

# **Assessing Hospital Disparities for Dual Eligible Patients: Thirty-Day All-Cause Unplanned Readmission Measures**

## **Methodology Report for 2018 Public Comment**

### **Submitted By:**

Yale New Haven Health Services Corporation/Center for Outcomes Research & Evaluation  
(YNHHSC/CORE)

### **Prepared For:**

Centers for Medicare & Medicaid Services (CMS)

**October 2018**

## **Center for Outcomes Research & Evaluation Project Team**

Anouk Lloren\*, PhD – Project Lead  
Guohai (Bruce) Zhou, PhD – Lead Analyst  
Shuling Liu\*, PhD – Lead Analyst  
Jeph Herrin\*, PhD – Analytic Consultant  
Thalia Farietta, PhD – Project Coordinator II  
Jeffrey Dussetschleger, DDS, MPH – Project Coordinator  
Sana Charania, BS – Research Associate  
Magdalyne Kucharski, BA – Research Assistant  
Yongfei Wang\*, MS – Supporting Analyst  
Sheng Zhou, ScM, MD – Supporting Analyst  
David Silvestri, MD, MBA – Clinical Consultant  
Alon Peltz, MD, MBA- Clinical Consultant  
Kerry McCole, MS, MPhil – Team Member  
Liana Fixell, MPH – Project Manager  
Melissa Miller, MPH – Senior Project Manager  
Zhenqiu Lin, PhD – Analytic Leadership, Director of Data Management and Analytics  
Susannah Bernheim, MD, MHS – Project Director  
Harlan M. Krumholz\*, MD, SM – Principal Investigator

\*Yale School of Medicine

## **Acknowledgements**

This work was a collaborative effort and the authors gratefully acknowledge and thank our many colleagues and collaborators for their thoughtful and instructive input. Special thanks to Kanchana Bhat, MPH; Jason Woodford, MS; Karen Dorsey, MD; and Lori Schroeder, LLM, JD from the Yale New Haven Health Services Corporation/Center for Outcomes Research and Evaluation, along with Sharon-Lise Normand, PhD from Harvard Medical School, Department of Health Care Policy.

We would also like to thank our Contracting Officer Representative at the Centers for Medicare & Medicaid Services, Dr. Lein Han, for her continued support of our work.

## Table of Contents

|                                                                                                       |    |
|-------------------------------------------------------------------------------------------------------|----|
| Table of Contents.....                                                                                | 3  |
| List of Tables .....                                                                                  | 6  |
| List of Figures .....                                                                                 | 8  |
| 1. Executive Summary.....                                                                             | 10 |
| 1.1 Background and Overview .....                                                                     | 10 |
| 1.2 Results.....                                                                                      | 10 |
| Results for Pneumonia Readmission and Dual Eligibility.....                                           | 10 |
| Results for Additional Readmission Measures and Social Risk Factors .....                             | 11 |
| Results from the Within-Hospital Disparity Method .....                                               | 11 |
| Results from the Dual/Race Outcome Rate Method .....                                                  | 11 |
| 1.3 Implications.....                                                                                 | 11 |
| 2. Public Comment.....                                                                                | 12 |
| 2.1 Purpose of the Public Comment Period.....                                                         | 12 |
| 2.2 Instructions for Providing Feedback .....                                                         | 12 |
| 3. Introduction .....                                                                                 | 14 |
| 3.1 Background .....                                                                                  | 14 |
| 3.2 Importance of Measuring Healthcare Disparities.....                                               | 15 |
| 3.3 Overview of Two Disparity Methods .....                                                           | 15 |
| 3.4 Rationale for Focusing on the Readmission Measures.....                                           | 16 |
| 3.5 Rationale for Focusing on Dual Eligibility Status as the Social Risk Factor .....                 | 17 |
| 3.6 Approach to Methods Development .....                                                             | 17 |
| 3.7 Questions for Public Comment.....                                                                 | 18 |
| 4. Overview of Pneumonia Readmission Measure.....                                                     | 19 |
| 4.1 Cohort .....                                                                                      | 19 |
| 4.2 Outcome .....                                                                                     | 20 |
| 4.3 Risk Adjustment Variables .....                                                                   | 20 |
| 4.4 Measure Calculation .....                                                                         | 20 |
| 5. Data Sources .....                                                                                 | 22 |
| 5.1 Medicare Administrative Claims Data .....                                                         | 22 |
| 5.2 Identifying Patient-Level Dual Eligibility Status Using the Master Beneficiary Summary File ..... | 22 |
| 5.3 Identifying Patient-Level Race (Black vs. Non-Black Patients).....                                | 22 |

|                                                                                                                  |    |
|------------------------------------------------------------------------------------------------------------------|----|
| 5.4 Identifying Hospital Characteristics Using the American Hospital Association Dataset.....                    | 23 |
| 6. The Within-Hospital Disparity Method .....                                                                    | 24 |
| 6.1 Goal .....                                                                                                   | 24 |
| 6.2 Key Principles .....                                                                                         | 24 |
| 6.3 Modeling Strategy.....                                                                                       | 25 |
| 6.4 Reporting Within-Hospital Disparities .....                                                                  | 26 |
| Absolute Rate Difference .....                                                                                   | 26 |
| Sample Size Considerations .....                                                                                 | 27 |
| Categorizing Hospital Performance .....                                                                          | 27 |
| 6.5 Evaluating the Within-Hospital Disparity Method .....                                                        | 28 |
| 6.6 Results .....                                                                                                | 28 |
| Unadjusted and Adjusted Difference in Overall Readmission Rates between Dual and Non-Dual Eligible Patients..... | 28 |
| Variance of the Hospital-Specific Disparity Effect .....                                                         | 29 |
| Hospital Absolute Rate Differences between Dual and Non-Dual Eligible Patients.....                              | 29 |
| Distribution of Hospital Performance .....                                                                       | 30 |
| Relationship Between Within-Hospital Disparities and Hospital Characteristics.....                               | 31 |
| Relationship between Within-Hospital Disparities and Overall Hospital Quality.....                               | 33 |
| 6.7 Questions for Public Comment .....                                                                           | 34 |
| 7. The Dual/Race Outcome Rate Method .....                                                                       | 35 |
| 7.1 Goal .....                                                                                                   | 35 |
| 7.2 Modelling Strategy .....                                                                                     | 35 |
| Estimating Dual Eligible Readmission Rates .....                                                                 | 35 |
| 7.3 Reporting Dual Eligible Readmission Rates.....                                                               | 35 |
| Risk-Standardized Readmission Rates for Dual Eligible Patients.....                                              | 35 |
| Sample Size Considerations .....                                                                                 | 36 |
| Categorizing Hospital Performance .....                                                                          | 36 |
| 7.4 Evaluating the Dual/Race Outcome Rate Method.....                                                            | 36 |
| 7.5 Results .....                                                                                                | 37 |
| Unadjusted and Adjusted Dual-Specific Readmission Rates .....                                                    | 37 |
| Between-Hospital Variance.....                                                                                   | 37 |
| Distribution of Hospital Performance .....                                                                       | 38 |
| Relationship Between Dual-Specific RSRRs and Hospital Characteristics.....                                       | 39 |

|                                                                                                             |    |
|-------------------------------------------------------------------------------------------------------------|----|
| Relationship Between Dual-Specific RSRRs and Overall Hospital Quality .....                                 | 41 |
| 7.6 Questions for Public Comment .....                                                                      | 42 |
| 8. Complementarity of Two Disparity Methods and Overall Hospital Quality .....                              | 43 |
| 9. Results for Additional Readmission Measures and Social Risk Factors .....                                | 45 |
| 9.1 Overview of Additional Readmission Measure Specifications.....                                          | 45 |
| 9.2 Within-Hospital Disparity Method Results for Readmission Measures.....                                  | 45 |
| 9.3 Dual Outcome Rate Method Results for Readmission Measures.....                                          | 47 |
| 9.4 Overview of Disparity Method Results for Readmission Measures Using Race.....                           | 48 |
| 9.5 Within-Hospital Disparity Method Results for Readmission Measures using Race (Black vs. Non-Black)..... | 49 |
| 9.6 Race Outcome Rate Method Results for Readmission Measures (Black vs. Non-Black).....                    | 50 |
| 10. Conclusion.....                                                                                         | 52 |
| 10.1 Summary .....                                                                                          | 52 |
| 10.2 Results.....                                                                                           | 52 |
| Results for Pneumonia Readmission and Dual Eligibility.....                                                 | 52 |
| Results for Additional Readmission Measures and Social Risk Factors .....                                   | 53 |
| Results from the Within-Hospital Disparity Method .....                                                     | 53 |
| Results from the Dual/Race Outcome Rate Method .....                                                        | 53 |
| 10.3 Limitations.....                                                                                       | 53 |
| 10.4 Implications.....                                                                                      | 54 |
| 11. References .....                                                                                        | 55 |
| 12. Appendices.....                                                                                         | 57 |
| Appendix A: Overview of Two Disparity Methods.....                                                          | 57 |
| Appendix B: Within-Hospital Disparity Method Results for Pneumonia Readmission.....                         | 58 |
| Appendix C: Dual Outcome Rate Method Results for Pneumonia Readmission.....                                 | 67 |
| Appendix D: Questions for Public Comment .....                                                              | 76 |

## List of Tables

|                                                                                                                                                                                                           |    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Table 1. Within-Hospital Disparity Method Results for Pneumonia Readmission .....                                                                                                                         | 29 |
| Table 2. Categorizing Hospital Results for the Within-Hospital Disparity Method (Using the Absolute Value of the Absolute Rate Difference) into Deciles for Pneumonia Readmission, Dual Eligibility ..... | 31 |
| Table 3. Dual Outcome Rate Method Results for Pneumonia Readmission .....                                                                                                                                 | 38 |
| Table 4. Categorizing Dual-Specific RSRRs into Deciles for Pneumonia Readmission .....                                                                                                                    | 39 |
| Table 5. Within-Hospital Disparity Method Results for Readmission Measures using Dual Eligibility.....                                                                                                    | 47 |
| Table 6. Dual-Specific RSRR Results for Readmission Measures .....                                                                                                                                        | 48 |
| Table 7. Within-Hospital Disparity Method Results for Readmission Measures using Race (Black vs. Non-Black).....                                                                                          | 50 |
| Table 8. Race Outcome Rate Method Results for Readmission Measures (Black vs. Non-Black) .....                                                                                                            | 51 |
|                                                                                                                                                                                                           |    |
| Table B1. Summary of Absolute Rate Difference in Readmission between Dual and Non-Dual Eligible Patients.....                                                                                             | 58 |
| Table B2. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Hospital Volume of Index Admissions* .....                                     | 58 |
| Table B3. Distribution of Absolute Rate Difference in Readmission between Dual and Non-Dual Eligible Patients by Proportion of Dual Eligible Patients in the Pneumonia Measure Cohort* .....              | 58 |
| Table B4. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Hospital Bed Size.....                                                         | 59 |
| Table B5. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Hospital Ownership Status.....                                                 | 60 |
| Table B6. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Hospital Teaching Status.....                                                  | 61 |
| Table B7. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Hospital Core-Based Statistical Area.....                                      | 62 |
| Table B8. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Safety-Net Hospital.....                                                       | 63 |
| Table B9. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Critical Access Hospital.....                                                  | 64 |
| Table B10. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Region.....                                                                   | 65 |
|                                                                                                                                                                                                           |    |
| Table C1. Summary of Dual-Specific RSRRs for Pneumonia Readmission.....                                                                                                                                   | 67 |
| Table C2. Distribution of Dual-Specific RSRRs by Hospital Volume of Index Admissions for Pneumonia Readmission * .....                                                                                    | 67 |
| Table C3. Distribution of Dual-Specific RSRRs by Proportion of Dual Eligible Patients in the Pneumonia Measure Cohort* .....                                                                              | 67 |
| Table C4. Distribution of Dual-Specific RSRRs by Hospital Bed Size for Pneumonia Readmission.....                                                                                                         | 68 |
| Table C5. Distribution of Dual-Specific RSRRs by Hospital Ownership Status for Pneumonia Readmission.....                                                                                                 | 69 |

|                                                                                                     |    |
|-----------------------------------------------------------------------------------------------------|----|
| Table C6. Distribution of Dual-Specific RSRRs by Hospital Teaching Status for Pneumonia             |    |
| Readmission.....                                                                                    | 70 |
| Table C7. Distribution of Dual-Specific RSRRs by Hospital Core-Based Statistical Area for Pneumonia |    |
| Readmission.....                                                                                    | 71 |
| Table C8. Distribution of Dual-Specific RSRRs by Safety-Net Hospital for Pneumonia                  |    |
| Readmission.....                                                                                    | 72 |
| Table C9. Distribution of Dual-Specific RSRRs by Critical Access Hospital for Pneumonia             |    |
| Readmission.....                                                                                    | 73 |
| Table C10. Distribution of Dual-Specific RSRRs by Region for Pneumonia Readmission.....             | 74 |

## List of Figures

|                                                                                                                                                                                                                                                                                                |        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Figure 1. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients Among All Hospitals .....                                                                                                                                              | 30     |
| Figure 2. Example of a Boxplot .....                                                                                                                                                                                                                                                           | 31     |
| Figure 3. Distribution of Absolute Rate Difference in Readmission between Dual and Non-Dual Eligible Patients by Quartiles of Hospital Index Admissions Volume for Pneumonia Readmission, for hospitals with at least 25 patients overall and 12 dual and 12 non-dual eligible patients) ..... | 32     |
| Figure 4. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Quartiles of Hospital Proportion of Dual Eligible Patients .....                                                                                                    | 33     |
| Figure 5. Relationship between Overall RSRR and Absolute Rate Difference between Dual and Non-Dual Eligible Patients for Pneumonia Readmission .....                                                                                                                                           | 34     |
| Figure 6. Distribution of RSRRs for Dual Eligible Patients .....                                                                                                                                                                                                                               | 38     |
| Figure 7. Distribution of Dual-Specific RSRRs by Quartiles of Hospital Index Admissions Volume for Pneumonia Readmission, for hospitals with at least 25 dual eligible patients) .....                                                                                                         | 40     |
| Figure 8. Distribution of Dual-Specific RSRRs by Quartiles of Hospital Proportion of Dual Eligible Patients for Pneumonia Readmission .....                                                                                                                                                    | 40     |
| Figure 9. Relationship between Overall RSRR and Dual-Specific RSRR for Pneumonia Readmission .....                                                                                                                                                                                             | 42     |
| Figure 10. Complementarity of Two Disparity Methods with the Overall Pneumonia Readmission Measure .....                                                                                                                                                                                       | 44     |
| <br>Figure A1. Two Methods for Uncovering Disparities in Health Outcomes .....                                                                                                                                                                                                                 | <br>57 |
| <br>Figure B1. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Hospital Bed Size .....                                                                                                                                        | <br>59 |
| Figure B2. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Hospital Ownership Status .....                                                                                                                                    | 60     |
| Figure B3. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Hospital Teaching Status .....                                                                                                                                     | 61     |
| Figure B4. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Hospital Core-Based Statistical Area .....                                                                                                                         | 62     |
| Figure B5. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Safety-Net Hospital .....                                                                                                                                          | 63     |
| Figure B6. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Critical Access Hospital .....                                                                                                                                     | 64     |
| Figure B7. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Region .....                                                                                                                                                       | 65     |
| <br>Figure C1. Distribution of Dual-Specific RSRRs by Hospital Bed Size for Pneumonia Readmission .....                                                                                                                                                                                        | <br>68 |
| Figure C2. Distribution of Dual-Specific RSRRs by Hospital Ownership Status for Pneumonia Readmission .....                                                                                                                                                                                    | 69     |
| Figure C3. Distribution of Dual-Specific RSRRs by Hospital Teaching Status for Pneumonia Readmission .....                                                                                                                                                                                     | 70     |



|                                                                                                                        |    |
|------------------------------------------------------------------------------------------------------------------------|----|
| Figure C4. Distribution of Dual-Specific RSRRs by Hospital Core-Based Statistical Area for Pneumonia Readmission ..... | 71 |
| Figure C5. Distribution of Dual-Specific RSRRs by Safety-Net Hospital for Pneumonia Readmission .....                  | 72 |
| Figure C6. Distribution of Dual-Specific RSRRs by Critical Access Hospital for Pneumonia Readmission ..                | 73 |
| Figure C7. Distribution of Dual-Specific RSRRs by Region for Pneumonia Readmission .....                               | 74 |

# **1. Executive Summary**

## **1.1 Background and Overview**

The Centers for Medicare & Medicaid Services (CMS) uses quality outcome measures in accountability programs in order to improve patient health care and well-being. These measurement initiatives evaluate quality of care provided to *all* patients cared for by a given hospital. Despite evidence showing that patients with social risk often experience lower quality of care, there are few initiatives that focus attention on the care of patients with social risk factors or that directly measure healthcare disparities.<sup>1-4</sup>

To fill this gap and better inform consumers about hospitals' quality of care, CMS has contracted with Yale New Haven Health Services Corporation/Center for Outcomes Research and Evaluation (YNHHSC/CORE) to develop methodologies for presenting outcome measures stratified by patient social risk factors. Examining quality differences between subgroups of patients has two main goals: ensuring transparency around disparities in health care and improving care for patients with social risk factors.

In this report, we provide detailed information on the development of two complementary methods that assess hospital performance for patients with social risk factors:

1. The Within-Hospital Disparity Method highlights differences in outcomes for patient groups based on social risk factors within a hospital.
2. The Dual/Race Outcome Rate Method allows for comparison of performance in care for patients with social risk factors across hospitals.

The report focuses on one specific social risk indicator, dual eligibility status (beneficiaries covered by both Medicare and Medicaid), and one outcome measure, pneumonia readmission. In addition, we provide results for six additional readmission measures, heart failure, acute myocardial infarction (AMI), chronic obstructive pulmonary disease (COPD), stroke, coronary artery bypass surgery (CABG), and total hip arthroplasty and/or knee arthroplasty (Hip/Knee), along with two social risk indicators, dual eligibility status and race.

Both disparity methods are designed to be reported in addition to overall hospital performance measures, since both disparity results and overall performance results provide important but distinct information.

Throughout the development of our methods, we obtained input from clinical and measurement experts, key stakeholders, and patients and families.

## **1.2 Results**

### **Results for Pneumonia Readmission and Dual Eligibility**

Results from the Within-Hospital Disparity Method for pneumonia readmission indicated that dual eligible patients are, on average, more likely to be readmitted compared to non-dual eligible patients from the same hospital. The mean hospital absolute rate difference in readmission between dual and non-dual eligible patients is 0.62%. Importantly, results showed that within-hospital disparities in

readmission rates vary significantly across different hospitals. Specifically, the absolute rate difference ranged from -0.54% to 2.93% across hospitals.

Similarly, results for the Dual Eligible Outcome Rate Method for pneumonia readmission showed that dual-specific readmission rates vary significantly across hospitals. The mean risk-standardized readmission rate (RSRR) for dual eligible patients is 19.0%, with a range from 15.2% to 26.6% across hospitals.

## **Results for Additional Readmission Measures and Social Risk Factors**

### **Results from the Within-Hospital Disparity Method**

Results indicated that following hospitalizations for heart failure, AMI, COPD, stroke, CABG, and Hip/Knee readmission, dual eligible patients are, on average, more likely to be readmitted compared to non-dual eligible patients from the same hospital. The median absolute rate difference in readmission between dual and non-dual eligible patients at the hospital level ranged from 0.60% for pneumonia readmission to 2.35% for CABG readmission. Results showed that within-hospital disparities in readmission rates vary significantly across different hospitals for some of these measures (pneumonia, COPD, and Hip/Knee readmission).

Similarly, results indicated that black patients are, on average, more likely to be readmitted compared to non-black patients from the same hospital for all readmission measures. The median absolute rate difference in readmission between black and non-black patients at the hospital level ranged from 0.32% for Hip/Knee readmission to 1.89% for pneumonia readmission. Again, results showed that within-hospital disparities in readmission rates varied significantly across different hospitals for some of the measures examined (AMI, pneumonia, COPD, and Hip/Knee readmission).

### **Results from the Dual/Race Outcome Rate Method**

Results for the Dual/Race Outcome Rate Method showed that dual-specific readmission rates vary significantly across hospitals for all measures, except for CABG readmission. The median RSRR for dual eligible patients at the hospital level is as low as 6.7% for the Hip/Knee readmission measure and as high as 25.1% for the heart failure measure.

Likewise, results for the Race Outcome Rate Method showed that black-specific readmission rates vary significantly across hospitals for all measures. The median RSRR for black patients ranges at the hospital level is as low as 5.6% for the Hip/Knee readmission measure and as high as 24.4% for the heart failure readmission measure.

## **1.3 Implications**

Taken together, our results demonstrate that the Within-Hospital Disparity Method and the Dual/Race Outcome Rate Method are methodologically feasible. The method results show variation across hospitals for both within-hospital disparities and outcome rates for patients with social risk factors. This variation suggests an opportunity for improvement in hospital performance for dual eligible patients and black patients that could be incentivized by reporting hospitals' calculated disparities and dual/race-specific readmission rates.

## 2. Public Comment

### 2.1 Purpose of the Public Comment Period

We are seeking stakeholder feedback on two disparity methods currently in development: 1) the Within-Hospital Disparity Method and 2) the Dual/Race Eligible Outcome Rate Method. An overview of the two methods and results for one social risk factor, dual eligibility, and one outcome, pneumonia readmission, are provided in this technical report. We also present high-level results for six additional measures (acute myocardial infarction, heart failure, stroke, coronary artery bypass grafting, and total hip and knee arthroplasty readmission) and an additional social risk factor (race).

These methodologies serve complementary goals: to highlight disparities in healthcare quality between dual and non-dual eligible patients within hospitals and to illuminate variation in healthcare quality for dual eligible patients across hospitals. The methods presented could be used to examine disparities for additional outcomes, such as mortality and complications, and other social risk factors, such as race. This public comment period seeks input from a wide variety of stakeholders regarding changes to the measure or the way the results are presented to improve measure understanding and usefulness.

We seek public input on the entire methodology, but we ask for specific input on the following aspects of the methods:

- Do you support the concept of supplementing outcome measure reporting by reporting disparities in outcomes for individuals with social risk factors?
- Do you support using methods that allow for reporting both disparities within hospitals and measure performance for patients with social risk factors across hospitals?
- Do you recommend evaluating disparities for specific outcome quality measures such as readmissions, mortality, and surgical complications?
- What feedback do you have regarding the selection of social risk factors that are feasible to collect and include?
- What information should be provided to hospitals and consumers if information on disparities goes into public reporting?

These questions are also flagged in call out boxes throughout the document and in [Appendix D](#).

### 2.2 Instructions for Providing Feedback

CMS requests interested parties to submit comments on the concept or specifications of the methods that may be suitable for this project. Instructions are as follows:

- To participate in the public comment, please send your comments to [CMSDisparityMethods@yale.edu](mailto:CMSDisparityMethods@yale.edu) and include “public comment” in the subject line of your email.
- Comments are due by 11:59 PM EST on November 30, 2018.
- If you are providing comments on behalf of an organization, include the organization’s name and contact information.
- If you are commenting as an individual, submit identifying or contact information, or indicate you wish to be anonymous.

- Please do not include personal health information (for example, date of birth, social security number, health insurance claim number) in your comments.

### 3. Introduction

#### 3.1 Background

The Centers for Medicare & Medicaid Services (CMS) uses quality outcome measures in accountability programs, such as the Hospital Inpatient Quality Reporting Program, with the goal of improving patient health care and well-being. These measurement initiatives evaluate quality of care provided to *all* patients cared for by a given hospital. Despite evidence showing that patients with social risk (such as low-income or minority patients) often experience lower quality of care, there are few initiatives that focus attention on the care of patients with social risk factors or that directly measure healthcare disparities.<sup>1-4</sup>

Examining quality differences between subgroups of patients (measure stratification) has two main goals: to ensure transparency by revealing potential disparities in health care for patients with social risk factors and to improve care for at-risk populations. This goal is distinct from risk adjustment, which changes how performance measures are computed to account for the potential effect of social risk factors on health care quality outcomes. In 2014, the Improving Medicare Post-Acute Care Transformation Act (IMPACT Act) (H.R. 4994) tasked the Assistant Secretary for Planning and Evaluation (ASPE) to examine the effect of social risk factors on Medicare quality and payment programs, and Medicare to implement changes based on those recommendations. Based on empirical results, the 2016 ASPE Report recommended, among other initiatives, that CMS 1) develop statistical techniques to report performance measures for patients with social risk factors, and 2) introduce health equity measures to illuminate disparities in healthcare quality.<sup>6</sup> In addition, CMS's Meaningful Measures Framework also highlighted the need to develop health equity measures.

To fill this gap, CMS has contracted with Yale New Haven Health Services Corporation/Center for Outcomes Research and Evaluation (YNHHSC/CORE) to develop methodologies for presenting outcome measures stratified by patient social risk factors, such as socioeconomic status (SES) or race/ethnicity, in order to report hospitals' quality of care for patients with social risk factors.

In this technical report, we provide detailed information on the development of two complementary methods to report disparities in patient outcomes. These methods measure healthcare quality for patients with a given social risk factor and identify hospitals where disparities in health care may exist.

In this report, we focus on one specific outcome measure and one particular social risk indicator:

- **Pneumonia readmission measure**, which assesses hospital quality by measuring how often patients who are discharged for pneumonia need to be re-hospitalized within 30 days; and,
- **Dual eligibility status** (beneficiaries covered by both Medicare and Medicaid) as a proxy for patients' limited income or assets.

In addition, we provide results for six additional readmission measures, heart failure, acute myocardial infarction (AMI), chronic obstructive pulmonary disease (COPD), stroke, coronary artery bypass surgery (CABG), and total hip arthroplasty and/or knee arthroplasty (Hip/Knee), along with two social risk indicators, dual eligibility status and race.

### 3.2 Importance of Measuring Healthcare Disparities

Although health equity has been a longstanding issue on the agenda of the American healthcare system, disparities in health outcomes persist.<sup>1,2,7-9</sup> The 2016 ASPE report found a 10% to 31% higher odds of readmission for low-SES patients compared to high-SES patients after accounting for patient comorbidities across conditions included in the Hospital Readmission Reduction Program (HRRP).<sup>6</sup> In addition, differences in odds of readmission between black and white patients ranged from 9% to 20% depending on the condition examined.<sup>6</sup> Health and healthcare disparities also impose considerable costs on the healthcare system. For instance, a study indicated that the economy loses an estimated \$309 billion per year due to the direct and indirect costs of health inequities for non-dominant racial and ethnic groups.<sup>10,11</sup> The variation in disparities provides evidence that hospitals can reduce disparities and highlights the importance of doing so.

There are several ways in which reporting disparities in outcomes can improve healthcare quality for patients with social risk factors. First, public reporting of stratified quality measures would increase transparency and allow consumers to make more informed choices.<sup>12</sup> Influencing beneficiaries' choice could in turn affect market share by reallocating patients with social risk factors to higher quality hospitals. Second, highlighting within-hospital disparities could encourage hospitals to improve outcomes for patients with social risks through quality improvement interventions. Evidence-based interventions show that hospital improvements, involving patients, caregivers, clinicians, and other stakeholders, can help reduce healthcare disparities.<sup>13-17</sup> These efforts include identifying patients with social risks during the initial admission; systematically screening health literacy of patients; and providing specific education and training for patients with social risk factors. Additional improvements can be made in improving communication with at-risk patients, their caregivers, and their clinicians as well as engaging local stakeholders to integrate community and healthcare resources in care coordination after discharge.

Reporting disparity measures could encourage hospitals to implement the aforementioned programs and thereby reduce the gap in outcomes between beneficiaries with and without social risk factors.

In summary, health equity measures are key to identifying and monitoring disparities in healthcare quality at individual hospitals, which can drive reductions in disparities of care and better inform patient choices.

### 3.3 Overview of Two Disparity Methods

We developed two methods to assess healthcare quality for patients with social risk factors at a given hospital and illuminate potential disparities (see [Figure A1 in Appendix A](#)):

1. The **Within-Hospital Disparity Method** measures the difference in health outcomes between patients who are full benefit dual eligible (dual) and patients who are not dual eligible (non-dual) within a hospital.
  - The goal is to show whether two patients who are admitted to the same hospital with the same condition and medical history will have similar outcomes if one patient is dual eligible and the other is not.

- The method extends the model used in current risk-adjusted outcome measures by including a "disparity factor." This is used to calculate an absolute rate difference for each hospital that reflects the difference in outcomes between dual and non-dual eligible patients at that hospital. This approach accounts for differences in patient characteristics such as age and medical conditions.
  - This method will show whether some hospitals are more successful at achieving similar outcomes, or equity, among different patient groups within the hospital.
2. The **Dual/Race Outcome Rate Method** assesses hospitals' performance for dual eligible patients.
- The goal is to compare outcomes for dual eligible patients across hospitals.
  - This method calculates a separate measure score for just the dual eligible patients at each hospital. This method also risk adjusts for patients' medical conditions to capture differences among hospitals rather than differences among patients so that hospitals can be compared fairly. It is reported as a risk-standardized readmission rate (RSRR) for dual eligible patients for each hospital.
  - This method will show whether some hospitals are more successful at achieving better outcomes for their dual eligible patients compared to other hospitals.

Both methods are intended to provide information on hospital quality that will supplement the existing pneumonia readmission measure, which will continue to be publicly reported. By pairing these two disparity scores with the overall performance measure, it will be evident if equity is achieved by providing poor quality of care to all patients.

### 3.4 Rationale for Focusing on the Readmission Measures

Readmission means being hospitalized for a medical problem after being sent home, or discharged, from an initial hospital stay, or admission. Readmissions have become a focus of hospital quality measurement and quality improvement programs because readmissions impact health and quality of life for patients, and because they are expensive to our healthcare system. Returning to the hospital shows that a patient's health has gotten worse instead of better. Readmission also means that a patient may continue to get physically weaker, may be unable to perform normal physical functions, and must spend additional time away from family, work, and home.

CMS began publicly reporting 30-day RSRRs for AMI, heart failure, and pneumonia for the nation's non-federal short-term acute care hospitals (including Indian Health Services hospitals) and critical access hospitals in July 2009 followed by Hip/Knee readmission in December 2013, COPD and stroke in 2014, CABG surgery in 2015.

CMS chose to initially provide hospitals with disparity results for the hospital 30-day, all-cause, risk-standardized readmission rate (RSRR) following pneumonia hospitalization measure (National Quality Forum [NQF] measure #0506) during a confidential reporting period. In this methodology report, we thus mainly focus on disparity results for the pneumonia readmission measure. However, we also provide an overview of results for additional readmission measures in [Section 9](#).



### **3.5 Rationale for Focusing on Dual Eligibility Status as the Social Risk Factor**

This report mainly focuses on dual eligibility as the social risk factor. Dual eligibility refers to patients who qualify for both Medicare and Medicaid benefits (i.e., patients who have Medicare and full Medicaid coverage). Eligibility for Medicaid benefits takes into account both the individual's income and resources. Numerous studies have demonstrated differential health status and health outcomes among dual and non-dual eligible patients, indicating that dual eligibility status can allow us to evaluate the differences in SES among patients. For instance, the 2016 ASPE report showed that dual eligibility is one of the most powerful predictors of poor health outcomes.<sup>6</sup>

In this report, we counted only full benefit dual eligible beneficiaries as “dual eligible”. Full benefit dual eligible beneficiaries receive full Medicaid benefits in addition to their Medicare benefits. Partial dual eligible beneficiaries qualify to have Medicaid pay for some, or all, of their Medicare premiums or cost-sharing, but do not receive Medicaid benefits. Income and resource limit thresholds are lower for full benefit dual eligible compared to partial dual eligible beneficiaries. Although full benefit dual eligibility income and resource levels can vary across states, for older adults (>65 years) the eligibility thresholds are relatively similar. In our report, partial dual eligible beneficiaries are not counted as “dual eligible”.

Further, unlike other candidate social risk variables, the dual eligible indicator is readily available, and accurate, for all Medicare beneficiaries.

Although this report mainly focuses on dual eligibility, the methods we present can be applied to other patient-level social risk factors, such as racial and ethnic minority status. In [Section 9](#), we provide an overview of results for an additional social risk factor, namely black race (black vs. non-black patients).

### **3.6 Approach to Methods Development**

We developed these methods in consultation with clinical and measurement experts, key stakeholders, and patients, families, and caregivers. Our methods can be applied to existing quality measures, such as the pneumonia readmission measure, that follow national guidelines for publicly reported outcome measures set by NQF, CMS's Measure Management System, and the American Heart Association's scientific statement “Standards for Statistical Models Used for Public Reporting of Health Outcomes”.<sup>18,19</sup>

Throughout the development of our methods, we obtained stakeholder input via four mechanisms. First, CMS described our work in the proposed inpatient prospective payment system rule for fiscal year (FY) 2018 and (FY) 2019. The (FY) 2018 rule presented a preliminary version of the Within-Hospital Disparity Method and results for the pneumonia readmission measure. The rule also discussed an alternative methodology for stratifying outcome measures that applies the statistical model used in currently implemented readmission measures separately to dual eligible (Dual/Race Outcome Rate Method) and non-dual eligible beneficiaries so that hospitals would receive a score for each subgroup of patients (one score for dual eligible patients, and one for non-dual eligible patients). Comments received supported the general goal of measure stratification and encouraged CMS to further evaluate both proposed methodologies.

Second, we regularly consulted with an advisory working group of five patients, family caregivers, and consumer advocates. The working group meetings addressed key issues surrounding the development of the two disparity methods, including the conceptual goal of the methods, their complementarity, and how best to report results for the disparity methods.

Third, we convened a technical expert panel (TEP) of diverse perspectives and backgrounds, consisting of clinicians, hospitals, purchasers, consumers, and experts in quality improvement and healthcare disparities. Convening a national TEP ensures transparency and helps method developers obtain balanced input from multiple stakeholders. During the TEP meeting, we received important input on the two disparities methods. TEP members weighed in on the conceptual goal of disparity measurement, and on the two methods for assessing performance differences between dual and non-dual eligible patients within and across hospitals.

Fourth, we hosted a webinar to inform hospital and consumer organizations about the disparity methods and the confidential reporting period taking place for the pneumonia readmission measure and dual eligibility. Following the webinar, we solicited feedback on the disparity methods.

### **3.7 Questions for Public Comment**

*Do you support the concept of supplementing outcome measure reporting by reporting disparities in outcomes for individuals with social risk factors?*

*Do you support using methods that allow for reporting both disparities within hospitals and measure performance for patients with social risk factors across hospitals?*

*Do you recommend evaluating disparities for specific outcome quality measures (such as readmissions, mortality, and surgical complications)?*

*In this report, we focused on two individual-level social risk factors, Medicaid/Medicare dual eligibility and black race. What feedback do you have regarding the selection of social risk factors that are feasible to collect and include?*

## 4. Overview of Pneumonia Readmission Measure

As mentioned above, we focused on presenting disparity method results for the pneumonia readmission measure (NQF #0506), since this measure was used in the confidential reporting period. This measure captures unplanned readmissions within 30-days of discharge for Medicare beneficiaries 65 years and older who were hospitalized at short-term acute care hospitals following an index admission for pneumonia. Below, we describe the key features of the pneumonia readmission measure as it is currently calculated and used in CMS programs. In [Section 9](#), we provide a brief overview of six additional readmission measures.

- Heart failure readmission (NQF #0330);
- Acute myocardial infarction (AMI) readmission (NQF #0505);
- Chronic obstructive pulmonary disease (COPD) readmission (NQF #1891);
- Stroke readmission;
- Coronary artery bypass surgery (CABG) readmission (NQF #2515); and,
- Total hip arthroplasty and/or knee arthroplasty (Hip/Knee) readmission (NQF #1551).

### 4.1 Cohort

Our analyses focus on the pneumonia readmission measure cohort, which assesses only inpatient admissions to non-federal short-term acute care hospitals or Veterans Affairs (VA) hospitals. The pneumonia measure cohort includes admission for patients:

- With a principal discharge diagnosis of pneumonia, or a principal discharge diagnosis of sepsis (not including severe sepsis) with a secondary discharge diagnosis of pneumonia coded as present on admission (POA) and no secondary diagnosis of severe sepsis coded as POA;
- Enrolled in Medicare Fee-For-Service Part A and Part B for the 12 months prior to the date of admission and Part A during their index admission to ensure adequate data for risk adjustment. VA beneficiaries are also included; and,
- Aged 65 years or older.

The measure excludes admission for patients who:

- Died during the hospitalization or who were discharged against medical advice; or,
- Transferred to another acute care institution. We attribute readmission to the hospital that ultimately discharged the patient to a non-acute care setting. Thus, for patients transferred from one short-term acute care hospital to another, only the last admission in the series of transfers is eligible for inclusion in the cohort. The previous admissions are not included.

The inclusion and exclusion criteria for the pneumonia readmission measure cohort are described fully in the original methodology report<sup>20</sup> and 2018 annual update report.<sup>21</sup>

## 4.2 Outcome

The outcome for the pneumonia readmission measure is 30-day all-cause unplanned readmission. Readmission is defined as an unplanned re-hospitalization to any short-term acute care facility within 30 days of the discharge date from an eligible index admission.

The measure captures unplanned readmissions that arise for acute clinical events requiring urgent re-hospitalization within 30 days of discharge. This means that only an unplanned inpatient admission to a short-term acute care hospital can qualify as a readmission. Planned readmissions, which are generally not a signal of quality of care, are not considered readmissions in the measure's outcome. Planned readmissions are identified using the Planned Readmission Algorithm (version 4.0), a set of criteria for identifying admissions that are typically planned according to procedure and diagnostic codes. Details about the Planned Readmission Algorithm (version 4.0) are available in the measure's 2018 annual update report.<sup>21</sup>

The measure assigns a dichotomous yes/no outcome to each patient indicating whether that patient has an unplanned readmission within 30 days. If a patient has at least one unplanned readmission within 30 days of discharge from the index admission, then the readmission outcome is "yes" and the patient would be considered "readmitted." If the first readmission after discharge is planned, any subsequent unplanned readmission is not considered in the outcome for that index admission because the unplanned readmission could be related to care provided during the intervening planned readmission rather than during the index hospitalization.

## 4.3 Risk Adjustment Variables

In order to provide a fair comparison between hospitals, each hospital rate is adjusted for patient age and medical conditions. For each patient, indicators for medical conditions are obtained from inpatient, outpatient, and physician Medicare administrative claims data extending 12 months prior to, and including, the index admission. For VA beneficiaries, risk-adjustment variables are also obtained from VA administrative data.

The measure adjusts for case mix differences among hospitals based on the clinical status of the patient at the time of the index admission. Accordingly, only comorbidities that convey information about the patient at the time of the index admission, or in the 12 months' prior, are included in the risk adjustment. Complications that arise during the hospitalization are not included in the risk adjustment. The complete list of comorbidity risk-adjustment variables is available in the 2018 annual updates report.<sup>21</sup>

## 4.4 Measure Calculation

This section provides an overview on the calculation of the overall pneumonia readmission measure. We built on this model to calculate disparity scores using the Within-Hospital Disparity Method (for more details, see [Section 6](#)) and the Dual/Race Outcome Rate Method (for more details, see [Section 7](#)).

The overall measure estimates hospital-level 30-day all-cause RSRRs for pneumonia readmission using a hierarchical logistic model. In brief, the approach simultaneously models data at the patient and hospital levels to account for the variance in patient outcomes within and between hospitals. At the patient

level, it models the log-odds of hospital readmission within 30 days of discharge using age, selected clinical covariates, and a hospital-specific effect. At the hospital level, the approach models the hospital-specific effect as arising from a normal distribution. The hospital-specific effect represents the underlying risk of a readmission at the hospital, after accounting for patient risk. The hospital-specific effects are given a distribution to account for the clustering (non-independence) of patients within the same hospital. If there were no differences among hospitals, then after adjusting for patient risk the hospital-specific effects should be identical across all hospitals.

The overall hospital RSRR is calculated as the ratio of the number of predicted readmissions to the number of expected readmissions at a given hospital, multiplied by the national observed readmission rate. For each hospital, the numerator of the ratio is the number of readmissions within 30 days predicted based on the hospital's performance with its observed case mix. The denominator is the number of readmissions expected based on the nation's performance with that hospital's case mix. This approach is analogous to a ratio of observed to expected used in other types of statistical analyses. It conceptually allows a particular hospital's performance, given its case mix, to be compared to an average hospital's performance with the same case mix. Thus, a lower ratio indicates lower-than-expected readmission rates or better quality, while a higher ratio indicates higher-than-expected readmission rates or worse quality.

For more details on the hierarchical logistic regression model, please see the 2018 AUS report on the [QualityNet website](http://www.qualitynet.org) ([www.qualitynet.org](http://www.qualitynet.org) > *Hospitals-Inpatient* > *Claims-Based and Hybrid Measure* > *Readmission Measures* > *Measure Methodology*).

## 5. Data Sources

### 5.1 Medicare Administrative Claims Data

The data sources used for our analyses on the pneumonia readmission measure are [Medicare administrative claims](#) and enrollment information for patients with hospitalizations between July 1, 2014 and June 30, 2017.<sup>1</sup> The datasets also contain associated inpatient, outpatient, and physician Medicare administrative claims for the 12 months prior to the index admission and the one month subsequent to the index admission for patients admitted in this time period. Medicare claims data was used to identify critical access hospital status.

### 5.2 Identifying Patient-Level Dual Eligibility Status Using the Master Beneficiary Summary File

The [Master Beneficiary Summary File \(MBSF\)](#) contains demographic, enrollment, and linking information about Medicare beneficiaries. There are four segments in the MBSF data consisting of beneficiary summary file or Medicare enrollment (A/B/C/D information), chronic conditions, cost and utilization, and National Death Index information. In particular, the beneficiary summary file includes enrollment information (similar to the Denominator File), such as the beneficiary unique identifier, state, zip code, date of birth, date of death, sex, race, age, monthly entitlement and enrollment information (A/B/C/D) and plan information for Medicare Advantage (Part C) and the Prescription Drug Program (Part D).

We use the variable “State reported dual eligible status code” in the MBSF file to identify dual eligible patients. This variable offers granular information on the type of Medicaid benefits to which Medicare patients were entitled. Specifically, patients can be stratified into two subgroups based on the level of Medicaid benefits they receive: (a) “full benefit dual eligible” (patients who receive full Medicaid benefits) and “partial dual eligible” (patients who qualify to have Medicaid pay some or all of Medicare premiums or cost-sharing, but do not receive Medicaid benefits). In this report, we focus on “full benefit dual eligible” beneficiaries only, and partial dual eligible beneficiaries (often with relatively higher income and resource levels than full benefit dual eligible) are not included.

### 5.3 Identifying Patient-Level Race (Black vs. Non-Black Patients)

Race is identified using information from the [Medicare Enrollment Database](#) (EDB). Racial/ethnic categories available include White (not Hispanic origin), Black (not Hispanic origin), Asian/Pacific Islander, Hispanic, Native American/Alaskan native, other, and unknown. However, previous research has shown that race/ethnicity data are not consistently captured in claims: sensitivity analyses showed that it is difficult to reliably distinguish between patients’ five above mentioned racial and ethnic groups. white and black patients are the only two groups with high sensitivity and specificity.<sup>22</sup> Therefore, we have chosen to examine black vs non-black patients.

---

<sup>1</sup> This is the same time period as the data used for public reporting of the overall pneumonia readmission measure on Hospital Compare that was updated in July 2018.

## **5.4 Identifying Hospital Characteristics Using the American Hospital Association Dataset**

For descriptive analyses to examine hospitals' results compared to hospitals with similar characteristics (peer groups) we used the [American Hospital Association \(AHA\) Annual Survey Database](#). The AHA data contains information on United States hospitals consisting of hospital location, organizational structure, personnel, hospital characteristics (size, type or classification), hospital facilities, and services offered. The dataset can be merged with Medicare claims data using the Medicare Provider Number or the National Provider Identifier. We used data on number of hospital beds, hospital ownership, teaching status, core-based statistical area, safety-net hospital status, and statistical area (region).

## **6. The Within-Hospital Disparity Method**

### **6.1 Goal**

The goal of the Within-Hospital Disparity Method is to illuminate within-hospital disparities between dual and non-dual eligible patients for a given performance measure. It answers the question: “Will two patients who differ only with respect to their dual eligibility status have different outcomes at a given hospital?”

In other words, this method is intended to illuminate whether dual eligible patients admitted to a particular hospital have worse health outcomes than non-dual eligible patients admitted to the same hospital. This method will allow us to measure the gap, or the disparity effect, across hospitals to assess whether some hospitals have a greater gap compared to others.

### **6.2 Key Principles**

We established key principles for an approach to measure within-hospital disparities for outcome measures. Measuring within-hospital disparities is a relatively straightforward task for quality measures constructed as a simple numerator/denominator percentage: the cohort can be split into two samples, and results are calculated separately for each patient subgroup within a hospital. For example, in many process of care quality measures, measuring within-hospital disparities can be achieved by simply calculating rates separately for each subgroup and comparing those rates. This is often referred to as measure stratification.

Achieving the same aim is somewhat more complicated for risk-adjusted measures, such as the pneumonia readmission measure. Risk adjustment allows outcome measures to account for different levels of illness among patients by using a statistical model. For instance, the statistical model accounts for the fact that older patients or diabetics will have an increased likelihood of being readmitted to the hospital and assumes that the risk factors have a similar impact on all patients who have that risk factor. We wanted the same assumption for a disparity methodology; patients’ risk factors should have the same impact on both subgroups of patients (that is, coefficients for those risk factors should be the same for both groups). If a disparity method divides the patients into groups before applying the statistical model, this could lead to applying different assumptions about risk factors to different subgroups of patients, which we wanted to avoid in our modelling approach. Instead, if we assume the same coefficients for risk factors across groups and the two groups have the same comorbidities, they will have the same expected outcome (the standard); however, the predicted or actual outcome (the reality) may be different. Therefore, by applying the same model to all patients, the method will reveal differences that are based primarily on disparities due to social risk as opposed to level of illness.

The other complexity for our risk-standardized measures is that they are “standardized” to a national rate. National readmission rates vary across subgroups of patients. Therefore, we needed an approach that did not apply a different standardization (national rate) to the two groups within a hospital. Doing so could create results suggesting an in-hospital disparity that actually just reflected differences in national rates.



Based on these considerations, CMS's and ASPE's policy goals to uncover disparities, and the particular context of extending CORE's risk-adjusted outcome measures, we established three principles to guide our development of a methodology to measure within-hospital disparities:

- The first principle is that patients with similar comorbidities should expect the same outcome regardless of their dual eligibility status. Technically, this means that the coefficients for comorbidities are the same across patient groups in our disparities method (i.e., the effect of risk factors is assumed to be the same for all patients).
- The second principle is that measured disparities should reflect differences in outcomes specific to a hospital, rather than differences in patient case mix or national readmission rates for patient subgroups. That is, we want to isolate the effect of social risk factors on health outcomes within the same hospital.
- The third principle is that our method should be aligned, to the greatest extent possible, with currently implemented risk-adjusted performance measures.

Using these principles, we sought to develop a method that would allow us to compare outcomes for dual and non-dual eligible beneficiaries within the same hospital.

### 6.3 Modeling Strategy

We sought to illuminate within-hospital disparities in readmission between dual and non-dual eligible patients based on the above principles. To do so, we took a broad view of measure stratification in which we considered not only measurement of separate subgroups, but also direct measurement of the differences between them. Taking this broader view, we developed the Within-Hospital Disparity Method. This approach models the disparity between subgroups of patients directly, allowing us to highlight disparities in readmission between dual and non-dual eligible patients within each hospital.

This approach builds on the model used in currently implemented readmission measures and incorporates two additional factors: 1) the patient-level dual eligibility indicator; and, 2) a hospital variable representing the proportion of dual eligible patients at that hospital. More specifically, we first construct a dual eligibility indicator for each patient, which is 1 if the patient is dual eligible and 0 if otherwise. Then, for each hospital we calculate the average of this indicator (i.e., the percentage of dual eligible patients at the hospital). We include both of these indicators in the original model:

1. **The patient-level dual eligibility indicator is included as a “random effect”;** that is, an effect, like the overall quality effect included in the overall hospital measure, that can vary from hospital to hospital. This is the “hospital-specific disparity effect” or simply the “hospital disparity effect”; and,
2. **The hospital variable representing the proportion of dual eligible patients in each hospital is included as a “fixed effect”;** that is, an effect that is constant, but specific for each hospital.

The coefficient for the patient-level dual eligibility indicator captures the within-hospital disparity directly and represents the differential impact of dual eligibility on readmissions within each hospital. This coefficient is the “hospital disparity effect”; it is the critical component for evaluating differences in readmission rates among subgroups of patients within a hospital. Because it is allowed to vary across hospitals, it provides an estimate of the effect of being dual eligible for each hospital. The key

advantages of this approach are that, consistent with the principles we established, it sets the same standards for dual and non-dual eligible patients. It then assesses the impact of dual eligibility on readmission risk within each hospital. The random effect directly estimates the disparity between dual and non-dual eligible patients.

The coefficient for the proportion of dual eligible patients at the hospital level reflects the difference in readmission rates between hospitals with different proportions of dual eligible patients. It is added to the model to reduce bias in estimating the patient-level dual eligibility effect and ensure that we correctly interpret the hospital-specific random coefficient for dual eligibility (i.e., the hospital disparity effect).

In order to simplify interpretation of the model results, we center each patient-level dual eligibility indicator by subtracting the percentage of dual eligible patients in that patient's hospital. Similarly, we center each hospital-level dual eligible factor by subtracting the average of all hospitals' percentages of dual eligible patients.

For more details on the modeling strategy, see the dry run methodology report on the [QualityNet website](http://www.qualitynet.org) ([www.qualitynet.org](http://www.qualitynet.org) > *Hospitals-Inpatient* > *Claims-Based and Hybrid Measure* > *Disparity Methods Confidential Reporting* > *Methodology*).

## **6.4 Reporting Within-Hospital Disparities**

### **Absolute Rate Difference**

To interpret the hospital-specific coefficient for dual eligibility, we report the absolute rate difference between dual and non-dual eligible beneficiaries. To do so, we calculate the difference in predicted readmission rate between an 'average' dual eligible and an 'average' non-dual eligible patient at each hospital.

The absolute rate difference can be interpreted as the difference in outcome rate between two hypothetical patients, one being dual eligible and the other being non-dual eligible, who have the same comorbidities. If the absolute rate difference is greater than 0, it means that dual eligible patients have higher readmission rates than non-dual eligible patients within the same hospital (positive within-hospital disparity); if it is lower than 0, it means that dual eligible patients have lower readmission rates than non-dual eligible patients within the same hospital (negative within-hospital disparity). If the absolute rate difference is equal to 0, it means that there are no disparities in readmission rates between dual and non-dual eligible patients within the same hospital.

For example, at hospital A if the average dual eligible patient has a predicted readmission rate of 16.8% and the average non-dual eligible patient has a predicted readmission rate of 14.7%, the absolute rate difference for hospital A would be 2.1%. This means that the readmission rate for dual eligible patients is 2.1% higher than the rate for non-dual eligible patients.

For more details on calculating the absolute rate difference, see the dry run methodology report on the [QualityNet website](http://www.qualitynet.org) ([www.qualitynet.org](http://www.qualitynet.org) > *Hospitals-Inpatient* > *Claims-Based and Hybrid Measure* > *Disparity Methods Confidential Reporting* > *Methodology*).

## **Sample Size Considerations**

Splitting patients into subgroups reduces the sample size, which could affect the reliability of stratified measures. Our current overall quality measures are typically reliable for sample sizes of 25 or more patients, and are therefore only publicly reported for hospitals with 25 or more patients.

For the Within-Hospital Disparity Method, we similarly plan to report results for hospitals with at least 25 patients overall and 12 patients in each subgroup. This sample size allows us to report results for as many hospitals as possible, but will limit reporting on hospitals where results may be less reliable and less meaningful. In addition, we report confidence intervals to account for uncertainty around disparity estimates.

## **Categorizing Hospital Performance**

One way to communicate important variation in disparity results is to categorize hospital performance into deciles. To do so, we divided the distribution of results into ten equal categories using the absolute value of the absolute rate difference in readmission between dual and non-dual eligible patients. Hospitals that fall into higher deciles have higher within-hospital disparities. In practical terms, this means that hospitals with the best performance and smallest disparities fall into the first decile, while hospitals with the worst performance and largest disparities fall into the last decile. This approach to categorize hospitals does not take into account the direction of disparities, meaning that hospitals with positive and negative disparities can fall into the same decile category.

Another way to categorize hospital performance is to strictly determine if disparities are statistically different from zero. To do this, we estimated the 95% confidence interval around each hospital's disparity effect. The use of confidence intervals formally incorporates uncertainties associated with the calculation of each hospital's dual vs. non-dual disparity. We use re-sampling and simulation techniques to derive hospital-specific interval estimates because the absolute rate difference is a complex function of parameter estimates. We use bootstrapping procedures to compute the 95% interval estimates for the absolute rate difference.

We assign hospitals to a performance category by comparing each hospital's disparity interval estimate to no disparity (rather than to the national observed disparity). Comparative performance for hospitals is classified as follows:

- “Higher readmission rates for dual eligible patients compared to non-dual eligible patients within the same hospital” if the 95% confidence interval for the absolute rate difference lies above 0 (dual eligible patients have a higher readmission rate than non-dual eligible patients);
- “No disparity between dual eligible patients and non-dual eligible patients within the same hospital” if the 95% confidence interval for the absolute rate difference covers 0;
- “Lower readmission rates for dual eligible patients compared to non-dual eligible patients within the same hospital” if the 95% confidence interval for the absolute rate difference lies below 0 (non-dual eligible patients have a higher readmission rate than dual eligible patients).

If a hospital has fewer than 25 patients overall or 12 dual or 12 non-dual eligible patients, we assign the hospital to a separate category, “Number of Cases Too Small.” This category is used when the number of cases is too small to reliably tell how well the hospital is performing.

For more details, see the subsection “Constructing 95% Confidence Intervals” in the dry run methodology report on the [QualityNet website](http://www.qualitynet.org) ([www.qualitynet.org](http://www.qualitynet.org) > *Hospitals-Inpatient* > *Claims-Based and Hybrid Measure* > *Disparity Methods Confidential Reporting* > *Methodology*).

## **6.5 Evaluating the Within-Hospital Disparity Method**

We applied the Within-Hospital Disparity Method to the pneumonia readmission measure using data from July 1, 2014 to June 30, 2017.

We summarized the number of hospitalizations, the percent of dual eligible patients, and the percent of hospitals in the pneumonia readmission cohort. We then examined the mean unadjusted and adjusted difference in readmission rates between dual and non-dual eligible patients for the pneumonia readmission measure at the national level.

For each hospital we calculated the absolute rate difference in readmission between dual and non-dual eligible patients and determined the confidence interval. We reported whether there is significant variation among hospitals by reporting the variance of the hospital disparity effect. We also reported the mean and the distribution of the absolute rate difference in readmission across hospitals, and “statistical outliers” (hospitals whose 95% confidence intervals for absolute rate difference lie fully above or fully below 0, indicating that readmission rates for dual eligible patients are higher/lower than readmission rates for non-dual eligible patients).

Finally, we examined the distribution of the absolute rate difference in readmission between dual and non-dual eligible patients across different types of hospitals (volume of index admissions, proportion of dual eligible patients in the measure cohort, bed size, safety-net hospital, critical access hospital, ownership status, teaching status, core-based statistical area, and region).

## **6.6 Results**

The pneumonia readmission measure cohort included 1,425,261 hospitalizations to 4,764 hospitals. 1,401,869 hospitalizations (98.4%) were successfully linked to the MBSF data to obtain dual eligible status. Of those hospitalizations, 22.7% are hospitalizations for dual eligible patients. For potential future public reporting, we would require hospitals to have at least 25 patients overall and 12 dual eligible patients and 12 non-dual eligible patients. Using these cut-offs, we could report disparities for 3,689 (77.4%) hospitals. Results stratified by hospital characteristics are presented for the 3,541 hospitals that met both the reporting criteria and were included in the AHA survey dataset.

### **Unadjusted and Adjusted Difference in Overall Readmission Rates between Dual and Non-Dual Eligible Patients**

The mean unadjusted readmission rate within 30 days of index discharge for all included hospitalizations is 16.7% across the three-year period examined. The unadjusted mean readmission rate among all dual eligible patients is 18.9%, while the rate is 16.1% among all non-dual eligible patients. Table 1 shows that the mean unadjusted difference in readmission rate between dual and non-dual eligible patients is 2.8%.

The adjusted difference in readmission rate between all dual and non-dual eligible patients at the national level accounts for patients’ comorbidities. The results show that the difference in overall

readmission rates between dual and non-dual eligible patients in terms of odds ratio is greater than 1 and is statistically significant (adjusted odds ratio: 1.05; 95% confidence interval [CI]: 1.03 – 1.06), indicating that, nationally, dual eligible patients are more likely to get readmitted than non-dual eligible patients after risk adjusting for case mix (Table 1).

### **Variance of the Hospital-Specific Disparity Effect**

We tested whether the variance of the hospital-specific disparity effect is significant (Table 1). Results show that the variance of the hospital-specific disparity effect on the scale of log-odds is 0.008 and is significantly larger than zero (p-value < 0.001). This indicates that the effect of dual eligibility on readmission differs significantly across hospitals. If there were no differences between hospitals, the variance of the hospital-specific disparity effect would be 0.

### **Hospital Absolute Rate Differences between Dual and Non-Dual Eligible Patients**

Table 1 indicates that the mean within-hospital absolute rate difference in readmission between dual and non-dual eligible patients among all hospitals is 0.62% with a median of 0.58% (10<sup>th</sup>, 25<sup>th</sup>, 75<sup>th</sup>, and 90<sup>th</sup> percentiles are 0.24%, 0.42%, 0.77%, and 1.04%, respectively).

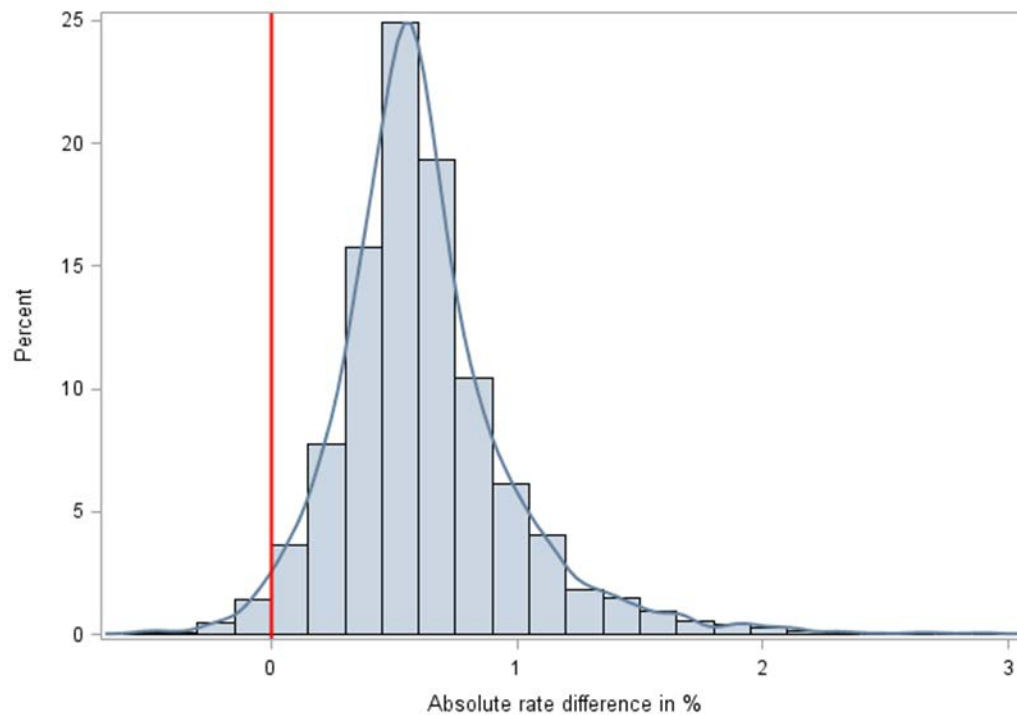
Figure 1 displays the overall distribution of hospital absolute rate difference in readmission between dual and non-dual eligible patients for the three-year dataset. Most of the hospitals have an absolute rate difference greater than 0 (on the right side of the red line), indicating dual eligible patients have a higher readmission rate than non-dual eligible patients in most hospitals.

Refer to [Table B1 in Appendix B](#) for more details.

**Table 1. Within-Hospital Disparity Method Results for Pneumonia Readmission (N=4,764)**

| Mean Unadjusted Dual vs Non-Dual Difference | Mean Adjusted Dual vs Non-Dual Difference (Odds Ratio) | Variance of the Hospital Disparity Effect | Mean Hospital Dual vs Non-Dual Absolute Rate Difference |
|---------------------------------------------|--------------------------------------------------------|-------------------------------------------|---------------------------------------------------------|
| 2.8%                                        | 1.05***                                                | 0.008***                                  | 0.62%                                                   |

**Figure 1. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients Among All Hospitals (N=4,764)**



### **Distribution of Hospital Performance**

Table 2 shows the distribution of the absolute rate difference in readmission between dual and non-dual eligible patients across hospitals by decile. We used absolute values of the absolute rate difference to categorize hospitals into deciles. The results show that the absolute rate differences ranged from 0.00% to 0.20% in the first decile and from 1.11% to 2.93% in the last decile.

Of the 4,764 hospitals in the pneumonia readmission cohort, no hospitals had statistically significant “lower readmission rates for dual eligible patients compared to non-dual eligible patients within the same hospital”, 3,684 (77%) had “no disparity between dual eligible patients and non-dual eligible patients within the same hospital”, and 5 (0.1%) had statistically significant “higher readmission rates for dual eligible patients compared to non-dual eligible patients within the same hospital.” 1,075 (23%) hospitals were classified as “number of cases too small” (fewer than 25 patients overall or 12 patients in each subgroup) to reliably assess hospital performance.

**Table 2. Categorizing Hospital Results for the Within-Hospital Disparity Method (Using the Absolute Value of the Absolute Rate Difference) into Deciles for Pneumonia Readmission, Dual Eligibility (N=3,689)**

| Deciles | Minimum | Maximum |
|---------|---------|---------|
| 1       | 0.00%   | 0.20%   |
| 2       | 0.21%   | 0.33%   |
| 3       | 0.33%   | 0.42%   |
| 4       | 0.42%   | 0.50%   |
| 5       | 0.50%   | 0.58%   |
| 6       | 0.58%   | 0.66%   |
| 7       | 0.66%   | 0.76%   |
| 8       | 0.76%   | 0.89%   |
| 9       | 0.89%   | 1.10%   |
| 10      | 1.11%   | 2.93%   |

### Relationship Between Within-Hospital Disparities and Hospital Characteristics

We examined the distribution of within-hospital disparities by volume of index admissions (Figure 3) and by proportion of dual eligible patients in the measure cohort (Figure 4). Boxplots are used to display summary statistics, specifically the distribution of results for hospitals based on several hospital characteristics. The box plot shows for a given hospital characteristic the minimum absolute rate difference, first quartile (25<sup>th</sup> percentile), median, mean, third quartile (75<sup>th</sup> percentile), and maximum (see Figure 2 for more details). The two points at the bottom and top are the minimum and maximum values, respectively. Half of the results fall in the box between the first and third quartiles; this value is known as the interquartile range (IQR). The fence and far fence or lines extending from the box represent a range of values within 1.5 of the IQR; dots outside of this range represent outliers, also known as extreme values.

**Figure 2. Example of a Boxplot**

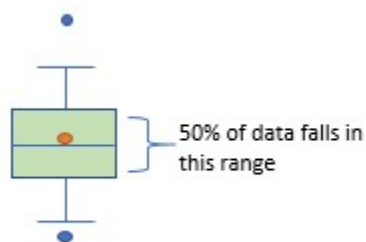


Figure 3 shows four box plots representing the distribution of the absolute rate difference between dual and non-dual eligible patients for hospitals divided into quartiles based on their volume of index admissions in the measure cohort. That is, each box plot represents 25% of the hospitals based on volume of index admissions for pneumonia, with hospitals having the lowest number of index

admissions represented on the left and hospitals having the highest number of index admissions represented on the right. Figure 3 shows that the mean absolute rate difference in readmission between dual and non-dual eligible patients is higher for hospitals with higher volumes of index admissions for pneumonia.

Refer to [Table B2 in Appendix B](#) for more details.

**Figure 3. Distribution of Absolute Rate Difference in Readmission between Dual and Non-Dual Eligible Patients by Quartiles of Hospital Index Admissions Volume for Pneumonia Readmission (N=3,689, for hospitals with at least 25 patients overall and 12 dual and 12 non-dual eligible patients)**

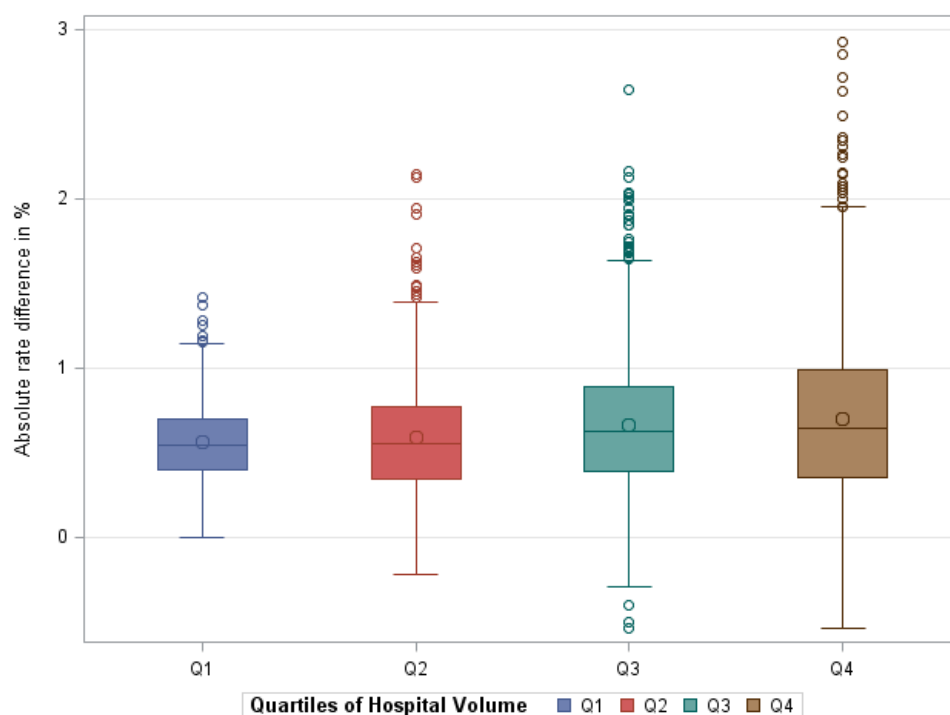


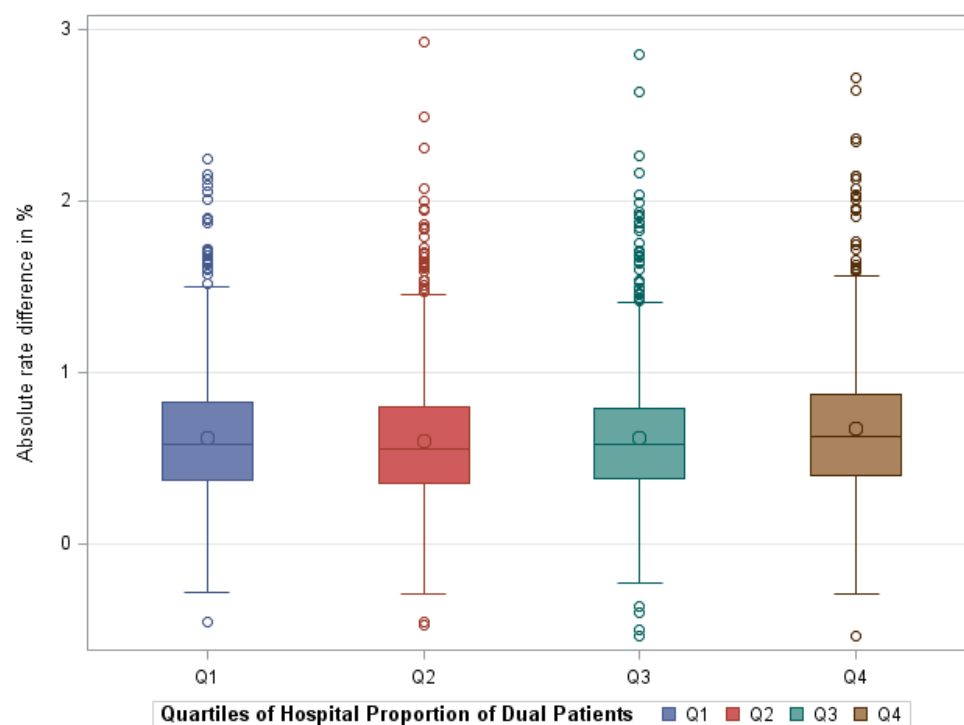
Figure 4 shows four box plots representing the distribution of the absolute rate difference between dual and non-dual eligible patients, each for a different quartile of proportion of dual eligible patients in the measure cohort. That is, each box plot represents 25% of the hospitals according to the proportion of dual eligible patients hospitalized with an index admission for pneumonia, with hospitals having the smallest proportion represented on the left and hospitals having the largest proportion represented on the right. Figure 4 shows that there is a small variation in the mean absolute rate difference in readmission between dual and non-dual eligible patients among hospitals with different proportions of dual eligible patients.

Refer to [Table B3 in Appendix B](#) for more details.

We examined the distribution of within-hospital disparities by other hospital characteristics using the AHA survey data (see [Appendix B](#)). Results show that there are small variations in within-hospital disparities by hospital type (hospital volume, proportion of dual eligible patients, bed size, safety-net hospital, critical access hospital, ownership status, teaching status, core-based statistical area, and region).



**Figure 4. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Quartiles of Hospital Proportion of Dual Eligible Patients (N=3,689)**



### Relationship between Within-Hospital Disparities and Overall Hospital Quality

Providing information about disparities in patient outcomes within hospitals should supplement the assessment of overall hospital quality provided through current readmission measures, which would remain unchanged. Shedding light on patterns of disparities by social risk factors and how they relate to overall hospital quality can help hospitals identify quality improvement targets.

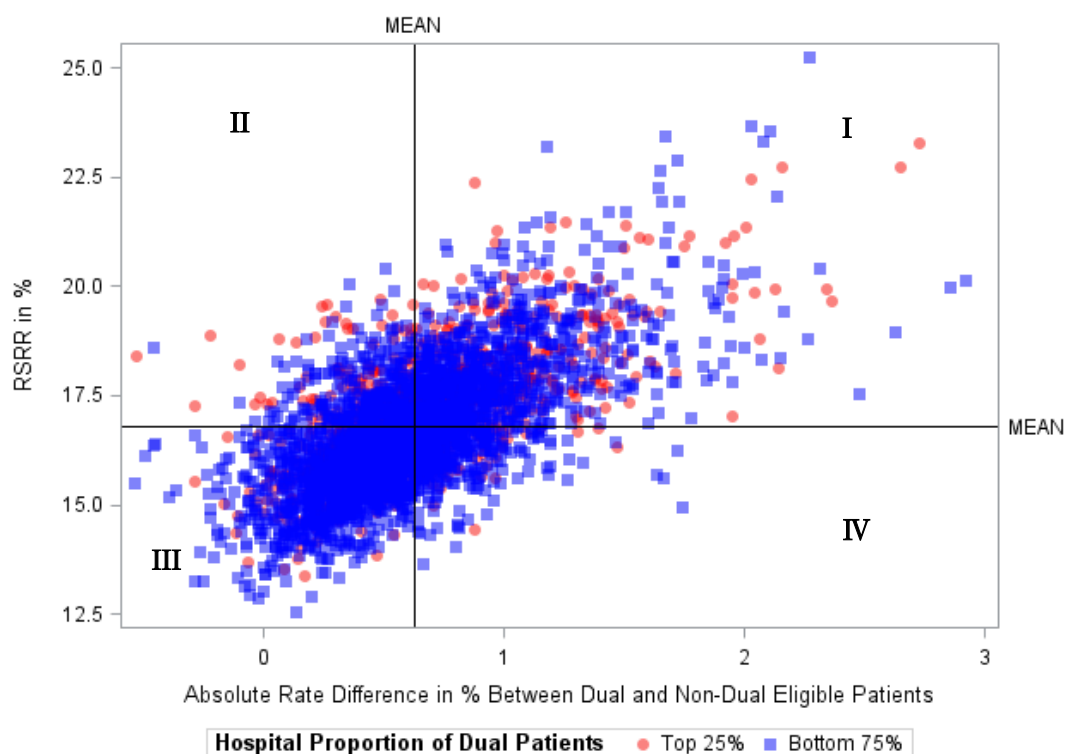
Figure 5 shows that there exists a positive correlation of 0.67 (95% CI 0.64 to 0.68) between a hospital's disparity and its overall RSRR for pneumonia readmission. That is, hospitals that had worse hospital quality in terms of their overall RSRR for pneumonia readmission tended to have larger disparities.

The quadrants in Figure 5 represent different types of relationships between a hospital's overall quality and absolute rate difference between dual and non-dual eligible patients:

- I. Hospitals falling in quadrant I have below average overall quality and above average disparities between dual and non-dual eligible patients.
- II. Hospitals falling in quadrant II have below average overall quality; however, they have lower than average disparities between dual and non-dual eligible patients.
- III. Hospitals falling in quadrant III have above average overall quality and lower than average disparities between dual and non-dual eligible patients.
- IV. Hospitals falling in quadrant IV have above average overall quality, but exhibit higher than average disparities between dual and non-dual eligible patients.

Figure 5 also shows that hospitals caring for a high proportion of dual eligible patients (red dots represent hospitals that care for the top 25% of dual eligible patients) are relatively similarly distributed in the four quadrants: 31% of hospitals caring for a high proportion of dual eligible patients fall in quadrant I; 28% fall in quadrant II; 21% fall in quadrant III; and 20% fall in quadrant IV. In summary, hospitals that care for a high proportion of dual eligible patients are only a little more likely to fall in quadrant I, which represents both worse overall quality and greater disparities. Conversely, a substantial proportion of hospitals that care for a high share of dual eligible patients can be found among the best overall performers and, at the same time, display low to no disparities (quadrant III).

**Figure 5. Relationship between Overall RSRR and Absolute Rate Difference between Dual and Non-Dual Eligible Patients for Pneumonia Readmission (N=3,689)**



## 6.7 Questions for Public Comment

*We are particularly interested in feedback about making the disparities information usable. What information should be provided to hospitals and consumers if information on disparities goes into public reporting?*

## 7. The Dual/Race Outcome Rate Method

### 7.1 Goal

The goal of the Dual/Race Outcome Rate Method is to measure and compare hospital performance for the subgroup of patients that are dual eligible. In contrast to the Within-Hospital Disparity Method, this method does not quantify the disparity in readmission between dual and non-dual eligible patients, but instead calculates a risk-standardized readmission rate (RSRR) for only dual eligible patients for each hospital. This method answers the question: “How does Hospital A perform for their dual eligible patients compared to Hospital B?”

### 7.2 Modelling Strategy

#### Estimating Dual Eligible Readmission Rates

We apply the model used in currently implemented readmission measures to a subset of patients, namely dual eligible patients, to calculate dual-specific RSRRs for each hospital. The outcome and risk-adjustment model are the same as in the currently reported 30-day readmission measures. However, the cohort is a subset of the overall measure cohort (i.e., dual eligible patients). This means that the model used to calculate dual-specific RSRRs adjusts for the same comorbidities as the model that includes all eligible Medicare patients, but the coefficients for comorbidities may be different. As a result, we cannot directly compare a hospital’s overall performance to their performance for dual eligible patients only.

We run this method on hospitals that have at least 1 dual eligible patient. We estimate RSRRs for dual eligible patients using hierarchical generalized linear models (HGLMs) (see model (1) below). This strategy accounts for within-hospital correlation of the observed readmission rate and accommodates the assumption that underlying differences in quality across hospitals lead to systematic differences in outcomes. We model the probability of readmission  $p_{ij}$  as a function of patient age and clinically relevant comorbidities with an intercept  $\epsilon_{0i}$  for the hospital-specific random effect.

For more details, see the statistical model on dry run methodology report on the [QualityNet website](http://www.qualitynet.org) ([www.qualitynet.org](http://www.qualitynet.org) > *Hospitals-Inpatient* > *Claims-Based and Hybrid Measure* > *Disparity Methods Confidential Reporting* > *Methodology*).

### 7.3 Reporting Dual Eligible Readmission Rates

#### Risk-Standardized Readmission Rates for Dual Eligible Patients

As for our overall quality measures, we estimate a hierarchical logistic regression model with a random hospital effect, or “hospital-specific effect” and pre-specified patient risk factors for dual eligible patients only. The results are used to construct, for each hospital, the ratio of the total number of predicted readmissions for dual eligible patients to the total number of expected readmissions for dual eligible patients. Predicted readmission for dual eligible patients is defined as the sum of the predicted probabilities of readmission for dual eligible patients at that hospital, including the hospital-specific effect. Expected readmission for dual eligible patients is defined as the sum of the predicted probabilities under the assumption that the hospital-specific effect is zero. This ratio is multiplied by the

overall national readmission rate for dual eligible patients to produce a “risk-standardized readmission rate” or RSRR for dual eligible patients.

### **Sample Size Considerations**

Our current overall quality measures are typically reliable for sample sizes of 25 or more patients. For the Dual/Race Outcome Rate Method, we would report results only for hospitals with at least 25 dual eligible patients. This sample size allows us to report results for as many hospitals as possible, but will limit reporting on hospitals where results may be less reliable and less meaningful.

### **Categorizing Hospital Performance**

One way to communicate important variation in disparity results is to categorize hospital performance into deciles. To do so, we divided the distribution of dual-specific RSRRs into ten equal categories. Hospitals that fall into higher deciles have higher dual-specific RSRRs. This means that hospitals with the best performance for dual eligible patients fall into the first decile, while hospitals with the worst performance for dual eligible patients fall into the last decile.

Another way to categorize hospital performance is to determine if hospital dual-specific RSRRs are statistically different from the national observed readmission rate for dual eligible patients. To do this, we estimate each hospital’s RSRR for dual eligible patients and the corresponding 95% confidence interval estimate. We assign hospitals to a performance category by comparing the interval estimate for each hospital’s dual-specific RSRR to the national observed readmission rate for dual eligible patients. Comparative performance for hospitals is classified as follows:

- “Worse than the national rate for dual eligible patients” if the entire 95% confidence interval surrounding the hospital’s rate for dual eligible patients is higher than the national observed readmission rate for dual eligible patients.
- “No different than the national rate for dual eligible patients” if the 95% confidence interval surrounding the hospital’s rate for dual eligible patients includes the national observed readmission rate for dual eligible patients.
- “Better than the national rate for dual eligible patients” if the entire 95% confidence interval surrounding the hospital’s rate for dual eligible patients is lower than the national observed readmission rate for dual eligible patients.

If a hospital has fewer than 25 dual eligible patients, we assign the hospital to a separate category, “Number of Cases Too Small.” This category is used when the number of cases is too small to reliably tell how well the hospital is performing. If a hospital has fewer than 25 dual eligible patients, the hospital’s readmission rate for dual eligible patients and interval estimates will not be publicly reported.

For more details, see the subsection “Constructing 95% Confidence Intervals” in the dry run methodology report on the [QualityNet website](http://www.qualitynet.org) ([www.qualitynet.org](http://www.qualitynet.org) > *Hospitals-Inpatient* > *Claims-Based and Hybrid Measure* > *Disparity Methods Confidential Reporting* > *Methodology*).

## **7.4 Evaluating the Dual/Race Outcome Rate Method**

We applied the Dual/Race Outcome Rate Method to the pneumonia readmission measure using data from July 1, 2014 to June 30, 2017.

We summarized the number of hospitalizations, the percent of dual eligible patients, and the percent of hospitals in the pneumonia readmission cohort. We then examined the mean unadjusted and adjusted 30-day readmission rate for pneumonia at the national level.

For each hospital we calculated the readmission rate for dual eligible patients and determined the confidence interval. We reported whether there is significant variation among hospitals by reporting the between-hospital variance. We also reported the mean and the distribution of dual-specific RSRRs, and “statistical outliers” (hospitals whose 95% confidence intervals of dual-specific RSRRs lie fully above or fully below the national readmission rate for dual eligible patients).

Finally, we examined the distribution of dual-specific RSRRs across different types of hospitals (volume of index admissions, proportion of dual eligible patients in the measure cohort, bed size, safety-net hospital, critical access hospital, ownership status, teaching status, core-based statistical area, and region).

## **7.5 Results**

The cohort includes 318,257 hospitalizations for dual eligible patients to 4,624 hospitals. To be included in the cohort, hospitals must have at least one dual eligible patient. For potential future public reporting, we would require hospitals to have at least 25 dual eligible patients. Using this cut-off, we could report dual-specific RSRRs for 2,968 (64.2%) hospitals. Results stratified by hospital characteristics are presented for 2,883 hospitals that met both the reporting criteria and were included in the AHA survey dataset.

### **Unadjusted and Adjusted Dual-Specific Readmission Rates**

The mean unadjusted readmission rate within 30 days of index discharge for all included hospitalizations is 16.7% across the three-year period examined. The unadjusted national readmission rate for dual eligible patients is 18.9%.

The adjusted mean readmission rates for dual eligible patients are consistent with the unadjusted rates, with the mean dual-specific RSRRs being 18.9% (10<sup>th</sup>, 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup>, and 90<sup>th</sup> percentiles are 17.7%, 18.3%, 18.8%, 19.5%, and 20.4%). The distribution of dual-specific RSRRs is described in Table 3 and Figure 6.

Refer to [Table C1 in Appendix C](#) for more details.

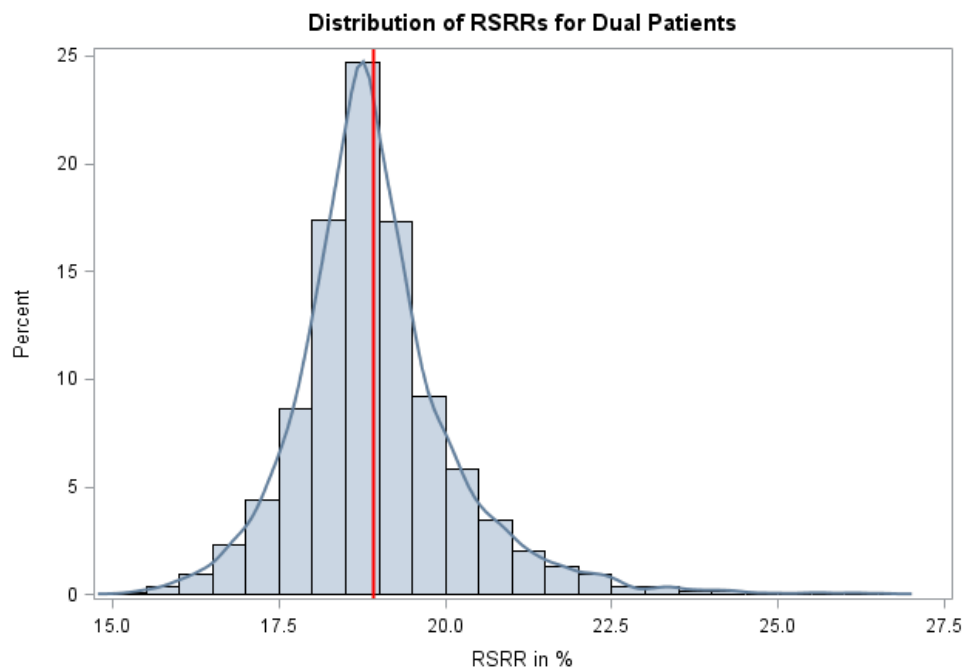
### **Between-Hospital Variance**

We tested whether the between-hospital variance is significant (Table 3). Results show that the between-hospital variance differs from zero (0.032; p-value < 0.001), indicating significant variation in readmission for dual eligible patients across hospitals. If there are no differences between hospitals, the between-hospital variance would be 0.

**Table 3. Dual Outcome Rate Method Results for Pneumonia Readmission (N=4,624)**

| Mean Unadjusted Dual-Specific Readmission Rate | Mean Adjusted Dual-Specific Readmission Rate | Between-Hospital Variance |
|------------------------------------------------|----------------------------------------------|---------------------------|
| 18.9%                                          | 18.9%                                        | 0.032***                  |

**Figure 6. Distribution of RSRRs for Dual Eligible Patients (N=4,624)**



### **Distribution of Hospital Performance**

Table 4 shows the distribution of dual-specific RSRRs across hospitals by decile. The results show that the dual-specific ranged from 15.23% to 17.37% in the first decile and 20.86% to 26.57% in the last decile.

Of 4,624 hospitals in the pneumonia readmission cohort, 50 (1.1%) performed “worse than the national dual readmission rate”, 1 (0.02%) performed “better than the national dual readmission rate”, and 2,917 (63.1%) performed “no different than the national dual readmission rate.” 1,656 (35.8%) were classified as “number of cases too small” (fewer than 25 dual eligible patients) to reliably assess hospital performance.

**Table 4. Categorizing Dual-Specific RSRRs into Deciles for Pneumonia Readmission (N=2,968)**

| Deciles | Minimum | Maximum |
|---------|---------|---------|
| 1       | 15.23%  | 17.37%  |
| 2       | 17.37%  | 17.88%  |
| 3       | 17.88%  | 18.22%  |
| 4       | 18.22%  | 18.56%  |
| 5       | 18.57%  | 18.89%  |
| 6       | 18.89%  | 19.20%  |
| 7       | 19.20%  | 19.56%  |
| 8       | 19.56%  | 20.06%  |
| 9       | 20.06%  | 20.86%  |
| 10      | 20.86%  | 26.57%  |

### **Relationship Between Dual-Specific RSRRs and Hospital Characteristics**

We examined the distribution of dual-specific RSRRs by volume of index admissions (Figure 7) and by proportion of dual eligible patients in the measure cohort (Figure 8).

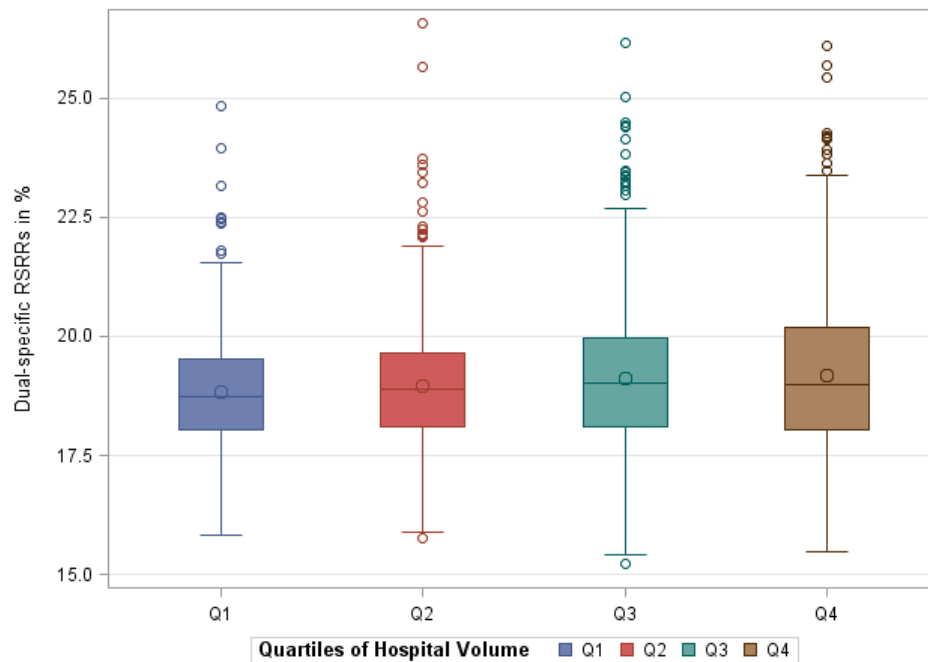
Figure 7 shows four box plots representing the distribution of dual-specific RSRRs for hospitals divided into quartiles based on their volume of index admissions in the measure cohort. That is, each box plot represents 25% of the hospitals based on volume of index admissions for pneumonia, with hospitals having the lowest number of index admissions represented on the left and hospitals having the highest number of index admissions represented on the right. Figure 7 suggests that mean readmission rate for dual eligible patients increases for hospitals with higher volumes of index admissions for pneumonia.

Refer to [Table C2 in Appendix C](#) for more details.

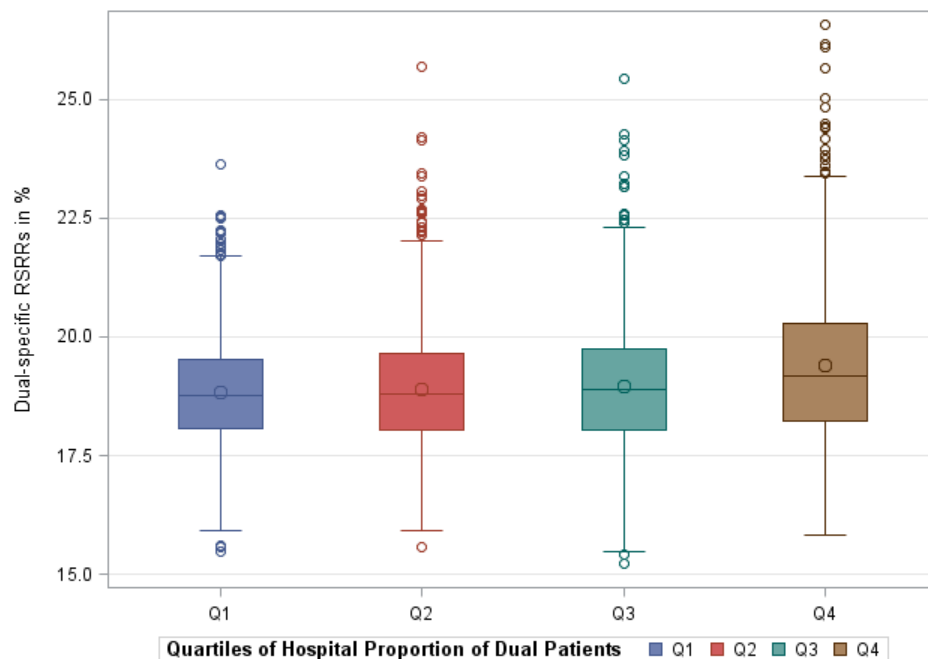
Figure 8 shows four box plots representing the distribution of dual-specific RSRRs, each for a different quartile of proportion of dual eligible patients in the measure cohort. That is, each box plot represents 25% of the hospitals according to the proportion of dual eligible patients hospitalized with an index admission for pneumonia, with hospitals having the smallest proportion represented on the left and hospitals having the largest proportion represented on the right. Figure 8 suggests that the mean readmission rate for dual eligible patients increases for hospitals with higher proportions of dual eligible patients.

Refer to [Table C3 in Appendix C](#) for more details.

**Figure 7. Distribution of Dual-Specific RSRRs by Quartiles of Hospital Index Admissions Volume for Pneumonia Readmission (N=2,968, for hospitals with at least 25 dual eligible patients)**



**Figure 8. Distribution of Dual-Specific RSRRs by Quartiles of Hospital Proportion of Dual Eligible Patients for Pneumonia Readmission (N=2,968)**



We also examined the distribution of readmission rates for dual eligible patients by other hospital characteristics using the AHA survey data (see [Appendix C](#)). Results show that dual-specific RSRRs do not



vary substantially by hospital type (hospital volume, proportion of dual eligible patients, bed size, safety-net hospital, critical access hospital, ownership status, teaching status, core-based statistical area, and region).

### **Relationship Between Dual-Specific RSRRs and Overall Hospital Quality**

Providing information about hospital performance for dual eligible patients should supplement the assessment of overall hospital quality provided through current readmission measures, which would remain unchanged. Shedding light on patterns of disparities by social risk factors and how they relate to overall hospital quality can help hospitals identify quality improvement targets.

Figure 9 shows that there exists a positive correlation of 0.68 (95% CI 0.66 to 0.70) between a hospital's dual-specific RSRR and its overall RSRR for pneumonia readmission. That is, hospitals that had worse performance in terms of their overall RSRR for pneumonia readmission tended to have larger dual-specific RSRRs.

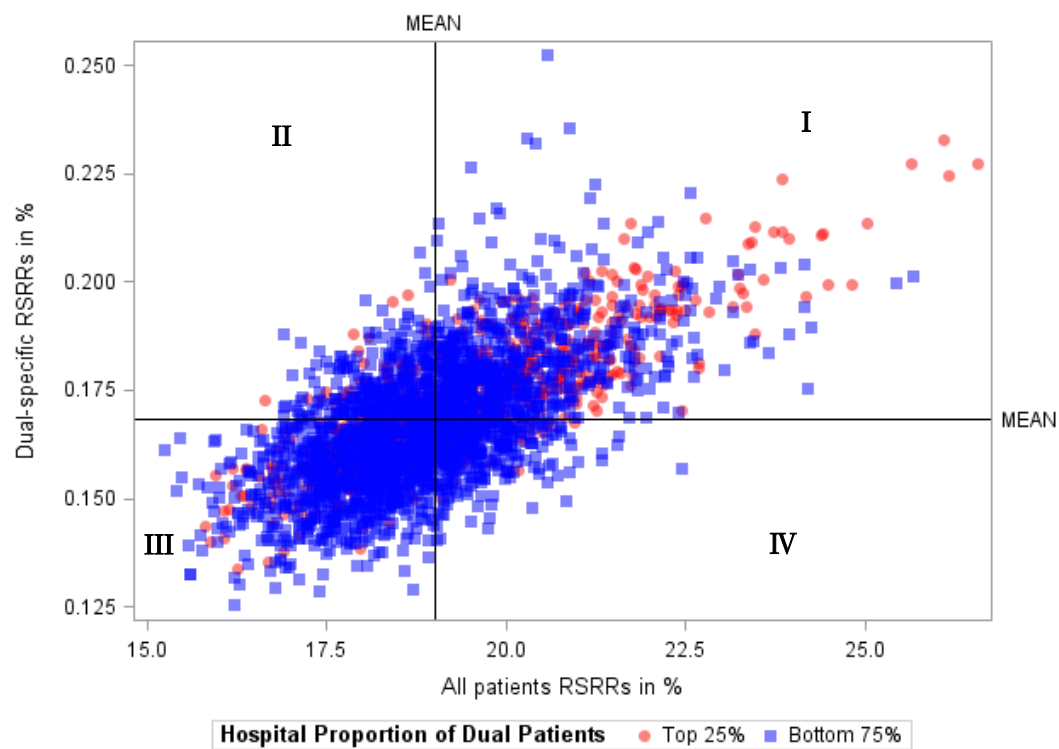
The quadrants in Figure 9 represent different types of relationships between a hospital's overall quality and dual-specific RSRR:

- I. Hospitals falling in quadrant I have above average readmission rates for all their patients and above average readmission rates for their dual eligible patients.
- II. Hospitals falling in quadrant II have lower than average readmission rates for all their patients, but have above average readmission rates for their dual eligible patients.
- III. Hospitals falling in quadrant III have lower than average readmission rates for all their patients and lower than average readmission rates for their dual eligible patients.
- IV. Hospitals falling in quadrant IV have above average readmission rates for all their patients, but lower than average readmission rates their dual eligible patients.

Figure 9 also shows that hospitals caring for a high proportion of dual eligible patients (red dots represent hospitals that care for the top 25% of dual eligible patients) are present in all four quadrants: 35% of hospitals caring for a high proportion of dual eligible patients fall in quadrant I; 21% fall in quadrant II; 21% fall in quadrant III; and 17% fall in quadrant IV.

This means that hospitals that care for a high proportion of dual eligible patients are only somewhat more likely to perform poorly (both overall and for their dual eligible patients). However, our results also show that a significant proportion of hospitals that care for a high share of dual eligible patients can be found among the best performers that provide high quality care overall and for their dual eligible patients (quadrant III).

**Figure 9. Relationship between Overall RSRR and Dual-Specific RSRR for Pneumonia Readmission (N=2,968)**



## 7.6 Questions for Public Comment

*We are particularly interested in feedback about making the disparities information usable. What information should be provided to hospitals and consumers if information on disparities goes into public reporting?*

## 8. Complementarity of Two Disparity Methods and Overall Hospital Quality

In Figure 10, we show how hospitals ( $n=3,581$ ) perform on the two disparity methods and the overall pneumonia readmission measure. The rows are first categorized by hospitals' dual-specific RSRRs. To create these categories, we divided hospitals into three equal groups, or terciles, based on their performance on dual-specific RSRRs (low, medium, and high).

Similarly, we created rows for hospitals' absolute rate difference in readmission between dual and non-dual eligible patients categorized in three levels (low, medium, and high). Finally, the overall hospital quality (overall RSRRs) is shown across the columns. For example, the first cell indicates that there are 680 hospitals that perform well on all three metrics. These hospitals are in the lowest third of hospitals based on their dual-specific RSRRs, the lowest third for within-hospital disparities, and the lowest third for overall readmission rates.

These results reveal that the two disparity methods are closely aligned. Hospitals with high dual-specific RSRRs (poorer performance for dual eligible patients) tend to have higher within-hospital disparities and higher overall readmission rates (poorer performance for all patients). Similarly, hospitals that have lower dual-specific RSRRs (better performance for dual eligible patients) tend to have lower within-hospital disparities and lower overall readmission rates (better performance for all patients). This finding is also reflected in the correlation between dual-specific RSRRs (Dual/Race Outcome Rate Method) and within-hospital disparities (Within-Hospital Disparity Method), which is as high as 0.939 (95% CI 0.935 to 0.942) and statistically significant ( $P\text{-value} < 0.001$ ).

Importantly, these results also suggest that the two methods complement each other and provide a more detailed understanding of quality of care and disparities. For instance, for 38 hospitals both the overall and the dual-specific RSRR is low, but the disparity effect is in the middle category. These hospitals are achieving good overall performance, but are not as successful at achieving equitable performance across patient subgroups.

**Figure 10. Complementarity of Two Disparity Methods with the Overall Pneumonia Readmission Measure (N=3,581)**

|                       |                | <div> <div>Better Overall Quality</div> <div>←</div> </div> |                  |                   |
|-----------------------|----------------|-------------------------------------------------------------|------------------|-------------------|
|                       |                | Low Overall RSRR                                            | Mid Overall RSRR | High Overall RSRR |
| <b>Low Dual RSRR</b>  | Low Disparity  | 680                                                         | 311              | 74                |
|                       | Mid Disparity  | 38                                                          | 55               | 34                |
|                       | High Disparity | 0                                                           | 0                | 1                 |
| <b>Mid Dual RSRR</b>  | Low Disparity  | 72                                                          | 9                | 40                |
|                       | Mid Disparity  | 285                                                         | 468              | 205               |
|                       | High Disparity | 20                                                          | 23               | 72                |
| <b>High Dual RSRR</b> | Low Disparity  | 0                                                           | 0                | 7                 |
|                       | Mid Disparity  | 28                                                          | 34               | 47                |
|                       | High Disparity | 70                                                          | 294              | 714               |

*Number of hospitals: 3,581*

## 9. Results for Additional Readmission Measures and Social Risk Factors

In the sections above, we described two methods for presenting disparities in hospital outcome measures. We applied both methods to a specific measure (pneumonia readmission) and social risk factor (dual eligibility). In this section, we provide results for additional readmission measures using both dual eligibility status and race as the social risk factor.

### 9.1 Overview of Additional Readmission Measure Specifications

We applied our two methods (the *Within-Hospital Disparity Method* and *Dual/Race Outcome Rate Method*) to the following six additional readmission measures: heart failure readmission (NQF #0330), acute myocardial infarction (AMI) readmission (NQF #0505), chronic obstructive pulmonary disease (COPD) readmission (NQF #1891), stroke readmission, coronary artery bypass surgery (CABG) readmission (NQF #2515), and total hip arthroplasty and/or knee arthroplasty (Hip/Knee) readmission (NQF #1551). Results for pneumonia readmission (NQF# 0506), described in detail above, are re-presented here for ease of comparability.

The condition-specific measures include admissions with a principal discharge diagnosis of AMI, heart failure, COPD, or stroke.

- The COPD measure cohort also includes admissions with a principal discharge diagnosis of acute respiratory failure and secondary diagnosis of COPD with exacerbation.

For the procedure-specific measures:

- The CABG measure includes admissions for patients with a qualifying isolated CABG surgery.
- The Hip/Knee measure includes elective primary Hip/Knee procedure during the index admission.

To be included in the measures, patients must be enrolled in Medicare FFS Part A and Part B for one year before their admission date, and enrolled in Part A during their index admission to ensure adequate data for risk adjustment. Patients who died during hospitalization or were discharged against medical advice were excluded from the measures.

For patients transferred to another acute care institution:

- The condition-specific (heart failure, AMI, COPD, and stroke) measures attribute readmission to the hospital that ultimately discharged the patient to a non-acute setting.
- The CABG readmission measure attributes readmission to the hospital that performed the surgery.
- The Hip/Knee readmission measure excludes transfer patients' admissions.

The inclusion and exclusion criteria for each measure cohort are described fully in the original methodology reports<sup>20</sup> and annual measure updates and specifications reports<sup>21</sup>.

### 9.2 Within-Hospital Disparity Method Results for Readmission Measures

Results presented in this section use a different data period than the one used for the pneumonia readmission analyses presented above (July 1, 2014 to June 30, 2017). Specifically, the analyses below

use Medicare administrative claims data for hospitalizations from July 1, 2012 to June 30, 2015 (data used for public reporting in calendar year 2016).

[Table 5](#) summarizes the results for the Within-Hospital Disparity Method for the seven readmission measures using dual eligibility as an indicator of social risk. The average observed disparity, which is the difference between the unadjusted readmission rates for all dual and non-dual eligible patients, varies from about 2% for Hip/Knee readmission to about 6% for CABG readmission ([Table 5](#), Column 2).

[Table 5](#), Column 3 provides information on the national overall disparity effect, which is fixed across hospitals and reflects disparities in readmission between dual and non-dual eligible patients after controlling for patients' comorbidities. The results show that the overall disparity odds ratio is greater than 1 and significant across all seven measures, indicating that *nationally dual eligible patients are more likely to get readmitted than non-dual eligible patients*.

We then report the median, minimum, maximum, and the 10<sup>th</sup> and 90<sup>th</sup> percentile for the absolute rate difference in readmission between dual and non-dual eligible patients at the hospital level for each measure ([Table 5](#), Column 4). The results show that, on average, readmission rates were higher among dual eligible patients compared to non-dual eligible patients for the seven measures examined and after risk adjusting for patients' comorbidities. The findings further indicate that the hospital absolute rate difference varied across hospitals. For example, the minimum and maximum absolute rate difference ranged from -1.11% to 3.56% for pneumonia readmission and from 0.52% to 1.88% for AMI readmission.

The variance of the hospital-specific disparity effect indicates that the effect of dual eligibility on readmission varies significantly across hospitals for pneumonia, COPD and Hip/Knee readmission, but not for AMI, heart failure, stroke, CABG, and Hip/Knee readmission.

The last column of [Table 5](#) shows how many hospitals we would publicly report the disparity results for if we apply the sample size cut-off as described in [Section 6.4](#) (at least 25 patients overall with 12 dual eligible patients and 12 non-dual eligible patients). Using this threshold, we can report within-hospital disparities for 3,778 (81%) of hospitals for pneumonia readmission, 3,077 (66%) of hospitals for COPD readmission, 2,987 (64%) of hospitals for heart failure readmission, 1,765 (40%) of hospitals for stroke readmission, 1,528 (36%) of hospitals for AMI readmission, 1,127 (32%) of hospitals for Hip/Knee readmission, and 269 (23%) of hospitals for CABG readmission.

Finally, there is a limited number of outlier hospitals across the seven readmission measures (results not shown in [Table 5](#)):

- For AMI and heart failure readmission, No hospitals with significant disparities;
- For CABG readmission, 112 (9.39%) hospitals with significant disparities in favor of non-dual eligible patients
- For COPD readmission, 1 (0.02%) hospital had significant disparities in favor of non-dual eligible patients;
- For Hip/Knee readmission, 3 (0.09%) in favor of non-dual eligible patients;
- For pneumonia readmission, 7 (0.15%) hospitals with significant disparities in favor of non-dual eligible patients; and,
- For stroke readmission 94 (2.12%) hospitals with significant disparities in favor of non-dual eligible patients.

**Table 5. Within-Hospital Disparity Method Results for Readmission Measures using Dual Eligibility**

| Readmission Measure  | Observed Disparity | National Overall Disparity Odds ratio | Median Absolute Rate Difference (min, 10 <sup>th</sup> , 90 <sup>th</sup> percentile, max) | Variance of Hospital-Specific Disparity Effect | Number of Hospitals for Reporting <sup>^</sup> (%) |
|----------------------|--------------------|---------------------------------------|--------------------------------------------------------------------------------------------|------------------------------------------------|----------------------------------------------------|
| <b>AMI</b>           | 5.7%               | 1.09***                               | 1.12%<br>(0.52%, 1.02%, 1.28%, 1.88%)                                                      | 0.006                                          | 1528 (36%)                                         |
| <b>CABG</b>          | 6.1%               | 1.21***                               | 2.35%<br>(-0.22%, 1.38%, 3.57%, 7.93%)                                                     | 0.012                                          | 269 (23%)                                          |
| <b>COPD</b>          | 4.0%               | 1.07***                               | 1.01%<br>(-0.66%, 0.68%, 1.44%, 3.06%)                                                     | 0.010**                                        | 3077 (66%)                                         |
| <b>Heart Failure</b> | 4.0%               | 1.07***                               | 1.10%<br>(0.34%, 0.92%, 1.32%, 2.21%)                                                      | 0.004                                          | 2987 (64%)                                         |
| <b>Hip/Knee</b>      | 2.3%               | 1.19***                               | 0.69%<br>(-0.86, 0.39%, 1.12%, 4.15%)                                                      | 0.101**                                        | 1127 (32%)                                         |
| <b>Pneumonia</b>     | 3.1%               | 1.05***                               | 0.60%<br>(-1.11%, 0.19%, 1.17%, 3.56%)                                                     | 0.011***                                       | 3778 (81%)                                         |
| <b>Stroke</b>        | 3.4%               | 1.11***                               | 1.08%<br>(0.57%, 0.94%, 1.30%, 2.08%)                                                      | 0.0004                                         | 1765 (40%)                                         |

\*p <0.05, \*\*p<0.01, \*\*\*p<0.001; ^ Hospitals with at least 25 patients overall and 12 dual and 12 non-dual eligible patients

### 9.3 Dual Outcome Rate Method Results for Readmission Measures

We applied the Dual Outcome Rate Method to the same seven readmission measures mentioned above using Medicare administrative claims data for hospitalizations from July 1, 2012 to June 30, 2015. [Table 6](#) summarizes the results.

The national observed readmission rate for dual eligible patients in the combined three-year dataset varied from 25.0% for heart failure readmission to 5.9% for Hip/Knee readmission ([Table 6](#), Column 2).

Similarly, the median dual-specific RSRR, which is the readmission rate for dual eligible patients after controlling for patients' comorbidities, varied from 25.1% for heart failure to 6.7% for Hip/Knee readmission ([Table 6](#), Column 3).

[Table 6](#), Column 4 also shows the between-hospital variance for the different readmission measures examined. Results indicate that the between-hospital variance is statistically significant across all seven readmission measures. This means that there is significant variation across hospitals for all seven readmission measures.

The last column of [Table 6](#) shows how many hospitals we would publicly report disparity results for if we apply the sample size cut-off as described in [Section 7.3](#) (at least 25 dual eligible patients). Using this threshold, we can report dual-specific RSRRs for 3,151 (69%) of hospitals for pneumonia readmission, 2,320 (53%) of hospitals for COPD readmission, 2,227 (50%) of hospitals for heart failure readmission, 1,038 (27%) of hospitals for stroke readmission, 900 (25%) for AMI readmission, 460 (15%) of hospitals for Hip/Knee readmission, and 65 (6%) of hospitals for CABG readmission.

**Table 6. Dual-Specific RSRR Results for Readmission Measures**

| Readmission Measure | Nationally Observed Readmission Rate for Duals | Median Dual-Specific RSRRs (min, 10 <sup>th</sup> , 90 <sup>th</sup> percentile, max) | Between Hospital Variance | Number of Hospitals for Reporting <sup>^</sup> (%) |
|---------------------|------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------|----------------------------------------------------|
| AMI                 | 22.1%                                          | 21.7%<br>(19.3%, 21.3%, 21.2%, 25.2%)                                                 | 0.0160***                 | 900 (25%)                                          |
| CABG                | 17.9%                                          | 19.9%<br>(17.0%, 19.3%, 20.8%, 23.5%)                                                 | 0.0395***                 | 65 (6%)                                            |
| COPD                | 22.8%                                          | 23.0%<br>(19.3%, 22.0%, 24.2%, 29.2%)                                                 | 0.0239***                 | 2320 (53%)                                         |
| Heart Failure       | 25.0%                                          | 25.1%<br>(21.6%, 24.2%, 27.0%, 30.1%)                                                 | 0.0212***                 | 2227 (50%)                                         |
| Hip/Knee            | 5.9%                                           | 6.7%<br>(4.5%, 6.3%, 7.4%, 11.2%)                                                     | 0.0902***                 | 460 (15%)                                          |
| Pneumonia           | 18.5%                                          | 19.3%<br>(14.3%, 19.9%, 21.1%, 28.9%)                                                 | 0.0349***                 | 3151 (69%)                                         |
| Stroke              | 15.3%                                          | 15.3%<br>(12.9%, 14.8%, 16.1%, 20.9%)                                                 | 0.0340***                 | 1038 (27%)                                         |

\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001; ^ Hospitals with at least 25 dual eligible patients

## 9.4 Overview of Disparity Method Results for Readmission Measures Using Race

We applied our two methods (Within-Hospital Disparity Method *and* Race Outcome Rate Method) using race as an indicator of social risk across the same seven readmission measures. Race and ethnicity disparities in health outcomes have been well established.<sup>12</sup> Specifically, black patients have been noted to have higher rates of hospital readmission within thirty days of discharge<sup>23,24</sup> although this finding has not been noted in all studies.<sup>25</sup>



As noted above, the variables for race and ethnicity available in Medicare administrative data are collected primarily from the Social Security Administration.<sup>26</sup> At present, Medicare administrative data for white and black patients appears to be more accurate than it is for other racial and ethnic groups.<sup>26,27</sup> As a result, we categorized beneficiaries only into *black* and *non-black* cohorts in this report.

### **9.5 Within-Hospital Disparity Method Results for Readmission Measures using Race (Black vs. Non-Black)**

The analyses presented below use Medicare administrative claims data for hospitalizations from July 1, 2012, to June 30, 2015.

[Table 7](#) summarizes the results for the Within-Hospital Disparity Method for the seven readmission measures, using black race as an indicator of social risk. The average observed disparity, which is the difference between the unadjusted readmission rates for all black and non-black patients, varies from about 1.05% for Hip/Knee readmission to about 4.81% for pneumonia readmission ([Table 7](#), Column 2).

We then provide information on the national overall disparity effect, which is fixed across hospitals and reflects outcome disparities between black and non-black patients after controlling for patients' comorbidities ([Table 7](#), Column 3). The results show that the overall disparity odds ratio is greater than 1 and significant across most readmissions measures (except for CABG readmission), indicating that, nationally, black patients are more likely to get readmitted than non-black patients.

[Table 7](#), Column 4 reports the median, minimum, maximum, and the 10<sup>th</sup> and 90<sup>th</sup> percentile for the absolute rate difference between black and non-black patients at the hospital level for each measure. The results show that, on average, the absolute readmission rates were higher among black patients compared to non-black patients for the seven measures examined and after risk adjusting for patients' comorbidities. The findings further indicate, that the hospital-specific absolute rate difference varied across hospitals. For example, the absolute rate difference ranged from 0.92% to 3.76% for pneumonia readmission and from -0.97% to 5.28% for AMI readmission.

The variance of the hospital-specific effect indicates that the effect of black race on readmission differs significantly across hospitals for pneumonia, COPD, Hip/Knee, and AMI readmissions, but not heart failure, stroke and CABG readmissions.

We also present how many hospitals would be able to report disparity results if we applied the sample size cut-off described above in [Section 6.4](#) (at least 25 patients overall with 12 black patients and 12 non-black patients). Using this threshold, we could report within-hospital disparities for 1,636 (35%) of hospitals for pneumonia readmission, 1,580 (35%) of hospitals for heart failure readmission, 1,331 (29%) for COPD readmission, 884 (25%) of hospitals for Hip/Knee readmission, 992 (22%) of hospitals for stroke readmission, 763 (18%) of hospitals for AMI readmission, and 180 (15%) of hospitals for CABG readmission.

**Table 7. Within-Hospital Disparity Method Results for Readmission Measures using Race (Black vs. Non-Black)**

| Readmission Measure  | Observed Disparity | National Overall Disparity Odds Ratio | Median Absolute Rate Difference (min, 10 <sup>th</sup> , 90 <sup>th</sup> percentile, max) | Variance of the Hospital-Specific Effect | Number of Hospitals for Reporting <sup>^</sup> (%) |
|----------------------|--------------------|---------------------------------------|--------------------------------------------------------------------------------------------|------------------------------------------|----------------------------------------------------|
| <b>AMI</b>           | 4.72%              | 1.078 ***                             | 0.89%<br>(-0.97%, 0.58%, 1.18%, 5.28%)                                                     | 0.029**                                  | 763 (18%)                                          |
| <b>CABG</b>          | 3.00%              | 1.040                                 | 0.46%<br>(-1.22%, -0.19%, 1.31%, 4.43%)                                                    | 0.009                                    | 180 (15%)                                          |
| <b>COPD</b>          | 2.34%              | 1.029 *                               | 0.43%<br>(-1.46%, 0.16%, 0.69%, 2.94%)                                                     | 0.0147**                                 | 1331 (29%)                                         |
| <b>Hip/Knee</b>      | 1.05%              | 1.086 **                              | 0.32%<br>(-0.73%, 0.20%, 0.56%, 1.74%)                                                     | 0.062**                                  | 884 (25%)                                          |
| <b>Heart Failure</b> | 2.86%              | 1.042 ***                             | 0.68%<br>(0.32%, 0.58%, 0.82%, 1.44%)                                                      | 0.001                                    | 1580 (35%)                                         |
| <b>Pneumonia</b>     | 4.81%              | 1.148 ***                             | 1.89%<br>(0.92%, 1.65%, 2.24%, 3.76%)                                                      | 0.006 *                                  | 1636 (35%)                                         |
| <b>Stroke</b>        | 4.43%              | 1.182 ***                             | 1.77%<br>(0.82%, 1.53%, 2.21%, 3.72%)                                                      | 0.006                                    | 992 (22%)                                          |

\*p <0.05, \*\*p<0.1, \*\*\*p<0.001; ^ Hospitals with at least 25 patients overall and 12 black and 12 non-black patients

## 9.6 Race Outcome Rate Method Results for Readmission Measures (Black vs. Non-Black)

We applied the Race Outcome Rate Method, using black race as an indicator of social risk, to the same seven readmission measures mentioned above with data used in public reporting in 2016. [Table 8](#) summarizes the results.

The national observed readmission rate for black patients in the combined three-year dataset varied from 24.4% for heart failure readmission to 5.6% for Hip/Knee readmission ([Table 8](#), Column 2). Similarly, the median black-specific RSRR, which is the readmission rate for black patients after controlling for patients' comorbidities, varied from 24.4% for heart failure to 5.6% for Hip/Knee readmission (Table 8, Column 3).

The between-hospital variance for the different readmission measures indicates that there is significant variation across hospitals for all seven readmission measures.

We also present how many hospitals we would publicly report disparity results for if we apply the sample size cut-off as described in [Section 7.3](#) (at least 25 black patients). Using this threshold, we can

report black-specific RSRRs for 1,149 (38%) of hospitals for heart failure readmission, 1,126 (34%) of hospitals for pneumonia readmission, 852 (30%) of hospitals for COPD readmission, 624 (23%) of hospitals for stroke readmission, 482 (21%) of hospitals for Hip/Knee readmission, 447 (21%) for AMI readmission, and 64 (7.1%) of hospitals for CABG readmission.

**Table 8. Race Outcome Rate Method Results for Readmission Measures (Black vs. Non-Black)**

| Readmission measure  | Nationally observed readmission rate for Black Patients | Median Black-specific RSRRs (Min, 10 <sup>th</sup> , 90 <sup>th</sup> percentile, Max) | Between hospital variance | Number of Hospitals for reporting <sup>^</sup> (%) |
|----------------------|---------------------------------------------------------|----------------------------------------------------------------------------------------|---------------------------|----------------------------------------------------|
| <b>AMI</b>           | 21.2%                                                   | 21.1%<br>(18.0%, 20.6%, 21.9%, 26.2%)                                                  | 0.026***                  | 447(21%)                                           |
| <b>CABG</b>          | 17.2%                                                   | 17.1%<br>(13.4%, 16.4%, 18.3%, 21.5%)                                                  | 0.060                     | 64 (7.1%)                                          |
| <b>COPD</b>          | 22.1%                                                   | 22.0%<br>(18.7%, 21.4%, 22.8%, 26.3%)                                                  | 0.022***                  | 852 (30%)                                          |
| <b>Heart Failure</b> | 24.4%                                                   | 24.4%<br>(21.0%, 23.6%, 25.3%, 30.0%)                                                  | 0.020***                  | 1149 (38%)                                         |
| <b>Hip/Knee</b>      | 5.6%                                                    | 5.6%<br>(4.0%, 5.3%, 6.0%, 7.6%)                                                       | 0.020***                  | 482 (21%)                                          |
| <b>Pneumonia</b>     | 21.5%                                                   | 21.5%<br>(17.7%, 20.8%, 22.4%, 27.5%)                                                  | 0.023***                  | 1126 (34%)                                         |
| <b>Stroke</b>        | 16.5%                                                   | 16.4%<br>(13.2%, 15.8%, 17.2%, 20.3%)                                                  | 0.031***                  | 624 (23%)                                          |

\*p <0.05, \*\*p<0.01, \*\*\*p<0.001; ^ Hospitals with at least 25 black patients

## **10. Conclusion**

### **10.1 Summary**

The aim of examining quality for patients with social risk factors is to illuminate disparities, incentivize quality improvement for vulnerable populations, and allow consumers to make informed choices. To this end, we developed two complementary methods that assess hospital performance for patients with social risk factors:

1. The Within-Hospital Disparity Method illuminate's differences in outcomes for patient groups based on social risk factors within a hospital.
2. The Dual/Race Outcome Rate Method allows for comparison of performance in care for patients with social risk factors across hospitals.

Both disparity methods are designed to be publicly reported in conjunction with overall hospital performance measures, since both disparity results and overall performance measures provide important but distinct information.

The two methods described in this report can be generalized to a wider set of patient-level social risk factors, such as SES, race, ethnicity, and gender. In addition, they can be applied to a variety of risk-adjusted outcome measures, such as mortality and complication measures.

In this report, we mainly focused on the 30-day pneumonia readmission measure (NQF #0506) using data from July 2014 to June 2017 and dual eligibility status as the social risk factor. We also provided results for six additional readmission measures (heart failure (NQF #0330), AMI (NQF #0505), COPD (NQF #1891), stroke, CABG (NQF #2515), and Hip/Knee readmission (NQF #1551)), along with two social risk indicators (dual eligibility status and race).

### **10.2 Results**

#### **Results for Pneumonia Readmission and Dual Eligibility**

Results from the Within-Hospital Disparity Method for pneumonia readmission indicated that dual eligible patients are, on average, more likely to be readmitted compared to non-dual eligible patients from the same hospital. The mean hospital absolute rate difference in readmission between dual and non-dual eligible patients is 0.62%. Importantly, results showed that within-hospital disparities in readmission rates vary significantly across different hospitals. Specifically, the absolute rate difference ranged from -0.54% to 2.93% across hospitals.

Similarly, results for the Dual Eligible Outcome Rate Method for pneumonia readmission showed that dual-specific readmission rates vary significantly across hospitals. The mean RSRR for dual eligible patients is 19.0%, with a range from 15.2% to 26.6% across hospitals.

## Results for Additional Readmission Measures and Social Risk Factors

### Results from the Within-Hospital Disparity Method

Results indicated that following hospitalizations for heart failure, AMI, COPD, stroke, CABG, and Hip/Knee readmission, dual eligible patients are, on average, more likely to be readmitted compared to non-dual eligible patients from the same hospital. The mean absolute rate difference in readmission between dual and non-dual eligible patients at the hospital level ranged from 0.70% for Hip/Knee readmission to 2.35% for CABG readmission. Results showed that within-hospital disparities in readmission rates vary significantly across different hospitals for some of these measures (pneumonia, COPD, and Hip/Knee readmission).

Similarly, results indicated that black patients are, on average, more likely to be readmitted compared to non-black patients from the same hospital for all readmission measures. The mean absolute rate difference in readmission between black and non-black patients at the hospital level ranged from 0.43% for COPD readmission to 1.89% for pneumonia readmission. Again, results showed that within-hospital disparities in readmission rates varied significantly across different hospitals for some of the measures examined (AMI, pneumonia, COPD, and Hip/Knee readmission).

### Results from the Dual/Race Outcome Rate Method

Results for the Dual/Race Outcome Rate Method showed that dual-specific readmission rates vary significantly across hospitals for all measures, except for CABG readmission. The mean RSRR for dual eligible patients at the hospital level is as low as 6.76% for the Hip/Knee readmission measure and as high as 25.21% for the heart failure measure.

Likewise, results for the Race Outcome Rate Method showed that black-specific readmission rates vary significantly across hospitals for all of measures. The mean RSRR for black patients ranges at the hospital level is as low as 5.55% for the Hip/Knee readmission measure and as high as to 24.51% for the heart failure readmission measure.

## 10.3 Limitations

The outlined disparity methods have certain limitations. First, our approach is limited by the availability of information on social risk factors in claims data. However, the social risk factor used in this report, dual eligibility, is generally available and accurately measured in claims data.<sup>1</sup> While some state-by-state variation in full benefit dual eligibility thresholds exists, our analysis finds this to be relatively small in the older adult (>65 years of age) population. This social risk factor captures patient attributes for which there is strong evidence of substantial disparities in health outcomes.<sup>6,7</sup>

Another limitation relates to the small sample sizes associated with specific cohorts. The examination of healthcare quality for subgroups of patients naturally results in smaller sample sizes. To ensure reliability of results we propose a minimum threshold of patients for reporting disparity results, though this means we cannot report results for all hospitals.

Finally, a practical limitation is that we did not account for overlapping social risk factors. Some patients might share multiple risk factors, such as dual eligibility, a non-dominant race, and a disability. These social risk factors might interact with each other or be more or less predominant at certain hospitals.

The aspiration of reporting on disparities is that the measures will illuminate important differences in quality which can then lead to further investigation by hospitals into the particular unique characteristics of their patient population as a means of finding solutions.

#### **10.4 Implications**

Taken together, our results show that the Within-Hospital Disparity Method and the Dual/Race Outcome Rate Method are technically feasible. The results support previous work which has demonstrated disparities in hospital outcomes for individuals with social risk factors. The methods reveal meaningful variation across hospitals for both within-hospital disparities and outcome rates for patients with social risk factors. This suggests an opportunity for improvement of hospital performance for dual eligible patients that could be incentivized by reporting hospitals' calculated disparities and dual-specific readmission rates.

The results for both disparity methods are specific to the social risk factor and outcome measure used. Results for other measures and social risk factors may differ in terms of hospitals' performance for patients with social risk factors, degree of variation across hospitals, and number of outlier hospitals.

## 11. References

1. Buntin MB, Ayanian JZ. Social Risk Factors and Equity in Medicare Payment. *New England Journal of Medicine*. 2017;376(6):507-510.
2. Joynt KE, Orav E, Jha AK. Thirty-Day Readmission Rates for Medicare Beneficiaries by Race and Site of Care. *JAMA*. 2011;305(7):675-681.
3. Lindenauer PK, Lagu T, Rothberg MB, et al. Income Inequality and 30 Day Outcomes After Acute Myocardial Infarction, Heart Failure, and Pneumonia: Retrospective Cohort Study. *British Medical Journal*. 2013;346.
4. Trivedi AN, Nsa W, Hausmann LRM, et al. Quality and Equity of Care in U.S. Hospitals. *New England Journal of Medicine*. 2014;371(24):2298-2308.
5. Jha AK. Changing my mind on SES Risk Adjustment. *An Ounce of Evidence: Health Policy*. Vol 20182014.
6. Assistant Secretary for Planning and Evaluation (ASPE). Report to Congress: Social Risk Factors and Performance Under Medicare's Value-Based Purchasing Programs. 2016; <https://aspe.hhs.gov/pdf-report/report-congress-social-risk-factors-and-performance-under-medicares-value-based-purchasing-programs>. Accessed June 21, 2018.
7. Dickman SL, Himmelstein DU, Woolhandler S. Inequality and the Health-Care System in the USA. *The Lancet*. 2017;389(10077):1431-1441.
8. Institute of Medicine. *Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care*. Washington DC: 2002 by the National Academy of Sciences; 2003.
9. Institute of Medicine. *How Far Have We Come in Reducing Health Disparities? Progress Since 2000: Workshop Summary*. Washington DC: National Academy of Sciences; 2012.
10. Ayanian JZ. The Costs of Racial Disparities in Health Care. 2016; <https://catalyst.nejm.org/the-costs-of-racial-disparities-in-health-care/>. Accessed July 2, 2018.
11. Kaiser Family Foundation. Focus on Health Care Disparities: Key Facts. 2012; <https://kaiserfamilyfoundation.files.wordpress.com/2013/01/8396.pdf>. Accessed July 2, 2018.
12. The National Academies of Sciences E, and Medicine,. *Accounting for Social Risk Factors in Medicare Payment: Identifying Social Risk Factors*. Washington DC: The National Academies Press; 2016.
13. Finding Answers: Solving Disparities Through Payment and Delivery System Reform 2017; <http://www.solvingdisparities.org/>. Accessed July 2, 2018.
14. Chin MH, Clarke AR, Nocon RS, et al. A Roadmap and Best Practices For Organizations to Reduce Racial and Ethnic Disparities in Health Care. *J Gen Intern Med*. 2012;27(8):992-1000.
15. Chin MH, Walters AE, Cook SC, Huang ES. Interventions to Reduce Racial and Ethnic Disparities in Health Care. *Medical Care Research and Review*. 2007;64(5\_suppl):7S-28S.
16. Schlotthauer AE, Badler A, Cook SC, Perez DJ, Chin MH. Evaluating Interventions to Reduce Health Care Disparities: An RWJF Program. *Health Aff (Millwood)*. 2008;27(2):568-573.
17. The National Academies of Sciences E, and Medicine,. *Systems Practices for the Care of Socially At-Risk Populations*. Washington DC: National Academies Press; 2016.
18. Krumholz HM, Brindis RG, Brush JE, et al. Standards for Statistical Models Used for Public Reporting of Health Outcomes: An American Heart Association Scientific Statement from the Quality of Care and Outcomes Research Interdisciplinary Writing Group: Cosponsored by the Council on Epidemiology and Prevention and the Stroke Council Endorsed by the American College of Cardiology Foundation. . *Circulation*. 2006;113(3):456-462.
19. National Quality Forum (NQF). Measure Evaluation Criteria and Guidance for Evaluating Measures for Endorsement. 2016; [https://www.qualityforum.org/Projects/i-m/Measure\\_Evaluation\\_Guidance/Measure\\_Evaluation\\_Guidance.aspx](https://www.qualityforum.org/Projects/i-m/Measure_Evaluation_Guidance/Measure_Evaluation_Guidance.aspx). Accessed July 2, 2018.

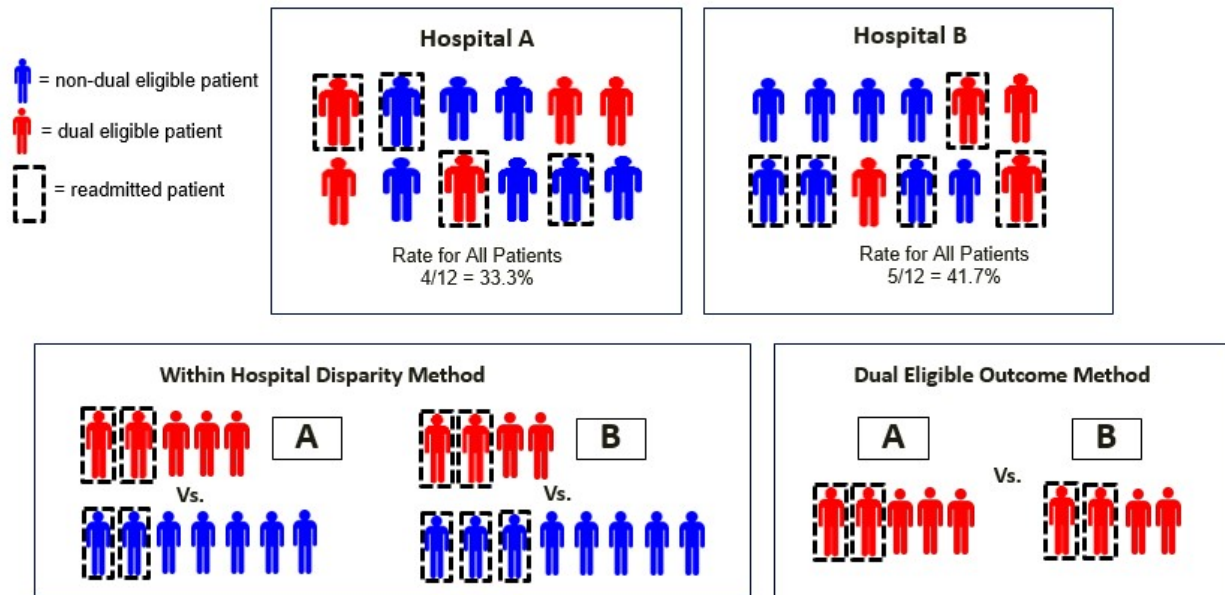
20. Krumholz H, Normand SL, Keenan P, et al. Hospital 30-Day Pneumonia Readmission Measure Methodology. 2008;  
<https://www.qualitynet.org/dcs/ContentServer?c=Page&pagename=QnetPublic%2FPage%2FQnetTier4&cid=1219069855841>. Accessed February 8, 2018.
21. Simoes J, Grady J, DeBuhr J, al. E. 2018 Condition-Specific Measures Updates and Specifications Report: Hospital-Level 30-Day Risk-Standardized Readmission Measures. . 2018.
22. Proctor K, Hodge C. Validating Medicare’s Race and Ethnicity Data. CMS, Office of Minority Health Using 2010 and 2000 Census data and 2011-2009 American Community Survey.
23. Calvillo–King ML, Arnold D, Eubank KJ, et al. Impact of Social Factors on Risk of Readmission or Mortality in Pneumonia and Heart Failure: Systematic Review *Journal of General Internal Medicine*. 2012;28:269-282.
24. Damiani G, Salvatori E, Silvestrini G, et al. Influence of socioeconomic factors on hospital readmissions for heart failure and acute myocardial infarction in patients 65 years and older: evidence from a systematic review. *Clinical Interventions in Aging*. 2015;10:237-245.
25. Ross JS, Mulvey GK, Stauffer B, et al. Statistical models and patient predictors of readmission for heart failure: A systematic review. *Archives of Internal Medicine*. 2008;168(13):1371-1386.
26. Filice CE, Joynt KE. Examining Race and Ethnicity Information in Medicare Administrative Data. *Medical Care*. 2017;55(12):e170-e176.
27. Zaslavsky AM, Ayanian JZ, Zaboriski LB. The Validity of Race and Ethnicity in Enrollment Data for Medicare Beneficiaries. *Health Services Research*. 2012;47(3pt2):1300-1321.
28. Fremont A, Weissman J, Hoch E, Elliott M. When Race/Ethnicity Data Are Lacking: Using Advanced Indirect Estimation Methods to Measure Disparities. *RAND Health Quarterly* 2016;6(1):16.



## 12. Appendices

### Appendix A: Overview of Two Disparity Methods

Figure A1. Two Methods for Uncovering Disparities in Health Outcomes



## Appendix B: Within-Hospital Disparity Method Results for Pneumonia Readmission

**Table B1. Summary of Absolute Rate Difference in Readmission between Dual and Non-Dual Eligible Patients**

| Hospital             | N     | Mean  | SD    | Median | Min    | 5 <sup>th</sup><br>Percentile | 10 <sup>th</sup><br>Percentile | 25 <sup>th</sup><br>Percentile | 75 <sup>th</sup><br>Percentile | 90 <sup>th</sup><br>Percentile | 95 <sup>th</sup><br>Percentile | Max   |
|----------------------|-------|-------|-------|--------|--------|-------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|-------|
| All Hospitals        | 4,764 | 0.62% | 0.35% | 0.57%  | -0.54% | 0.12%                         | 0.24%                          | 0.42%                          | 0.77%                          | 1.04%                          | 1.27%                          | 2.93% |
| Reporting Hospitals* | 3,689 | 0.63% | 0.39% | 0.58%  | -0.54% | 0.09%                         | 0.20%                          | 0.37%                          | 0.82%                          | 1.11%                          | 1.34%                          | 2.93% |

\*Reporting hospitals have at least 25 patients overall and 12 dual eligible and 12 non-dual eligible patients

**Table B2. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Hospital Volume of Index Admissions\* (N=3,689)**

| Hospital Volume | N   | Mean  | SD    | Median | Min    | 25 <sup>th</sup><br>Percentile | 75 <sup>th</sup><br>Percentile | Max   |
|-----------------|-----|-------|-------|--------|--------|--------------------------------|--------------------------------|-------|
| Q1              | 934 | 0.56% | 0.22% | 0.54%  | -0.00% | 0.40%                          | 0.70%                          | 1.42% |
| Q2              | 914 | 0.58% | 0.33% | 0.55%  | -0.22% | 0.34%                          | 0.77%                          | 2.15% |
| Q3              | 913 | 0.66% | 0.42% | 0.62%  | -0.54% | 0.39%                          | 0.89%                          | 2.64% |
| Q4              | 928 | 0.70% | 0.52% | 0.65%  | -0.54% | 0.35%                          | 0.99%                          | 2.93% |

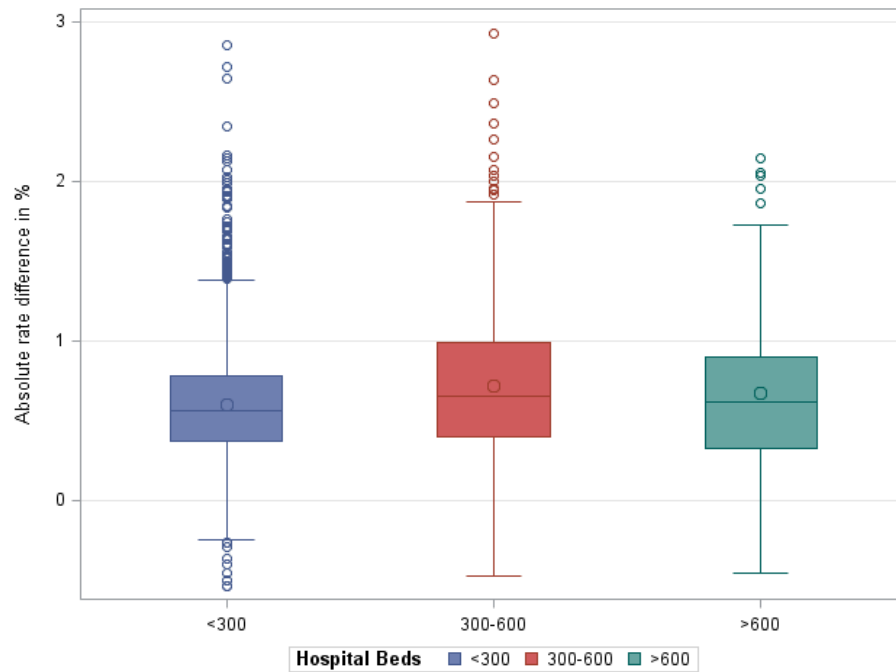
\* Q1: ≤ 129; Q2: 129 to 268; Q3: 268 -512; Q4: ≥ 512

**Table B3. Distribution of Absolute Rate Difference in Readmission between Dual and Non-Dual Eligible Patients by Proportion of Dual Eligible Patients in the Pneumonia Measure Cohort\* (N=3,689)**

| Proportion of Dual Eligible Patients | N   | Mean  | SD    | Median | Min    | 25 <sup>th</sup><br>Percentile | 75 <sup>th</sup><br>Percentile | Max   |
|--------------------------------------|-----|-------|-------|--------|--------|--------------------------------|--------------------------------|-------|
| Q1                                   | 925 | 0.62% | 0.38% | 0.58%  | -0.46% | 0.37%                          | 0.82%                          | 2.25% |
| Q2                                   | 920 | 0.60% | 0.39% | 0.55%  | -0.47% | 0.35%                          | 0.80%                          | 2.93% |
| Q3                                   | 923 | 0.62% | 0.38% | 0.58%  | -0.54% | 0.38%                          | 0.79%                          | 2.86% |
| Q4                                   | 921 | 0.67% | 0.40% | 0.62%  | -0.54% | 0.40%                          | 0.87%                          | 2.72% |

\* Q1: ≤ 17.1%; Q2: 17.1% to 23.7%; Q3: 23.7% -33.1%; Q4: ≥ 33.1%

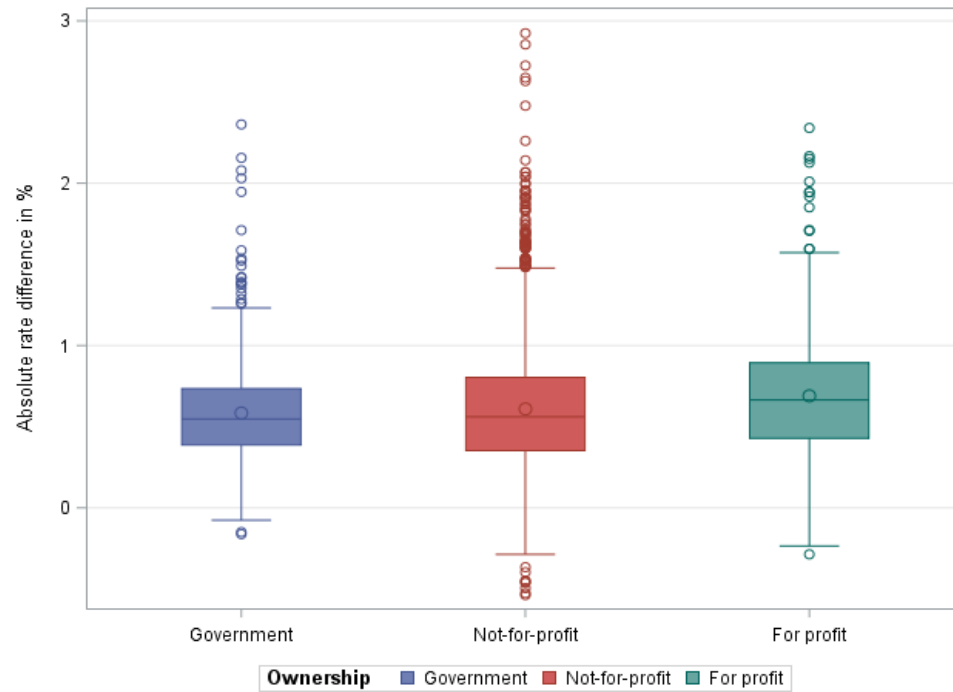
**Figure B1. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Hospital Bed Size (N=3,541)**



**Table B4. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Hospital Bed Size (N=3,541)**

| Hospital Bed Size | N    | Mean  | SD    | Median | Min    | 25 <sup>th</sup> Percentile | 75 <sup>th</sup> Percentile | Max   |
|-------------------|------|-------|-------|--------|--------|-----------------------------|-----------------------------|-------|
| < 300             | 2808 | 0.59% | 0.35% | 0.56%  | -0.54% | 0.37%                       | 0.78%                       | 2.86% |
| 300-600           | 557  | 0.72% | 0.49% | 0.65%  | -0.47% | 0.40%                       | 0.99%                       | 2.93% |
| > 600             | 176  | 0.67% | 0.49% | 0.61%  | -0.46% | 0.33%                       | 0.90%                       | 2.15% |

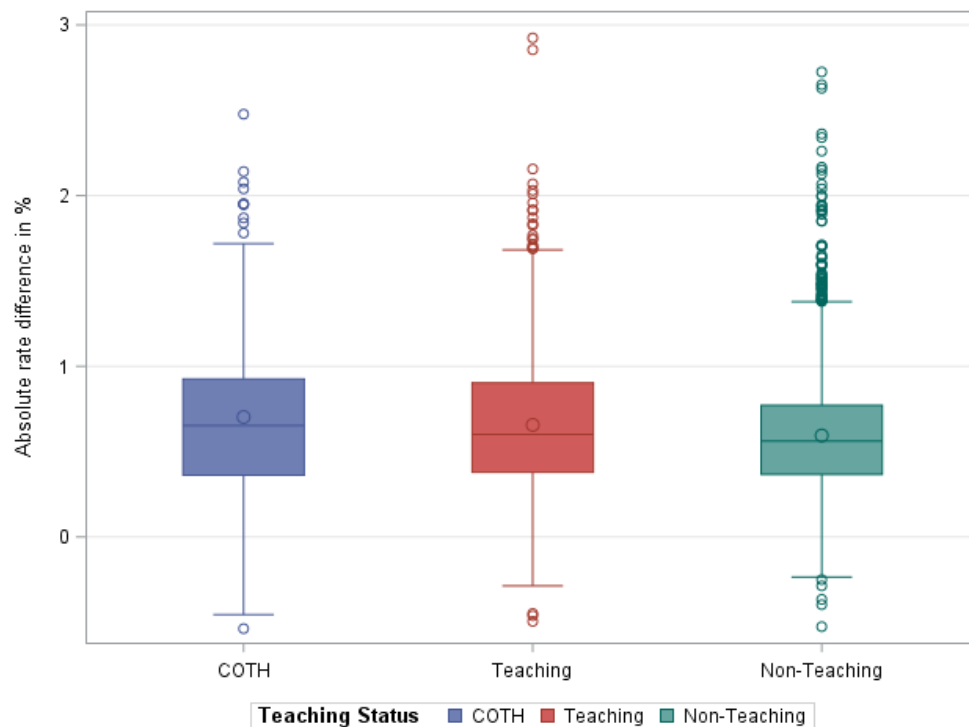
**Figure B2. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Hospital Ownership Status (N=3,541)**



**Table B5. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Hospital Ownership Status (N=3,541)**

| Hospital Ownership Status | N    | Mean  | SD    | Median | Min    | 25 <sup>th</sup> Percentile | 75 <sup>th</sup> Percentile | Max   |
|---------------------------|------|-------|-------|--------|--------|-----------------------------|-----------------------------|-------|
| Government                | 701  | 0.58% | 0.32% | 0.55%  | -0.16% | 0.39%                       | 0.74%                       | 2.36% |
| Not-for-profit            | 2236 | 0.61% | 0.40% | 0.56%  | -0.54  | 0.35%                       | 0.80%                       | 2.93% |
| For profit                | 604  | 0.69% | 0.39% | 0.66%  | -0.29% | 0.43%                       | 0.89%                       | 2.34% |

**Figure B3. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Hospital Teaching Status (N=3,541)**

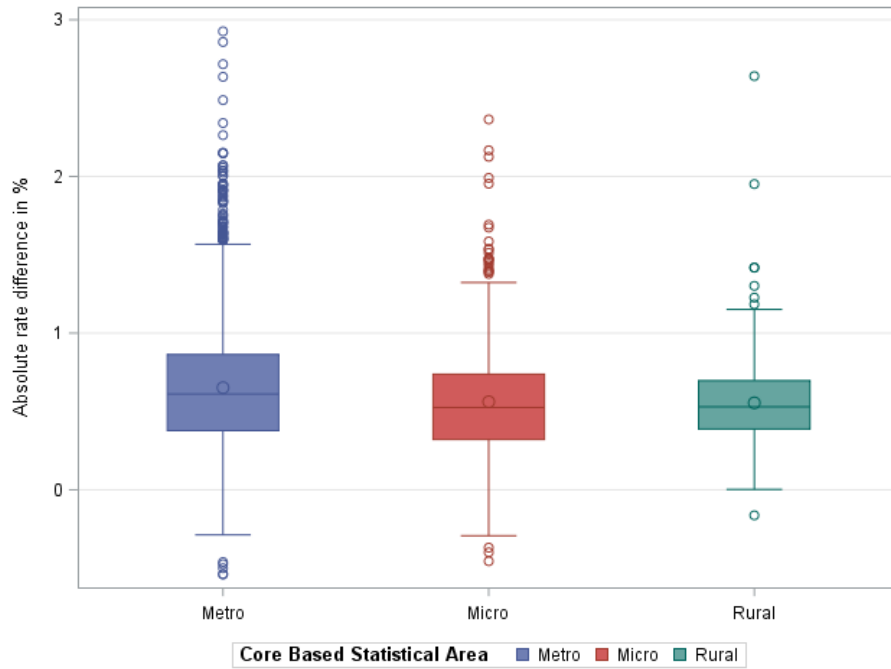


**Table B6. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Hospital Teaching Status (N=3,541)**

| Hospital Teaching Status | N    | Mean  | SD    | Median | Min    | 25 <sup>th</sup> Percentile | 75 <sup>th</sup> Percentile | Max   |
|--------------------------|------|-------|-------|--------|--------|-----------------------------|-----------------------------|-------|
| COTH*                    | 227  | 0.70% | 0.49% | 0.65%  | -0.54% | 0.36%                       | 0.92%                       | 2.49% |
| Teaching                 | 922  | 0.65% | 0.43% | 0.60%  | -0.50% | 0.38%                       | 0.90%                       | 2.93% |
| Non-teaching             | 2392 | 0.59% | 0.35% | 0.56%  | -0.54% | 0.36%                       | 0.77%                       | 2.72% |

\*Council of Teaching Hospitals and Health Systems (COTH)

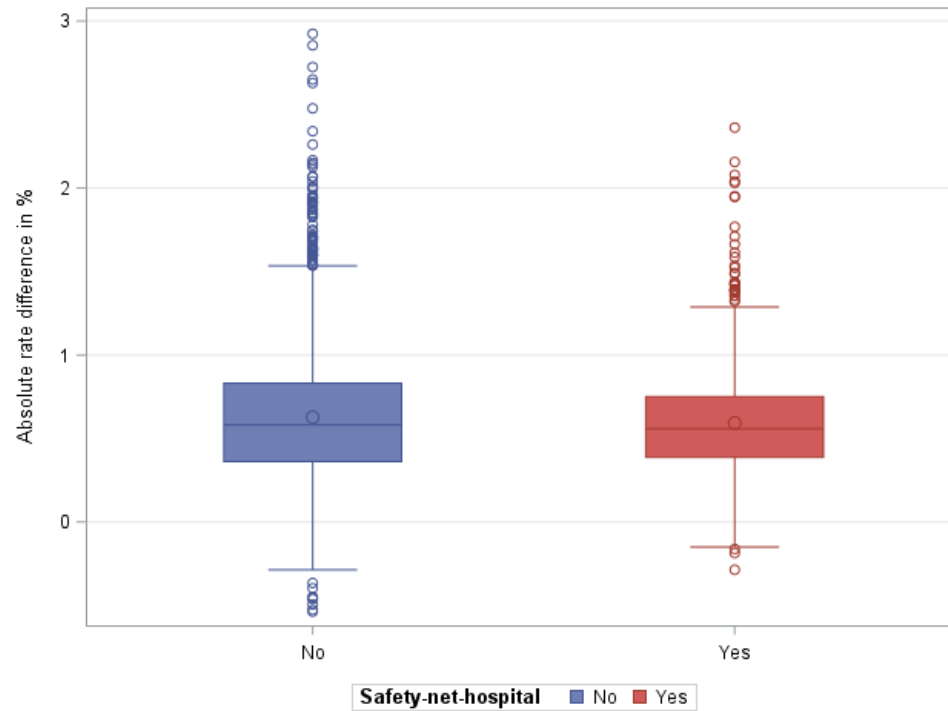
**Figure B4. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Hospital Core-Based Statistical Area (N=3,541)**



**Table B7. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Hospital Core-Based Statistical Area (N=3,541)**

| Hospital Core-Based Statistical Area | N    | Mean  | SD    | Median | Min    | 25 <sup>th</sup> Percentile | 75 <sup>th</sup> Percentile | Max   |
|--------------------------------------|------|-------|-------|--------|--------|-----------------------------|-----------------------------|-------|
| Metro                                | 2213 | 0.65% | 0.42% | 0.61%  | -0.54% | 0.38%                       | 0.86%                       | 2.93% |
| Micro                                | 643  | 0.56% | 0.36% | 0.53%  | -0.46% | 0.32%                       | 0.74%                       | 2.36% |
| Rural                                | 685  | 0.55% | 0.26% | 0.53%  | -0.16% | 0.39%                       | 0.70%                       | 2.64% |

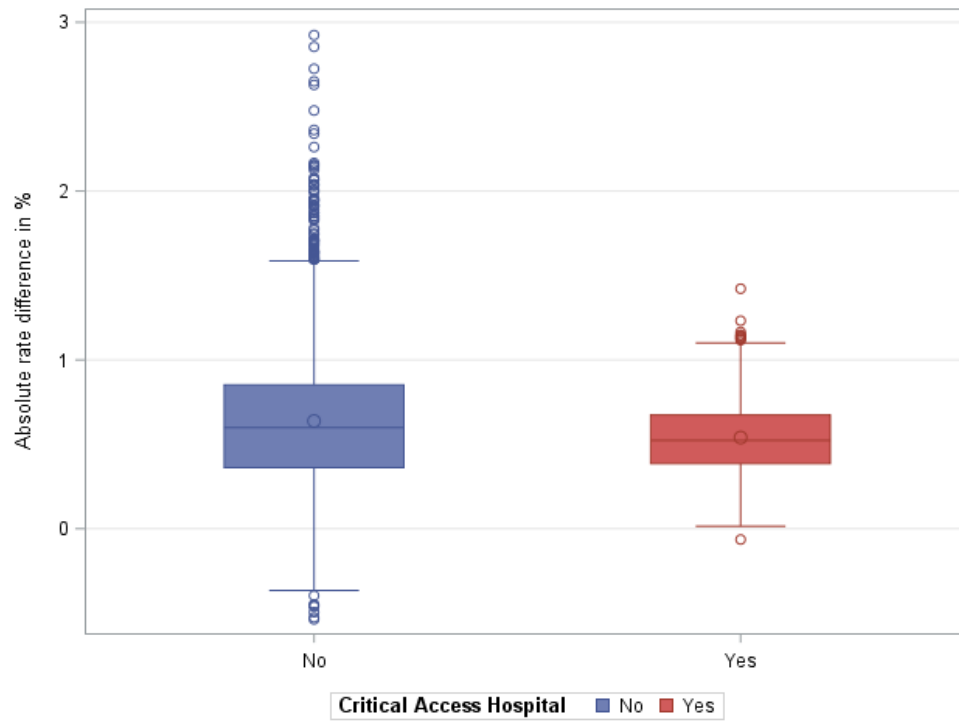
**Figure B5. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Safety-Net Hospital (N=3,541)**



**Table B8. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Safety-Net Hospital (N=3,541)**

| Safety-Net Hospital | N    | Mean  | SD    | Median | Min    | 25 <sup>th</sup> Percentile | 75 <sup>th</sup> Percentile | Max   |
|---------------------|------|-------|-------|--------|--------|-----------------------------|-----------------------------|-------|
| No                  | 2566 | 0.63% | 0.40% | 0.58%  | -0.54% | 0.36%                       | 0.83%                       | 2.93% |
| Yes                 | 975  | 0.59% | 0.33% | 0.56%  | -0.29% | 0.39%                       | 0.75%                       | 2.36% |

**Figure B6. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Critical Access Hospital (N=3,541)**

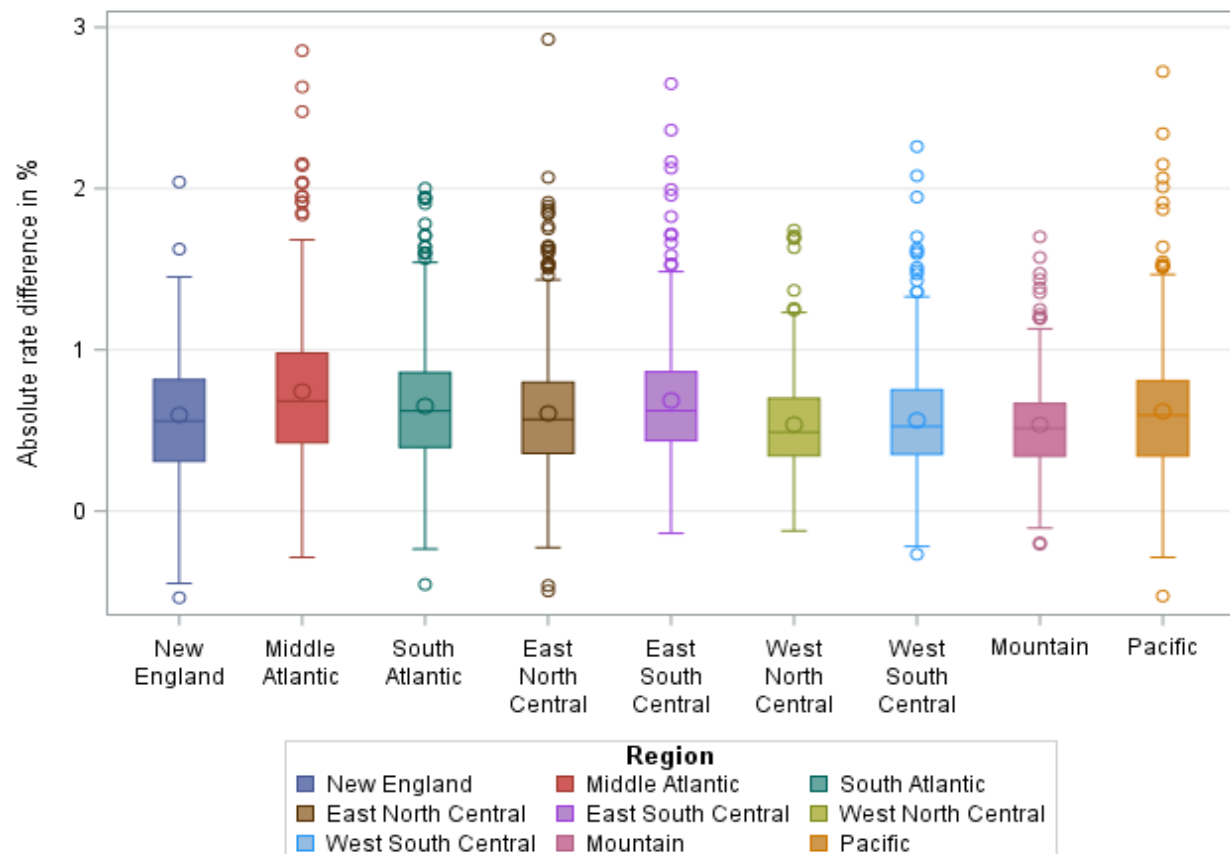


**Table B9. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Critical Access Hospital (N=3,541)**

| Critical Access Hospital | N    | Mean  | SD    | Median | Min    | 25 <sup>th</sup> Percentile | 75 <sup>th</sup> Percentile | Max   |
|--------------------------|------|-------|-------|--------|--------|-----------------------------|-----------------------------|-------|
| No                       | 2810 | 0.64% | 0.41% | 0.60%  | -0.54% | 0.36%                       | 0.85%                       | 2.93% |
| Yes                      | 731  | 0.54% | 0.22% | 0.52%  | -0.06% | 0.38%                       | 0.67%                       | 1.42% |



**Figure B7. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Region (N=3,541)**



**Table B10. Distribution of Absolute Rate Difference in Pneumonia Readmission between Dual and Non-Dual Eligible Patients by Region (N=3,541)**

| Hospital Region    | N   | Mean  | SD    | Median | Min    | 25 <sup>th</sup> Percentile | 75 <sup>th</sup> Percentile | Max   |
|--------------------|-----|-------|-------|--------|--------|-----------------------------|-----------------------------|-------|
| New England        | 135 | 0.59% | 0.41% | 0.56%  | -0.54% | 0.31%                       | 0.82%                       | 2.04% |
| Middle Atlantic    | 354 | 0.74% | 0.46% | 0.68%  | -0.29% | 0.42%                       | 0.98%                       | 2.86% |
| South Atlantic     | 598 | 0.65% | 0.37% | 0.62%  | -0.46% | 0.39%                       | 0.85%                       | 2.00% |
| East North Central | 606 | 0.60% | 0.39% | 0.57%  | -0.50% | 0.36%                       | 0.80%                       | 2.93% |
| East South Central | 334 | 0.68% | 0.40% | 0.62%  | -0.14% | 0.43%                       | 0.86%                       | 2.64% |
| West North Central | 395 | 0.54% | 0.30% | 0.49%  | -0.12% | 0.34%                       | 0.70%                       | 1.75% |

| Hospital Region    | N   | Mean  | SD    | Median | Min    | 25 <sup>th</sup> Percentile | 75 <sup>th</sup> Percentile | Max   |
|--------------------|-----|-------|-------|--------|--------|-----------------------------|-----------------------------|-------|
| West South Central | 500 | 0.56% | 0.34% | 0.52%  | -0.27% | 0.35%                       | 0.75%                       | 2.26% |
| Mountain           | 223 | 0.53% | 0.32% | 0.51%  | -0.20% | 0.34%                       | 0.67%                       | 1.70% |
| Pacific            | 396 | 0.62% | 0.41% | 0.60%  | -0.54% | 0.34%                       | 0.81%                       | 2.72% |

## Appendix C: Dual Outcome Rate Method Results for Pneumonia Readmission

**Table C1. Summary of Dual-Specific RSRRs for Pneumonia Readmission**

| Hospital             | N    | Mean    | SD    | Median | Min     | 5 <sup>th</sup><br>Percentile | 10 <sup>th</sup><br>Percentile | 25 <sup>th</sup><br>Percentile | 75 <sup>th</sup><br>Percentile | 90 <sup>th</sup><br>Percentile | 95 <sup>th</sup><br>Percentile | Max    |
|----------------------|------|---------|-------|--------|---------|-------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------|
| All Hospitals        | 4624 | 18.95 % | 1.20% | 18.82% | 15.23 % | 17.22%                        | 17.65%                         | 18.27%                         | 19.47%                         | 20.38%                         | 21.11%                         | 26.57% |
| Reporting Hospitals* | 2968 | 19.02 % | 1.43% | 18.89% | 15.23 % | 16.93%                        | 17.37%                         | 18.07%                         | 19.79%                         | 20.86%                         | 21.59%                         | 26.57% |

\*Reporting hospitals have at least 25 dual eligible patients

**Table C2. Distribution of Dual-Specific RSRRs by Hospital Volume of Index Admissions for Pneumonia Readmission \* (N=2,968)**

| Hospital Volume | N   | Mean   | SD    | Median | Min    | 25 <sup>th</sup><br>Percentile | 75 <sup>th</sup><br>Percentile | Max    |
|-----------------|-----|--------|-------|--------|--------|--------------------------------|--------------------------------|--------|
| Q1              | 750 | 18.82% | 1.15% | 18.73% | 15.82% | 18.03%                         | 19.51%                         | 24.82% |
| Q2              | 738 | 18.97% | 1.31% | 18.88% | 15.77% | 18.11%                         | 19.66%                         | 26.57% |
| Q3              | 734 | 19.11% | 1.53% | 19.02% | 15.23% | 18.09%                         | 19.97%                         | 26.17% |
| Q4              | 746 | 19.17% | 1.67% | 18.99% | 15.46% | 18.04%                         | 20.20%                         | 26.11% |

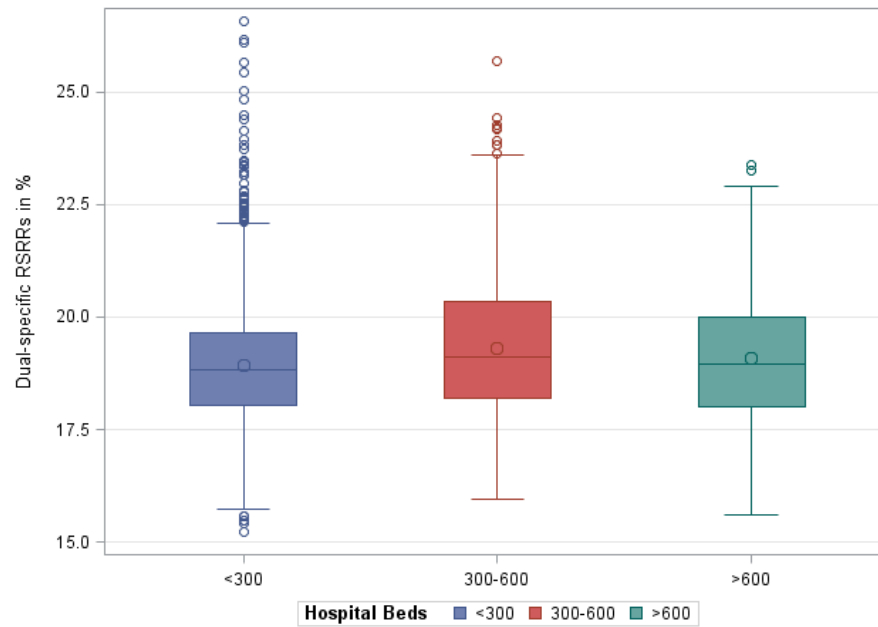
\* Q1: ≤ 182; Q2: 182 to 335; Q3: 335 to 583; Q4: ≥ 583

**Table C3. Distribution of Dual-Specific RSRRs by Proportion of Dual Eligible Patients in the Pneumonia Measure Cohort\* (N=2,968)**

| Proportion of Dual Eligible Patients | N   | Mean   | SD    | Median | Min    | 25 <sup>th</sup><br>Percentile | 75 <sup>th</sup><br>Percentile | Max    |
|--------------------------------------|-----|--------|-------|--------|--------|--------------------------------|--------------------------------|--------|
| Q1                                   | 745 | 18.83% | 1.19% | 18.77% | 15.46% | 18.08%                         | 19.53%                         | 23.65% |
| Q2                                   | 742 | 18.90% | 1.36% | 18.78% | 15.57% | 18.02%                         | 19.66%                         | 25.68% |
| Q3                                   | 739 | 18.96% | 1.42% | 18.88% | 15.23% | 18.03%                         | 19.76%                         | 25.44% |
| Q4                                   | 742 | 19.39% | 1.66% | 19.18% | 15.82% | 18.22%                         | 20.29%                         | 26.57% |

\* Q1: ≤ 17.6%; Q2: 17.6% to 24.2%; Q3: 24.2% to 33.8%; Q4: ≥ 33.8%

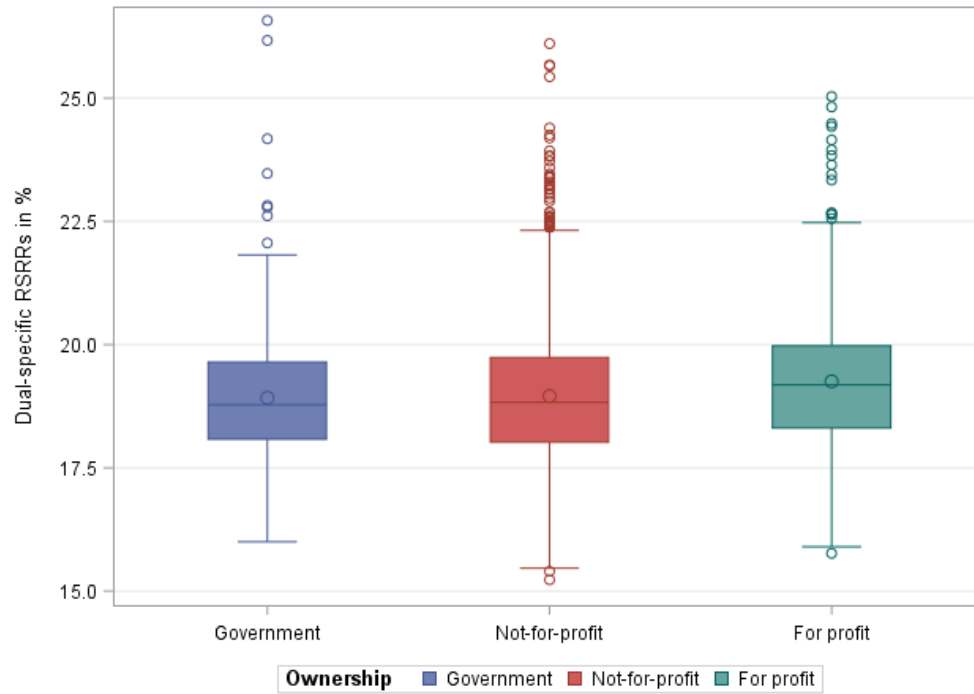
**Figure C1. Distribution of Dual-Specific RSRRs by Hospital Bed Size for Pneumonia Readmission (N=2,883)**



**Table C4. Distribution of Dual-Specific RSRRs by Hospital Bed Size for Pneumonia Readmission (N=2,883)**

| Hospital Bed Size | N    | Mean   | SD    | Median | Min    | 25 <sup>th</sup> Percentile | 75 <sup>th</sup> Percentile | Max    |
|-------------------|------|--------|-------|--------|--------|-----------------------------|-----------------------------|--------|
| < 300             | 2156 | 18.93% | 1.36% | 18.82% | 15.23% | 18.05%                      | 19.65%                      | 26.57% |
| 300-600           | 549  | 19.30  | 1.64% | 19.10% | 15.96% | 18.18%                      | 20.35%                      | 25.68% |
| > 600             | 178  | 19.08  | 1.55% | 18.94% | 15.60% | 18.00%                      | 20.00%                      | 23.38% |

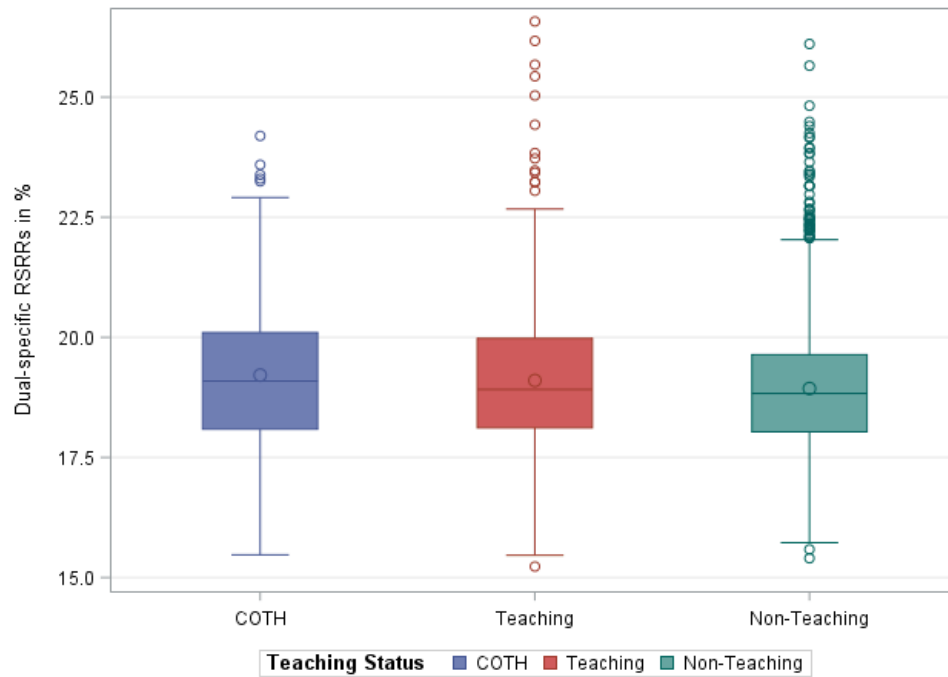
**Figure C2. Distribution of Dual-Specific RSRRs by Hospital Ownership Status for Pneumonia Readmission (N=2,883)**



**Table C5. Distribution of Dual-Specific RSRRs by Hospital Ownership Status for Pneumonia Readmission (N=2,883)**

| Hospital Ownership Status | N    | Mean   | SD    | Median | Min    | 25 <sup>th</sup> Percentile | 75 <sup>th</sup> Percentile | Max    |
|---------------------------|------|--------|-------|--------|--------|-----------------------------|-----------------------------|--------|
| Government                | 474  | 18.92% | 1.35% | 18.78% | 16.00% | 18.08%                      | 19.65%                      | 26.57% |
| Not-for-profit            | 1888 | 18.96% | 1.44% | 18.83% | 15.23% | 18.02%                      | 19.74%                      | 26.11% |
| For profit                | 521  | 19.26% | 1.47% | 19.18% | 15.77% | 18.31%                      | 19.98%                      | 25.03% |

**Figure C3. Distribution of Dual-Specific RSRRs by Hospital Teaching Status for Pneumonia Readmission (N=2,883)**

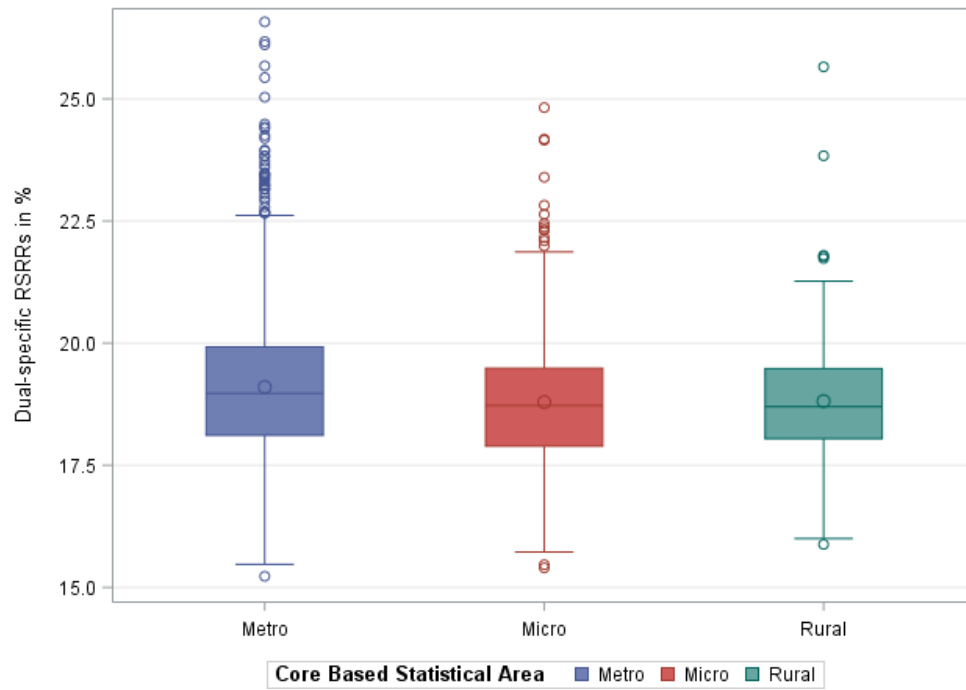


**Table C6. Distribution of Dual-Specific RSRRs by Hospital Teaching Status for Pneumonia Readmission (N=2,883)**

| Hospital Teaching Status | N    | Mean   | SD    | Median | Min    | 25 <sup>th</sup> Percentile | 75 <sup>th</sup> Percentile | Max    |
|--------------------------|------|--------|-------|--------|--------|-----------------------------|-----------------------------|--------|
| COTH*                    | 223  | 19.21% | 1.53% | 19.09% | 15.47% | 18.09%                      | 20.10%                      | 24.19% |
| Teaching                 | 870  | 19.10% | 1.55% | 18.92% | 15.23% | 18.12%                      | 19.98%                      | 26.57% |
| Non-teaching             | 1790 | 18.93% | 1.35% | 18.83% | 15.40% | 18.03%                      | 19.64%                      | 26.11% |

\* Council of Teaching Hospitals and Health Systems

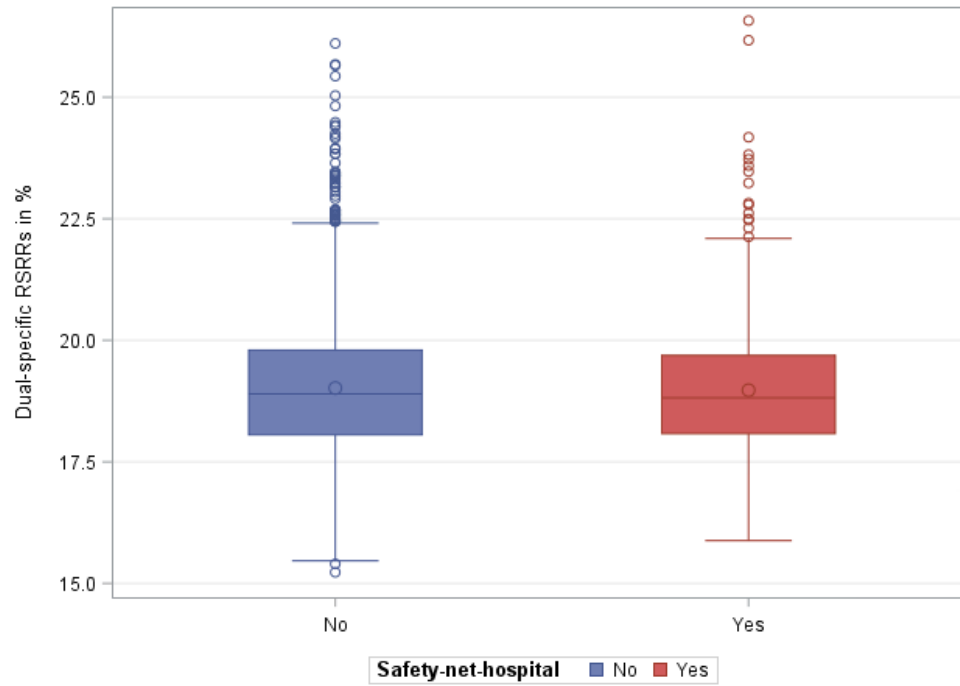
**Figure C4. Distribution of Dual-Specific RSRRs by Hospital Core-Based Statistical Area for Pneumonia Readmission (N=2,883)**



**Table C7. Distribution of Dual-Specific RSRRs by Hospital Core-Based Statistical Area for Pneumonia Readmission (N=2,883)**

| Hospital Core-Based Statistical Area | N     | Mean   | SD     | Median | Min    | 25 <sup>th</sup> Percentile | 75 <sup>th</sup> Percentile | Max    |
|--------------------------------------|-------|--------|--------|--------|--------|-----------------------------|-----------------------------|--------|
| Metro                                | 19.10 | 18.50% | 18.97% | 15.23% | 18.11% | 19.92%                      | 26.57%                      | 19.10% |
| Micro                                | 521   | 18.79% | 1.33%  | 18.72% | 15.40% | 17.89%                      | 19.49%                      | 24.82% |
| Rural                                | 393   | 18.81% | 1.14%  | 18.70% | 15.88% | 18.05%                      | 19.48%                      | 25.66% |

**Figure C5. Distribution of Dual-Specific RSRRs by Safety-Net Hospital for Pneumonia Readmission (N=2,883)**

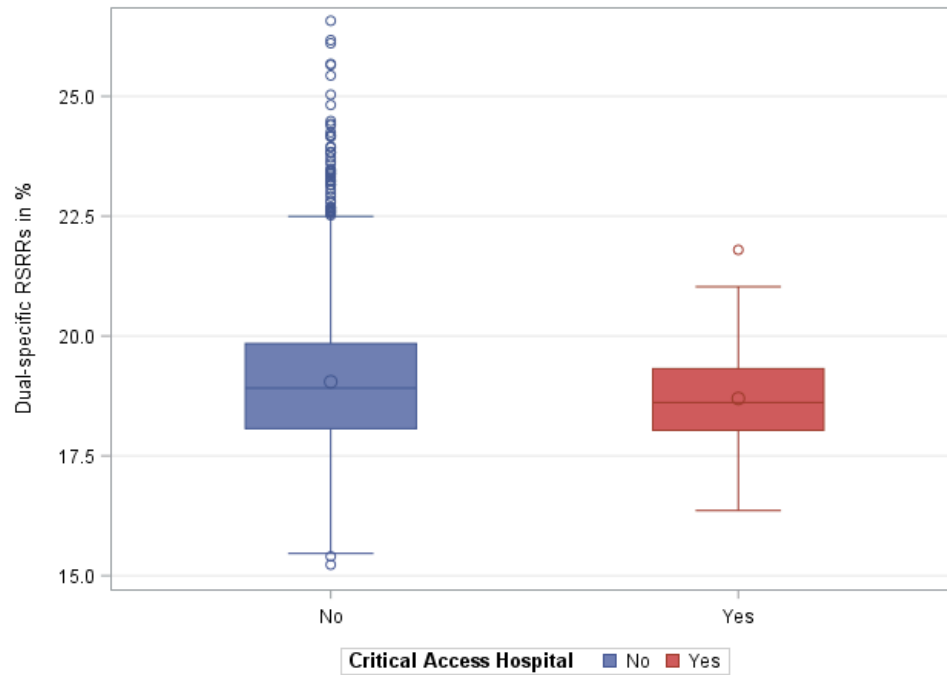


**Table C8. Distribution of Dual-Specific RSRRs by Safety-Net Hospital for Pneumonia Readmission (N=2,883)**

| Safety-Net Hospital | N    | Mean   | SD    | Median | Min    | 25 <sup>th</sup> Percentile | 75 <sup>th</sup> Percentile | Max    |
|---------------------|------|--------|-------|--------|--------|-----------------------------|-----------------------------|--------|
| No                  | 2189 | 19.02% | 1.45% | 18.90% | 15.23% | 18.06%                      | 19.80%                      | 26.11% |
| Yes                 | 694  | 18.97% | 1.39% | 18.82% | 15.88% | 18.08%                      | 19.69%                      | 26.57% |



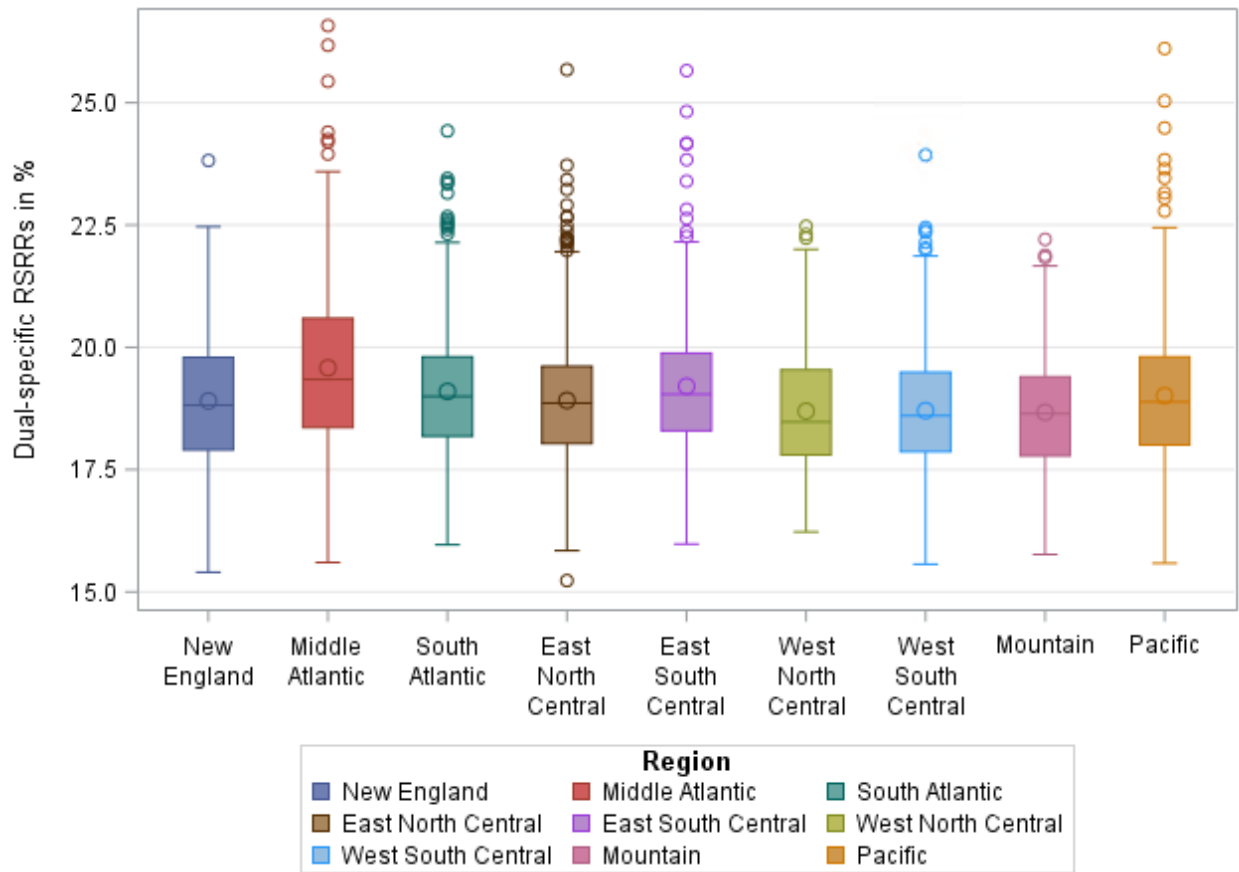
**Figure C6. Distribution of Dual-Specific RSRRs by Critical Access Hospital for Pneumonia Readmission (N=2,883)**



**Table C9. Distribution of Dual-Specific RSRRs by Critical Access Hospital for Pneumonia Readmission (N=2,883)**

| Critical Access Hospital | N    | Mean   | SD    | Median | Min    | 25 <sup>th</sup> Percentile | 75 <sup>th</sup> Percentile | Max    |
|--------------------------|------|--------|-------|--------|--------|-----------------------------|-----------------------------|--------|
| No                       | 2561 | 19.05% | 1.48% | 18.91% | 15.23% | 18.07%                      | 19.84%                      | 26.57% |
| Yes                      | 322  | 18.70% | 0.99% | 18.61% | 16.36% | 18.03%                      | 19.32%                      | 21.80% |

**Figure C7. Distribution of Dual-Specific RSRRs by Region for Pneumonia Readmission (N=2,883)**



**Table C10. Distribution of Dual-Specific RSRRs by Region for Pneumonia Readmission (N=2,883)**

| Hospital Region    | N   | Mean   | SD    | Median | Min    | 25 <sup>th</sup> Percentile | 75 <sup>th</sup> Percentile | Max    |
|--------------------|-----|--------|-------|--------|--------|-----------------------------|-----------------------------|--------|
| New England        | 121 | 18.90% | 1.45% | 18.82% | 15.40% | 17.90%                      | 19.79%                      | 23.82% |
| Middle Atlantic    | 334 | 19.58% | 1.68% | 19.34% | 15.60% | 18.36%                      | 20.59%                      | 26.57% |
| South Atlantic     | 521 | 19.10% | 1.35% | 19.00% | 15.96% | 18.18%                      | 19.80%                      | 24.43% |
| East North Central | 495 | 18.92% | 1.38% | 18.86% | 15.23% | 18.04%                      | 19.61%                      | 25.68% |
| East South Central | 283 | 19.20% | 1.43% | 19.04% | 15.98% | 18.30%                      | 19.88%                      | 25.66% |
| West North Central | 236 | 18.70% | 1.24% | 18.48% | 16.23% | 17.80%                      | 19.54%                      | 22.48% |

| Hospital Region    | N   | Mean   | SD    | Median | Min    | 25 <sup>th</sup> Percentile | 75 <sup>th</sup> Percentile | Max    |
|--------------------|-----|--------|-------|--------|--------|-----------------------------|-----------------------------|--------|
| West South Central | 402 | 18.71% | 1.28% | 18.60% | 15.57% | 17.87%                      | 19.49%                      | 23.93% |
| Mountain           | 144 | 18.67% | 1.28% | 18.65% | 15.77% | 17.78%                      | 19.40%                      | 22.21% |
| Pacific            | 347 | 19.01% | 1.54% | 18.88% | 15.59% | 18.00%                      | 19.80%                      | 26.11% |

## Appendix D: Questions for Public Comment

### Introduction

*Do you support the concept of supplementing outcome measure reporting by reporting disparities in outcomes for individuals with social risk factors?*

*Do you support using methods that allow for reporting both disparities within hospitals and measure performance for patients with social risk factors across hospitals?*

*Do you recommend evaluating disparities for specific outcome quality measures (such as readmissions, mortality, and surgical complications)?*

*In this report, we focused on two individual-level social risk factors, Medicaid/Medicare dual eligibility and black race. What feedback do you have regarding the selection of social risk factors that are feasible to collect and include?*

### The Within-Hospital Disparity Method

*We are particularly interested in feedback about making the disparities information usable. What information should be provided to hospitals and consumers if information on disparities goes into public reporting?*

### The Dual/Race Outcome Rate Method

*We are particularly interested in feedback about making the disparities information usable. What information should be provided to hospitals and consumers if information on disparities goes into public reporting?*