
0.164	0.206	0.070	0.851	0.056	0.022	0.086	92
0.145	0.201	0.063	0.799	0.075	0.036	0.034	87
0.131	0.205	0.071	0.814	0.060	0.021	0.050	48
0.119	0.214	0.067	0.829	0.026	0.029	0.064	149
0.111	0.217	0.062	0.825	0.012	0.039	0.060	124
0.103	0.208	0.053	0.764	0.049	0.056	-0.001	137
0.096	0.193	0.078	0.744	0.110	0.006	-0.020	168
0.087	0.201	0.070	0.755	0.076	0.021	-0.010	34
0.081	0.207	0.087	0.805	0.052	-0.011	0.041	38
0.075	0.220	0.066	0.810	0.000	0.029	0.046	60
0.069	0.208	0.093	0.811	0.047	-0.024	0.046	136
0.063	0.209	0.068	0.760	0.043	0.025	-0.005	112
0.058	0.218	0.068	0.786	0.009	0.027	0.021	71
0.052	0.208	0.083	0.772	0.048	-0.004	0.008	57
0.047	0.212	0.071	0.758	0.034	0.020	-0.007	130
0.042	0.219	0.072	0.784	0.004	0.019	0.019	84
0.038	0.201	0.084	0.734	0.075	-0.006	-0.031	54
0.033	0.203	0.080	0.727	0.067	0.003	-0.038	51
0.028	0.209	0.072	0.731	0.044	0.018	-0.034	213
0.025	0.212	0.084	0.762	0.032	-0.005	-0.003	151
0.021	0.216	0.091	0.789	0.016	-0.019	0.024	83
0.017	0.217	0.086	0.780	0.012	-0.010	0.015	39
0.013	0.215	0.085	0.766	0.018	-0.007	0.001	42
0.009	0.234	0.064	0.795	-0.056	0.034	0.031	36
0.004	0.218	0.092	0.783	0.008	-0.021	0.018	72
0.001	0.218	0.077	0.751	0.007	0.007	-0.014	44
-0.004	0.227	0.062	0.749	-0.026	0.038	-0.016	201
-0.009	0.208	0.108	0.761	0.049	-0.054	-0.003	28
-0.012	0.230	0.072	0.774	-0.040	0.019	0.009	73
-0.018	0.226	0.081	0.770	-0.023	-0.000	0.006	47
-0.022	0.214	0.087	0.730	0.025	-0.012	-0.035	47
-0.027	0.214	0.092	0.735	0.025	-0.022	-0.030	277
-0.033	0.213	0.106	0.753	0.029	-0.051	-0.011	84
-0.038	0.227	0.070	0.731	-0.027	0.023	-0.034	108
-0.043	0.239	0.052	0.742	-0.077	0.058	-0.023	217
-0.048	0.217	0.079	0.699	0.014	0.004	-0.066	102
-0.054	0.219	0.084	0.711	0.005	-0.006	-0.053	42
-0.060	0.237	0.077	0.763	-0.066	0.008	-0.002	132
-0.068	0.231	0.069	0.716	-0.044	0.025	-0.049	109
-0.075	0.219	0.092	0.705	0.006	-0.022	-0.059	72
-0.082	0.237	0.074	0.733	-0.066	0.015	-0.031	80
-0.090	0.238	0.085	0.752	-0.070	-0.008	-0.012	29
-0.099	0.260	0.049	0.758	-0.158	0.065	-0.006	204
-0.110	0.246	0.070	0.734	-0.102	0.022	-0.031	51
-0.121	0.235	0.085	0.713	-0.062	-0.008	-0.052	112
-0.136	0.240	0.068	0.683	-0.080	0.026	-0.081	243
-0.151	0.232	0.106	0.712	-0.048	-0.051	-0.053	94
-0.182	0.254	0.098	0.750	-0.134	-0.034	-0.015	139
-0.236	0.267	0.085	0.723	-0.187	-0.007	-0.042	54

COLOR KEY
Green: Score in best (dark) or second best (light) quintiles
Red: Sscore in worst (dark) or second worst (light) quintiles

To create the sample, hospitals were first ranked by composite score. Starting with the highest score, the 25th hospital and every 50th hospital after that were selected.

Changes in Rates Sufficient to Move Hospitals to Neighboring Quintile Categories

Supplemental Analysis for NQF Review of Care Transitions Composite Measure

2/23/2010

A question arising from the previous table is how much each hospital's performance on its measures would have to change for the hospital to move to some neighboring quintile category. In order to provide an answer to this question, we selected five hospitals with combination scores in the middle of each of the quintile examples (denoting them as hospitals A, B, C, D, and E) and calculated how much each of their measures would have to alter to move the hospital to another quintile (obviously, hospital A in the top quintile could not move up and hospital E in the bottom quintile could not move down, but otherwise the hospitals could move either up or down, if their performance on a measure or group of measures changed sufficiently).

Table 1 gives the individual measures for the five hospitals selected for illustration.

Table 1: Rates and Quintile Category for Example Hospitals

Hospital	Readmission rate (μ=22.0%)	ED rate (μ=8.1%)	E&M rate (μ=76.5%)	Quintile Category
A	21.4%	6.7%	82.9%	5 star
B	20.8%	8.3%	77.2%	4 star
C	23.4%	6.4%	79.5%	3 star
D	22.7%	7.0%	73.1%	2 star
E	24.6%	7.0%	73.4%	1 star

We should note that the quintile categories of these example hospitals do not align with any individual measure, including the readmission rate which has the highest weight and makes the largest individual contribution. Each hospital's combined overall score and resulting quintile category is a function of all individual measures and not overly dependent on any single one. Even the E&M measure, which has a weight only ¼ as large as the readmission rate makes an important contribution to the overall score, no doubt due to its large variation.

Change in Readmission Rate

Table 2 lists each hospital's observed readmission rate and indicates how much of a change in rate would be needed to move the hospital into an adjacent quintile. The table indicates that reasonably small changes in readmission rates by hospitals (i.e., from .4% to 1.0%) would facilitate a move into a higher or lower quintile category. Of the eight example scenarios, only one - hospital B's lowering its readmission rate by .7% to 20.1% - would result in a readmission rate outside the current range formed by all five hospitals. This indicates how sensitive the quintile ranking might be to an individual measure and

how a reasonably small change might be enough to move the hospital either up or down one ranking.

Table 2: Changes in Readmission Rate Sufficient to Move Hospitals

Hospital	Readmission rate (μ=22.0%)	Current Category	Change to move up to higher quintile	Change to move down to lower quintile
A	21.4%	5 star	--	1.0%
B	20.8%	4 star	-0.7%	0.6%
C	23.4%	3 star	-0.4%	0.7%
D	22.7%	2 star	-0.6%	0.8%
E	24.6%	1 star	-1.0%	--

Change in Emergency Department Rate

Table 3 similarly lists each hospital's observed rate of ambulatory visits to emergency departments and the changes needed to move hospitals to another quintile. The table shows that the changes in ED visit rates prompting such moves would have to be significantly larger (i.e. from .8% to 2.0%), and that in many cases the resulting ED rates would be outside the current range of 6.4% to 8.3%. Due to their lower values and a corresponding smaller variation, the ED measures produce a smaller, albeit still important impact on quintile rankings.

Table 3: Changes in Emergency Department Rate Sufficient to Move Hospitals

Hospital	Emergency Department rate (μ=8.1%)	Current Category	Change to move up to higher quintile	Change to move down to lower quintile
A	6.7%	5 star	--	1.9%
B	8.3%	4 star	-1.3%	1.3%
C	6.4%	3 star	-0.8%	1.2%
D	7.0%	2 star	-1.2%	1.6%
E	7.0%	1 star	-2.0%	--

Change in E&M Rate

Table 4 lists the change in E&M rates needed to move our five example hospitals to neighboring quintiles. It should be noted that because of the way the overall measure is constructed, the sign on the needed changes will be reversed from what they were for ED and readmission rates. Table 4 indicates that changes in E&M rates leading to quintile moves are larger still from any seen before (i.e. from 1.7% to 4.0%). However, because of the large variation in original E&M rates, the resulting rates would still, for the most part, lie within the original range of rates (the one exception is the rate hospital D would need to move it down into the lowest quintile). Obviously, such hypothetical rates would

be feasible and we may conclude that combined, overall scores will be sensitive to their E&M component.

Table 4: Changes in E&M Rate Sufficient to Move Hospitals

Hospital	E&M rate (μ=76.5%)	Current Category	Change to move up to higher quintile	Change to move down to lower quintile
A	82.9%	5 star	--	-3.9%
B	77.2%	4 star	2.6%	-2.5%
C	79.5%	3 star	1.7%	-2.4%
D	73.1%	2 star	2.4%	-3.2%
E	73.4%	1 star	4.0%	--