

**CENTER FOR HEALTH
INFORMATION AND ANALYSIS**

**HOSPITAL-WIDE ADULT ALL-PAYER
READMISSIONS IN MASSACHUSETTS: 2011-2013**

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CONTENTS

- EXECUTIVE SUMMARY 1
- I. INTRODUCTION 2
- II. STATEWIDE ALL-PAYER READMISSIONS 3
 - 1. TIMING OF READMISSIONS 3
 - 2. READMISSIONS BY DEMOGRAPHICS 4
 - 3. READMISSIONS BY DISCHARGE SETTING 5
 - 4. READMISSIONS BY DISCHARGE DIAGNOSIS 7
 - 5. READMISSIONS BY PAYER TYPE 9
 - 6. READMISSIONS AMONG PATIENTS WITH FREQUENT HOSPITALIZATIONS 10
- III. ALL-PAYER READMISSIONS BY HOSPITAL 12
 - 1. HOSPITAL READMISSION RATES OVER TIME 13
 - 2. RISK-STANDARDIZED READMISSION RATES (RSRRS) 15
 - 3. READMISSIONS BY HOSPITAL CHARACTERISTICS 17
- IV. CONCLUSIONS 21
- V. ABOUT THE READMISSIONS METHODOLOGY 22
- APPENDIX A: READMISSIONS METHODOLOGY 24
- APPENDIX B: MASSACHUSETTS ACUTE CARE HOSPITALS
AND THEIR CHARACTERISTICS 31
- APPENDIX C: REGIONAL MAPPING OF MASSACHUSETTS
ACUTE CARE HOSPITALS 34
- APPENDIX D: DATA CATEGORIZATION AND GROUPING 36

EXECUTIVE SUMMARY

Hospital readmissions are a central issue in efforts to improve health care quality and reduce costs. Readmissions within 30 days of a prior hospitalization have been identified as a costly and potentially preventable problem, both nationally and in Massachusetts. In Massachusetts, the Centers for Medicare and Medicaid Services (CMS) penalized 80% of acute hospitals for higher-than-expected Medicare readmission rates in federal fiscal year 2015¹, and the Commonwealth's Health Policy Commission estimates readmission costs at \$700 million annually.²

This report presents the first look at readmissions in the Massachusetts adult all-payer population using the Hospital-Wide All-Cause Unplanned 30-day Readmission Measure developed by CMS and the Yale Center for Outcomes Research³. To date, unplanned hospital readmissions have been assessed primarily among the Medicare fee-for-service (FFS) population by CMS. This measure is part of the Massachusetts Statewide Quality Advisory Committee's Standard Quality Measure Set.⁴

Hospitals continue to make efforts to reduce the rate of unplanned readmissions and rates continue to decrease slightly. While the overall statewide readmission rate declined slightly from 2011 to 2013, readmissions varied greatly by several of the patient and system characteristics studied, including patient age, payer type, and discharge setting. In particular, this report's findings suggest potential opportunities to focus efforts on the subset of patients who are frequently hospitalized. There may be value in better understanding and addressing the post-acute care requirements of hospital users, particularly those of frequent users.

This report provides insight into the characteristics of the adult readmission population across the Commonwealth. This information will aid providers, health plans, and policymakers in their continued efforts to increase quality and reduce costs associated with unplanned readmissions.

KEY FINDINGS

- In state fiscal year 2013, the all-payer adult readmission rate in Massachusetts was 15.0%. This statewide rate decreased slightly each year from 15.9% in state fiscal year 2011, to 15.4% in 2012, to 15.0% in 2013.
- More than 80% of all readmitted patients returned to the same hospital from which they were initially discharged.
- During the three years from 2011 to 2013, the 7% of hospitalized patients who were hospitalized four or more times in a twelve-month period accounted for 25% of all hospitalizations and 59% of all readmissions in the state. The readmission rate among this frequently hospitalized group was 36.0%, more than double the statewide readmission rate.
- More than one in every three (37%) readmissions occurred within seven days of discharge.
- Patients who were discharged into skilled nursing facilities or to home with home health agency care had higher rates of readmission than those discharged to home (18.2% vs. 11.8%).
- Medicare and Medicaid⁵ readmission rates were higher (17.3% and 17.0%) than the commercial rate of 9.8%. Readmissions among individuals covered by public payers comprise 81% of all readmissions in the state.
- After accounting for patient case mix and hospital service mix, few hospitals had readmission rates statistically different from the statewide rate. Of the 62 acute care hospitals included in this analysis, four had adjusted readmission rates above the state average and two had adjusted readmission rates below the state average.⁶

1 Data obtained from Rau, J. (2014). Medicare fines 2,610 hospitals in third round of readmission penalties. *Kaiser Health News*, October 2, 2014, available at <http://kaiserhealthnews.org/news/medicare-readmissions-penalties-2015/>.

2 Based on FY2009 data from: Massachusetts Health Policy Commission (2014). 2014 Cost Trends Report. Boston, MA: Health Policy Commission. Available from <http://www.mass.gov/anf/budget-taxes-and-procurement/oversight-agencies/health-policy-commission/publications/>.

3 Horwitz et al. (2012). Hospital-wide all-cause unplanned readmission measure. Final technical report. New Haven, CT: Yale New Haven Health Services Corporation/Center for Outcomes Research & Evaluation. Available from: <http://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/HospitalQualityInits/Measure-Methodology.html>.

4 Standard Quality Measure Set (SQMS) available at: <http://chiamass.gov/sqms/>.

5 The Medicare category includes patients with Medicare or Medicare Managed Care as the expected primary source of payment for their hospital stay. The Medicaid category includes patients with Medicaid/MassHealth, Medicaid Managed Care, or Commonwealth Care as the expected primary source of payment for their hospital stay.

6 Statistically significant differences.

I. INTRODUCTION

Unplanned readmissions are a costly and potentially preventable problem that impact patient health and experience of care. At the national level, one in five Medicare patients is readmitted at an estimated cost of \$26 billion annually. In Massachusetts, CMS penalized 80% of the hospitals in the Commonwealth for higher-than-expected Medicare readmission rates in federal fiscal year 2015⁷, and the Commonwealth's Health Policy Commission estimates readmission costs at \$700 million annually.⁸

To calculate all-payer unplanned adult readmissions in Massachusetts, CHIA adapted⁹ the Yale/CMS Hospital-Wide All-Cause Unplanned 30-day Readmission Measure¹⁰ for use with CHIA's all-payer hospital discharge datasets. This measure is part of the Massachusetts Standard Quality Measure Set recommended by the Statewide Quality Advisory Committee¹¹. This report is the first examination of hospital readmissions in the Massachusetts all-payer population using this methodology.

Readmissions have previously been assessed primarily among the Medicare fee-for-service (FFS) population by CMS, using both disease-specific and all-cause measures. Originally, CMS focused on disease-specific measures for six clinical areas where penalties for higher-than-expected readmissions may apply: acute myocardial infarction, heart failure, pneumonia, chronic obstructive pulmonary disease (COPD), elective hip replacement, and elective knee replacement. Realizing the need for a broader measure, in 2013 CMS began reporting on the Hospital-Wide All-Cause Unplanned 30-day Readmission Measure.

However, readmissions occur across all payer types, and evaluating all-payer readmission rates across the spectrum of the Commonwealth's hospitals and patients will give providers and policymakers a more comprehensive and accurate picture to potentially improve quality and reduce waste.

Besides this Introduction, the report includes four sections:

- Section II provides statewide observed (unadjusted) readmission rates by demographics, discharge setting, payer type, discharge diagnosis, and frequent hospitalizations.
- Section III provides risk-standardized readmission rates (RSRRs) for hospitals over time as well as by hospital characteristics such as region, system, and tax status. These risk-standardized readmission rates take into account differences across hospitals in patient age, patient case mix (how complicated or seriously ill patients are), and service mix (the particular blend of services a hospital provides) which may impact readmissions, and therefore allow for a better comparison across hospitals or groups of hospitals.
- Section IV provides summary conclusions.
- Section V gives information on the methodology used in this report.

The Appendices provides a more detailed discussion of the methodology as well as detail on hospital characteristics and regions.

⁷ Data obtained from Rau, J. (2014). Medicare fines 2,610 hospitals in third round of readmission penalties. *Kaiser Health News*, October 2, 2014, available at <http://kaiserhealthnews.org/news/medicare-readmissions-penalties-2015/>.

⁸ Based on FY2009 data from: Massachusetts Health Policy Commission (2014). 2014 Cost Trends Report. Boston, MA: Health Policy Commission. Available from <http://www.mass.gov/anf/budget-taxes-and-procurement/oversight-agencies/health-policy-commission/publications/>.

⁹ Please see Section V: About the Readmissions Methodology and Appendix A: Readmissions Methodology for details.

¹⁰ Horwitz et. al. (2012). Hospital-wide all-cause unplanned readmission measure. Final technical report. New Haven CT: Yale New Haven Health Services Corporation/Center for Outcomes Research & Evaluation. Available from: <http://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/HospitalQualityInits/Measure-Methodology.html>.

¹¹ Standard Quality Measure Set (SQMS) available at: <http://chiamass.gov/sqms/>.

II. STATEWIDE ALL-PAYER READMISSIONS

Section II of this report includes observed (unadjusted) statewide readmissions presented by patient demographics, discharge setting, discharge diagnosis, and payer type. Readmission patterns of patients who frequently use hospital services are also provided.

Variations in observed readmission rates may be due to differences across hospitals in patient case mix (how seriously ill or complicated patients are) and service mix (the types of services a given hospital provides). Hospital-specific readmission rates that are adjusted to account for these factors are provided in Section III.

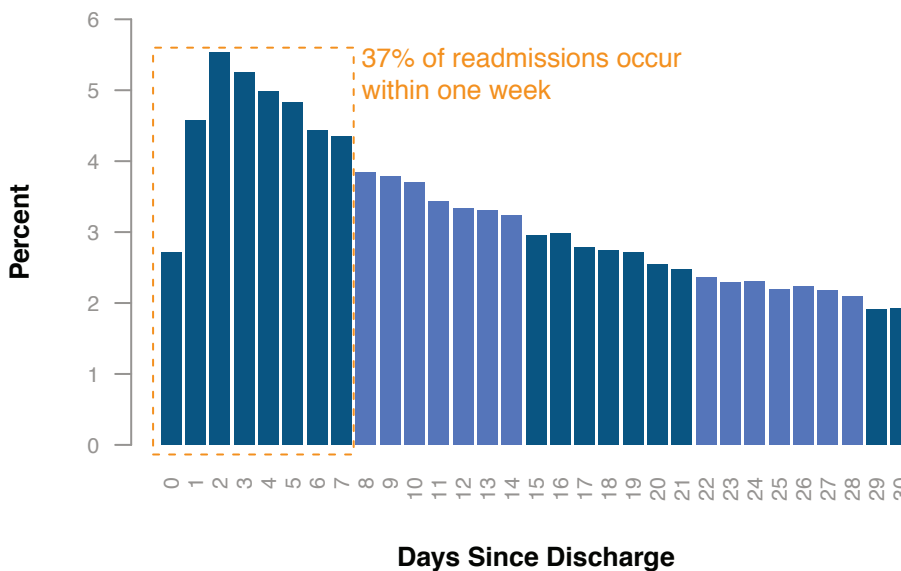
The information in this report is based on acute-care discharges from Massachusetts hospitals among adults aged 18 and over who were hospitalized for non-obstetric and non-primary psychiatric related reasons.

For more information on the methods used in this report, please see Section V: About the Readmissions Methodology and for further details, Appendix A: Readmissions Methodology.

1. TIMING OF READMISSIONS

Figure 1: All-Payer Readmissions by Days since Discharge, July 2012 to June 2013

Readmissions peak two days after discharge but occur throughout the 30 day period.



Note: Analyses exclude obstetric and primary psychiatric discharges.

Data source: Massachusetts Hospital Inpatient Discharge Databases, July 2012 – June 2013.

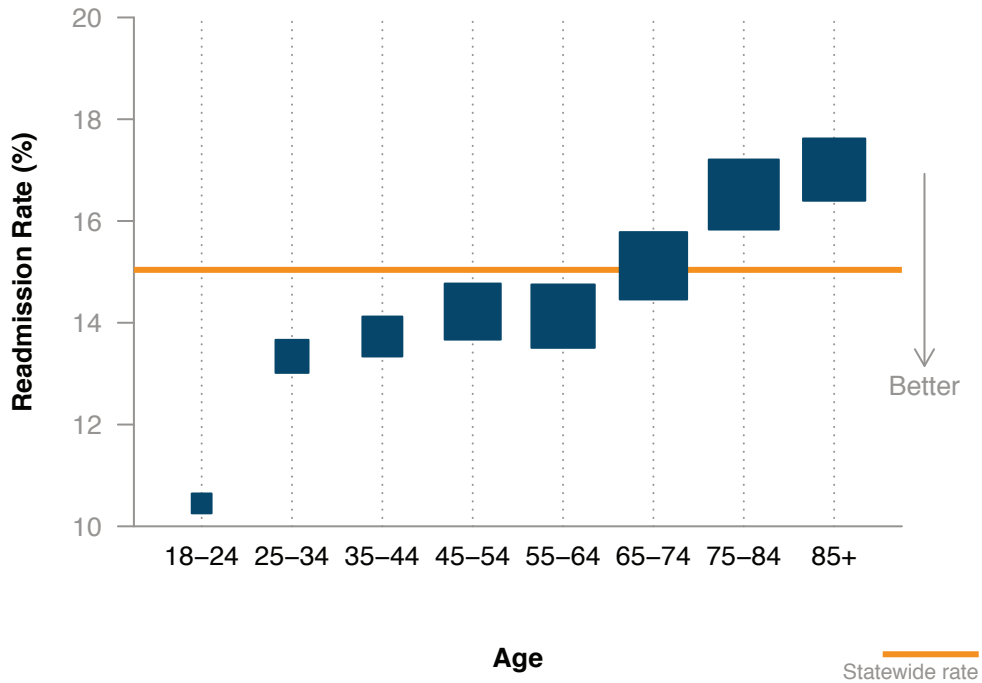
In this analysis any admission within 30 days of an eligible discharge¹² for a patient is counted as a readmission, except for those that are deemed as planned. Therefore, readmissions can occur at any point within that 30-day period. Figure 1 shows the percentage of readmissions by day since initial discharge. Readmissions peak at two days and show a steady decline thereafter. Over one-third (37%) of all readmissions occur within 7 days of discharge, and the majority of readmissions (61%) occur within 14 days of discharge. Nearly 40% of readmissions occur more than two weeks after discharge.

¹² A specific set of criteria are applied to define the set of eligible “index” admissions, which may or may not subsequently result in a readmission. For details see Section V: About the Readmissions Methodology, and Appendix A: Readmissions Methodology.

2. READMISSIONS BY DEMOGRAPHICS

Figure 2: All-Payer Readmission Rates by Patient Age, July 2012 to June 2013

Readmission rates increased with patient age.



Note: The size of the squares in the figure is proportional to the number of readmissions. Analyses exclude obstetric and primary psychiatric discharges.

Data source: Massachusetts Hospital Inpatient Discharge Databases, July 2012 – June 2013.

In fiscal year 2013, 47% of discharges and 43% of readmissions occurred among adults aged 18-64, with readmission rates ranging from 10.4% among adults aged 18-24 to 14.2% among adults aged 45-54.

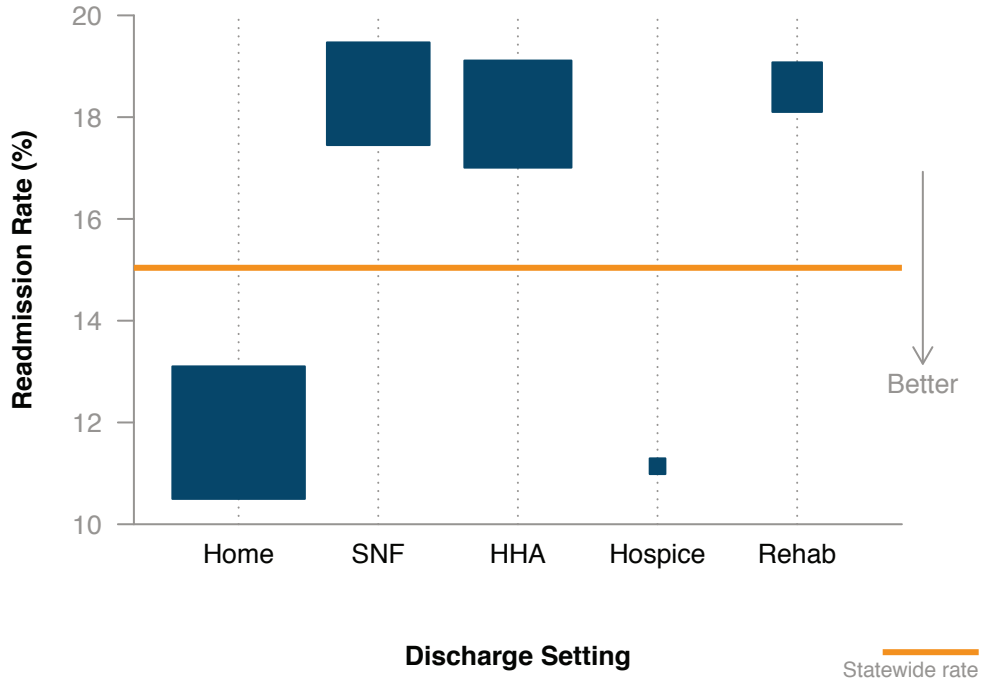
About 53% of all discharges and 57% of all readmissions occurred among adults aged 65 and over. Readmission rates were 15.1%, 16.5%, and 17.0% among adults aged 65-74, 75-84, and 85 and over, respectively.

In 2013, the readmission rate was slightly higher in males (15.7%) than in females (14.5%).

3. READMISSIONS BY DISCHARGE SETTING

Figure 3: All-Payer Readmission Rates by Discharge Setting, July 2012 to June 2013

Patients discharged to home (without home health agency care) and hospice have lower readmission rates than those discharged to post-acute care.



Note: SNF = Skilled nursing facility. HHA= Home with home health agency care. The size of the squares in the figure is proportional to the number of readmissions. Analyses exclude obstetric and primary psychiatric discharges.

Data source: Massachusetts Hospital Inpatient Discharge Databases, July 2012 – June 2013.

Opportunities to improve transitions from the hospital to post-acute care setting play an important role in reducing readmissions. At the same time, it is possible that readmission rates from post-acute care facilities are higher because patients by definition have more ongoing skilled care needs. CHIA analyzed readmissions following discharge to home, skilled nursing facilities, home with home health agency care, hospice, and rehabilitation. Statewide, 51% of the discharges were to home, 22% were to home with home health agency care, and 20% were to a skilled nursing facility.

Table 1: All-Payer Readmissions by Discharge Setting, July 2012 to June 2013

	Number of Discharges	Percentage of Discharges	Number of Readmissions	Percentage of Readmissions	Readmission Rate
Home	258,860	50.9%	30,541	39.9%	11.8%
SNF	99,346	19.5%	18,335	24.0%	18.5%
HHA	110,419	21.7%	19,946	26.1%	18.1%
Hospice	3,851	0.8%	429	0.6%	11.1%
Rehab	22,988	4.5%	4,273	5.6%	18.6%
Total	508,354	100.0%	76,481	100.0%	15.0%

Note: Figures do not sum to those in the total row because the table excludes “other” discharge settings and missing values.

Data source: Massachusetts Hospital Inpatient Discharge Databases, July 2012 – June 2013.

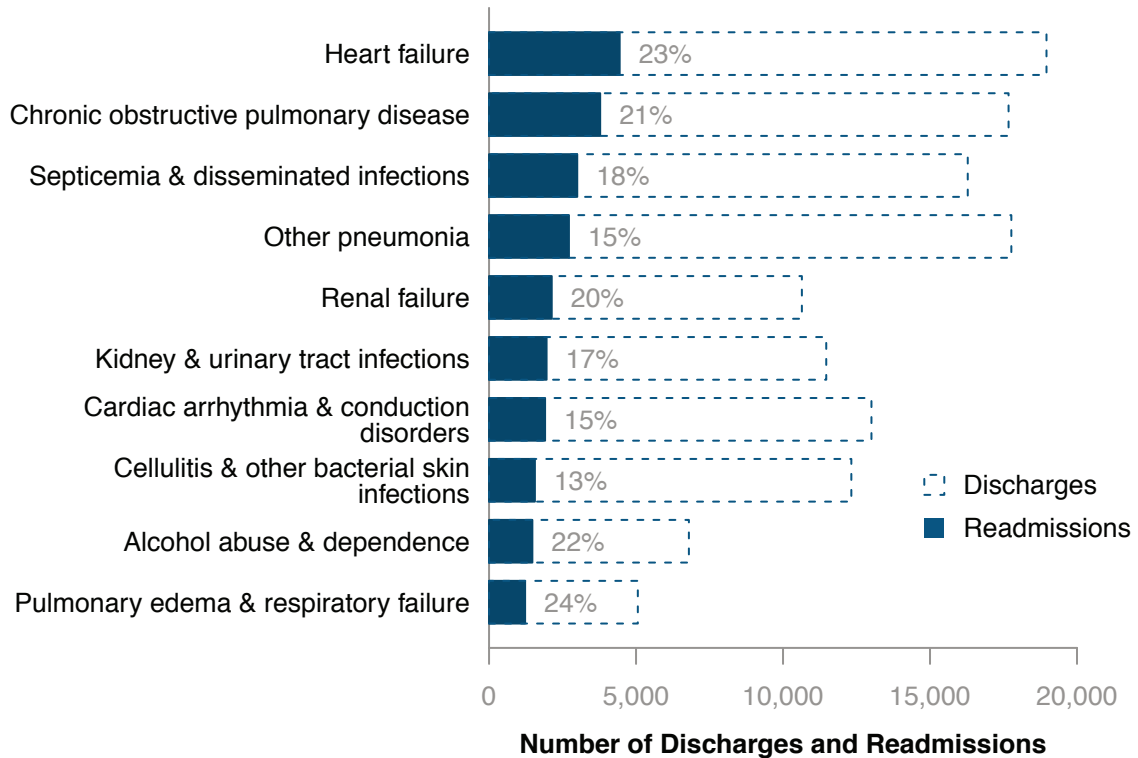
The readmission rate among individuals discharged to home was lower than average, 11.8%, and the readmission rate among individuals discharged to home with home health agency care and to skilled nursing facilities was higher than average (18.1% and 18.5% respectively). The 51% of patients discharged to home accounted for a disproportionately smaller percentage of readmissions (40%), while patients discharged to post-acute care (skilled nursing facility, home with home health agency care, hospice, rehabilitation) comprised a relatively smaller number of discharges, but a larger proportion of all readmissions, likely due to differences in patient characteristics.

The proportion of discharges to home varied by region where the hospitals are located, ranging from 44% in the Cape and Islands region to 59% in the Central Massachusetts region. There was also large regional variation in the proportion of discharges to home with home health agency care (range 12% to 26%) and to skilled nursing facilities (range 15% to 39%).

4. READMISSIONS BY DISCHARGE DIAGNOSIS

Figure 4: Top Ten Discharge Diagnoses Resulting in the Highest Number of Readmissions, July 2012 to June 2013

The top ten diagnostic categories accounted for 32% of readmissions.



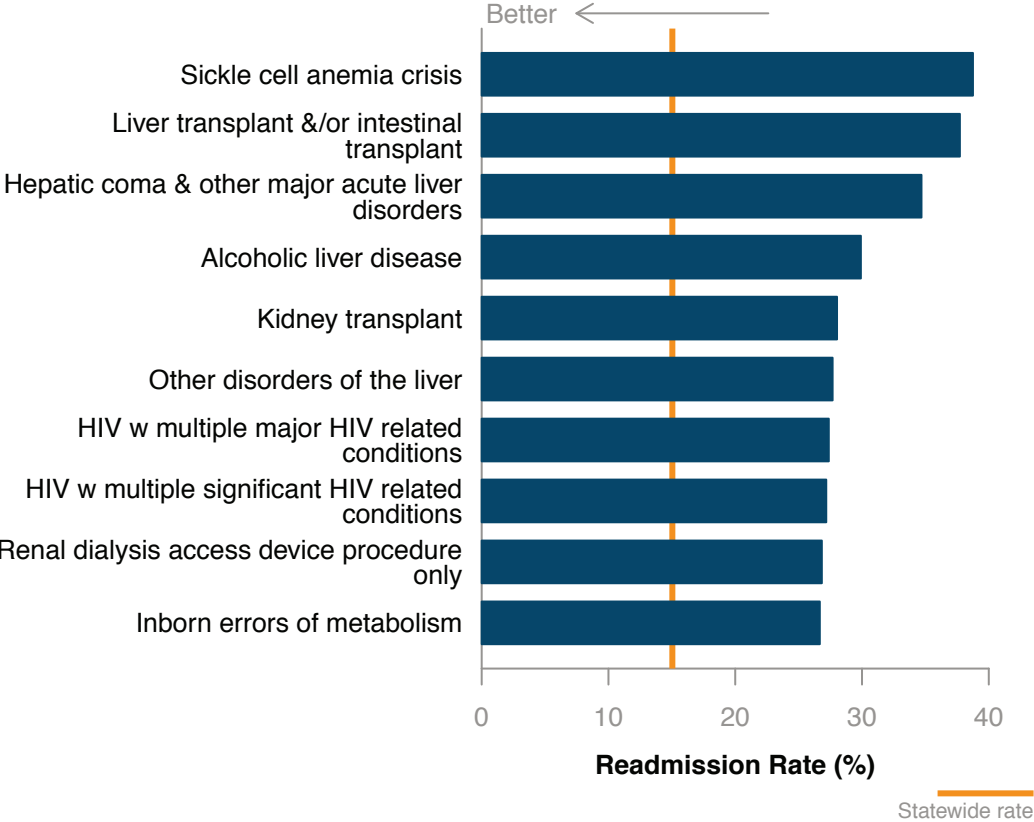
Note: The percentage figure in each bar gives the readmission rate for that diagnosis. Diagnostic categories are defined by the All-Payer Refined Diagnosis-Related Group (APR-DRG). Analyses exclude obstetric and primary psychiatric discharges.

Data source: Massachusetts Hospital Inpatient Discharge Databases, July 2012 – June 2013.

The ten discharge diagnoses that resulted in the highest number of readmissions are: heart failure, chronic obstructive pulmonary disease (COPD), sepsis, pneumonia, kidney failure, kidney and urinary tract infections, cardiac arrhythmias, cellulitis, alcohol abuse and dependence, and pulmonary edema and respiratory failure. In total, the top five diagnoses resulting in the highest number of readmissions accounted for 21% of all readmissions, and the top ten diagnoses accounted for nearly one-third of all readmissions (32%).

Figure 5: Top Ten Discharge Diagnoses Resulting in the Highest Rates of Readmissions, July 2012 to June 2013

The top ten conditions by readmission rate all had rates above 25%.



Note: Diagnostic categories are defined by the All-Payer Refined Diagnosis-Related Group (APR-DRG). Analyses exclude obstetric and primary psychiatric discharges. Diagnoses with fewer than 100 discharges are excluded from the analysis.

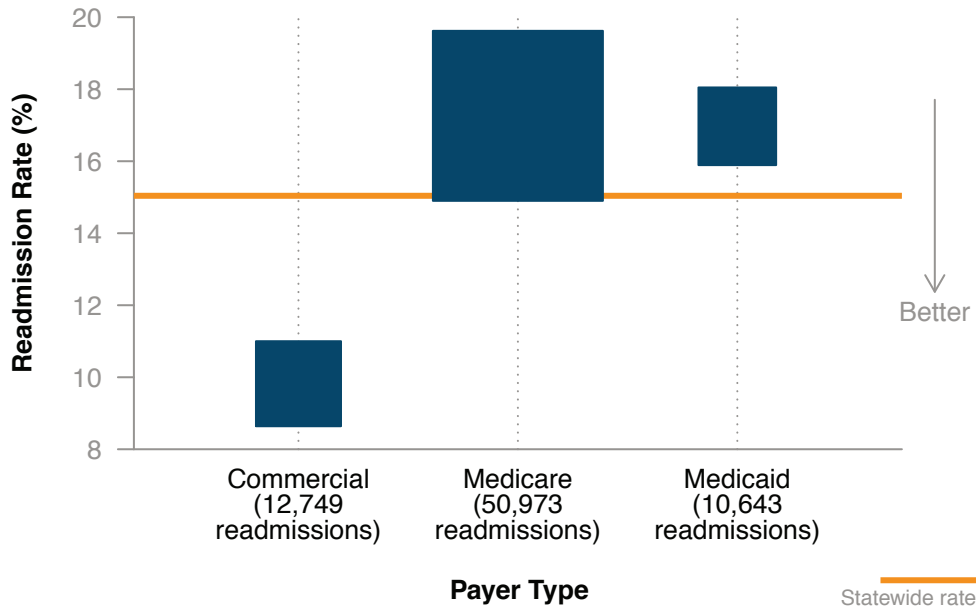
Data source: Massachusetts Hospital Inpatient Discharge Databases, July 2012 – June 2013.

In addition to examining the diagnoses that resulted in the highest *numbers* of readmissions, it is also informative to identify the diagnoses associated with the highest *rates* of readmission. These latter diagnoses account for fewer total readmissions, but the high rates of readmission make these potentially fruitful areas of focus. Patients discharged with a diagnosis of sickle cell anemia have the highest diagnosis-specific readmission rate, at 38.8%. Other diagnoses with high readmission rates include transplants (28-38%), liver disease (28-35%), HIV (26-27%), and kidney-related issues (27%).

5. READMISSIONS BY PAYER TYPE

Figure 6: All-Payer Readmission Rates by Payer Type, July 2012 to June 2013

Readmission rates varied by payer type; patients with commercial payers had lower readmission rates than those with public payers.



Note: The size of the squares in the figure is proportional to the number of readmissions. Analyses exclude obstetric and primary psychiatric discharges.

Data source: Massachusetts Hospital Inpatient Discharge Databases, July 2012 – June 2013.

Readmissions among individuals covered by public payers comprised 81% of all readmissions in the state. The largest number of readmissions occurred among Medicare beneficiaries (67%), followed by individuals covered by private plans (17%), and Medicaid (14%). Medicare and Medicaid readmission rates were the highest and nearly the same (17.3% and 17.0%, respectively), while the readmission rate for individuals covered by private plans, at 9.8%, was lower than the state average.

Table 2: All-Payer Readmissions by Payer Type, July 2012 to June 2013

	Number of Discharges	Percent of Discharges	Number of Readmissions	Percent of Readmissions	Readmission Rate
Commercial	129,873	25.6%	12,749	16.7%	9.8%
Medicare	295,261	58.1%	50,973	66.7%	17.3%
Medicaid	62,717	12.3%	10,643	13.9%	17.0%
Total	508,354	100.0%	76,481	100.0%	15.0%

Note: Figures do not sum to those in the total row because the table excludes Self-Pay and Other payer categories, which together account for 4% of discharges.

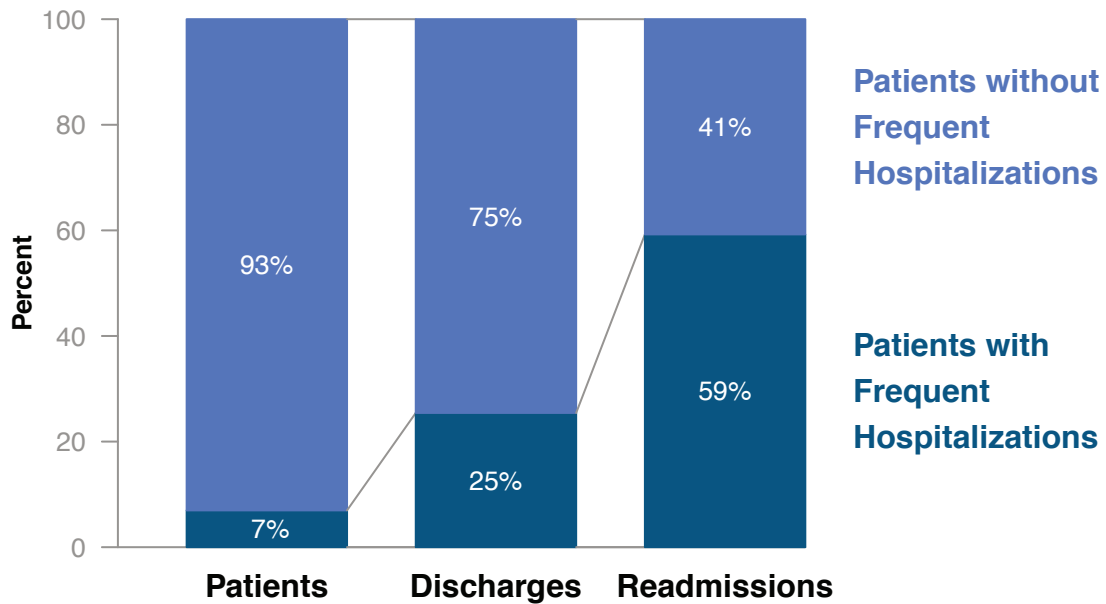
Data source: Massachusetts Hospital Inpatient Discharge Databases, July 2012 – June 2013.

The differences in readmission rates by payer type are likely influenced by additional characteristics of patients and of their health care services. For example, the age distributions of patients enrolled in Medicaid, Medicare, and commercial insurance vary, and patient age is associated with higher readmission rates (see Figure 2).

6. READMISSIONS AMONG PATIENTS WITH FREQUENT HOSPITALIZATIONS

Figure 7: All-Payer Readmissions among Frequently Hospitalized Patients, July 2010 to June 2013

People who were frequently hospitalized made up only 7% of the population but accounted for 59% of readmissions.



Note: Analyses exclude obstetric and primary psychiatric discharges. Frequently hospitalized patients defined as those with four or more discharges within any 1-year period during the 3-year study period.

Data source: Massachusetts Hospital Inpatient Discharge Databases, July 2010 – June 2013.

Readmission patterns were examined among the subgroup of individuals who were frequently hospitalized. Frequently hospitalized patients are defined as those with *four or more* hospitalizations within a 12-month period at any point during the three study years. During the three-year span July 1, 2010 to June 30, 2013, 7% of patients (approximately 60,000) were in this high-utilization group. This group accounted for 25% of all hospitalizations and 59% of all readmissions in the state.¹³ The readmission rate among this frequently hospitalized cohort was 36.0%, double the statewide readmission rate.

¹³ During the same three-year period, about 14% of patients were hospitalized three or more times in a 12-month period. This group accounted for 39% of all hospitalizations and 78% of all readmissions in the state.

Table 3: All-Payer Readmissions among Frequently Hospitalized Patients, July 2010 to June 2013

	Number of Patients	Percentage within Group	Number of Discharges	Number of Readmissions	Readmission Rate (%)
Frequently Hospitalized Patients	58,674	100.0%	403,352	145,307	36.0%
Commercial	9,724	16.6%	58,313	20,717	35.5%
Medicare	40,357	68.8%	281,371	99,820	35.5%
Medicaid	7,026	12.0%	55,327	21,774	39.4%
Other Patients	783,403	100.0%	1,182,784	99,974	8.5%
Commercial	274,844	35.1%	361,551	21,257	5.9%
Medicare	377,443	48.2%	634,973	64,749	10.2%
Medicaid	87,677	11.2%	131,277	10,468	8.0%
Total Patients	842,077	-----	1,586,136	245,281	15.5%

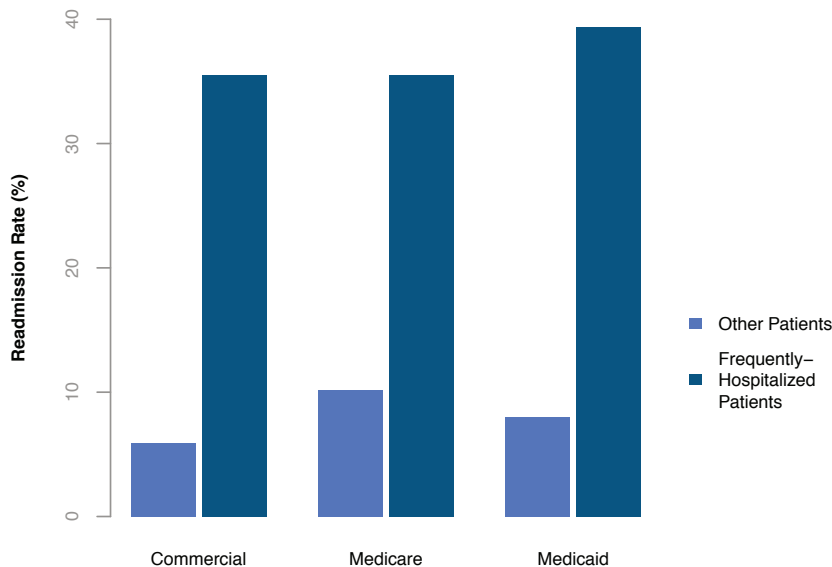
Note: Analyses exclude obstetric and primary psychiatric discharges. Frequently hospitalized patients defined as those with four or more discharges within any 1-year period during the 3-year study period. Figures within the Frequently Hospitalized group and the Other group do not sum to totals because the table excludes payer types “Other” and “Self-pay” which together account for 5.4% of discharges.

Data source: Massachusetts Hospital Inpatient Discharge Databases, July 2010 – June 2013.

Notably, the 93% of the people hospitalized three or fewer times in a twelve month period accounted for only 41% of all readmissions. The readmission rate among this large proportion of the hospitalized population in Massachusetts was only 8.5%, approximately half of the statewide readmission rate. The cohort of frequently hospitalized patients is older, and 69% of the frequently hospitalized patients had Medicare coverage (vs. 48% among the other patients). Table 3 shows figures for the frequently hospitalized group and the remaining patients by payer type. Despite the high prevalence of Medicare coverage in the frequently hospitalized group, this group may present an opportunity for focused readmission reduction efforts across payer types, since their readmission rates in each case exceed 35% (see Figure 8).

Figure 8: Readmission Rates among Frequently Hospitalized Patients by Payer Type, July 2010 to June 2013

Readmission rates for frequently hospitalized patients are high across payer types.



Note: Analyses exclude obstetric and primary psychiatric discharges. Frequently hospitalized patients defined as those with four or more discharges within any 1-year period during the 3-year study period.

Data source: Massachusetts Hospital Inpatient Discharge Databases, July 2010 – June 2013.

III. ALL-PAYER READMISSIONS BY HOSPITAL

Section III contains analyses of both observed (unadjusted) and risk-standardized readmission rates (RSRRs) by hospital. This section also shows weighted RSRRs by five characteristics of hospitals:¹⁴

1. Geographic region
2. Hospital affiliation
3. Hospital cohort (special, academic, community, teaching)
4. Disproportionate share status
5. Tax status

With observed hospital readmission rates, some portion of differences among hospitals may arise because the hospitals differ in the age or comorbidities of the patients they tend to see, or in the types of conditions they tend to treat. The RSRR adjustments take into account differences across hospitals in patient case mix and service mix which may impact readmissions, and therefore allow for a better comparison across hospitals.

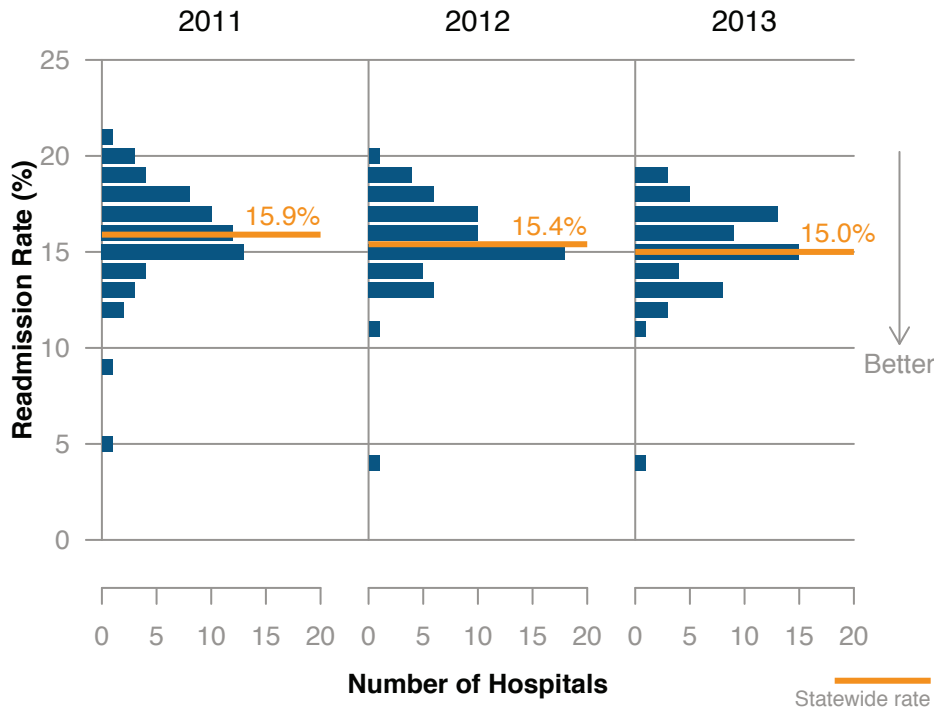
The information is based on acute-care discharges from Massachusetts hospitals among adults aged 18 and over who were hospitalized for non-obstetric and non-primary psychiatric related reasons.

¹⁴ In the analyses of RSRRs by hospital characteristics, the RSRRs are weighted using the inverse of the variance of the hospital-specific RSRR, as described by Krumholz et al. (2009). Patterns of hospital performance in acute myocardial infarction and heart failure 30-day mortality and readmission. *Circulation: Cardiovascular Quality and Outcomes*, 2, 407-413.

1. HOSPITAL READMISSION RATES OVER TIME

Figure 9: Hospital All-Payer Readmission Rates by Year, July 2010 to June 2013

Readmission rates decreased by one percentage point from 2011 to 2013.



Note: Analyses exclude obstetric and primary psychiatric diagnoses.

Data source: Massachusetts Hospital Inpatient Discharge Databases, July 2010 – June 2013.

The all-payer, state-wide readmission rate decreased by approximately one percentage point over the 3-year study period, from 15.9% in 2011, to 15.4% in 2012, and 15.0% in 2013. Figure 9 shows the distribution of hospitals' rates across the three years. This trend is consistent with analyses of national Medicare readmission rates over time¹⁵.

¹⁵ Schwartz, J. et al. (2014). Medicare hospital quality chartbook: Performance report on outcome measures. New Haven, CT: Yale New Haven Health Services Corporation Center for Outcomes Research and Evaluation. Available from <http://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/HospitalQualityInits/Downloads/Medicare-Hospital-Quality-Chartbook-2014.pdf>.

Table 4: All-Payer Readmission Rates by Hospital for 2011 and 2013

Hospital	Readmission Rate 2011	Readmission Rate 2013	Percent Change
Anna Jaques Hospital	16.3%	15.1%	-7.2%
Athol Memorial Hospital	14.4%	13.0%	-10.1%
Baystate Franklin Medical Center	14.8%	14.9%	1.2%
Baystate Mary Lane Hospital	12.0%	12.9%	7.2%
Baystate Medical Center	14.3%	14.7%	3.2%
Berkshire Medical Center	15.9%	16.1%	1.2%
Beth Israel Deaconess Hospital - Needham	12.5%	12.0%	-3.9%
Beth Israel Deaconess Medical Center	17.8%	15.7%	-11.6%
Beth Israel Deaconess Hospital - Milton	15.8%	14.3%	-9.8%
Boston Medical Center	17.6%	16.3%	-7.1%
Brigham and Women's Faulkner Hospital	15.1%	14.6%	-3.5%
Brigham and Women's Hospital	15.9%	15.4%	-3.3%
Cambridge Health Alliance	19.0%	17.7%	-6.6%
Cape Cod Hospital	12.9%	12.0%	-7.4%
Clinton Hospital	19.2%	18.6%	-3.1%
Cooley Dickinson Hospital	14.2%	12.8%	-9.9%
Emerson Hospital	11.5%	12.1%	5.6%
Fairview Hospital	14.8%	18.0%	21.4%
Falmouth Hospital	16.1%	13.6%	-16.1%
Hallmark Health	19.0%	17.4%	-8.1%
Harrington Memorial Hospital	15.5%	12.6%	-18.6%
HealthAlliance Hospital	15.5%	16.4%	6.4%
Heywood Hospital	16.1%	16.8%	3.9%
Holyoke Medical Center	17.1%	14.8%	-13.5%
Jordan Hospital	15.9%	13.2%	-17.4%
Lahey Clinic	14.6%	15.1%	3.6%
Lawrence General Hospital	14.4%	14.7%	1.9%
Lowell General Hospital	14.7%	14.7%	0.1%
Marlborough Hospital	15.0%	16.2%	7.6%
Martha's Vineyard Hospital	12.3%	18.1%	46.9%
Massachusetts Eye and Ear Infirmary *	8.6%	10.5%	22.1%
Massachusetts General Hospital	14.2%	14.2%	-0.5%
Mercy Medical Center	14.0%	14.5%	3.7%
Merrimack Valley Hospital	16.9%	17.5%	3.9%
MetroWest Medical Center	17.5%	15.9%	-9.1%
Milford Regional Medical Center	16.8%	16.6%	-1.3%
Morton Hospital, A Steward Family Hospital	20.1%	16.4%	-18.4%
Mount Auburn Hospital	14.8%	12.7%	-13.7%
Nantucket Cottage Hospital	16.7%	16.0%	-4.3%
Nashoba Valley Medical Center	15.9%	13.7%	-13.5%
New England Baptist Hospital *	4.4%	3.4%	-22.2%
Newton-Wellesley Hospital	13.9%	11.8%	-15.0%
Noble Hospital	13.4%	14.4%	7.9%
North Adams Regional Hospital	16.0%	12.9%	-19.7%
North Shore Medical Center	14.4%	14.4%	-0.2%
Northeast Hospital	17.3%	16.7%	-3.7%
Quincy Medical Center, A Steward Family	17.0%	14.8%	-12.6%
Saint Vincent Hospital	17.0%	15.6%	-8.0%
Signature Healthcare Brockton Hospital	18.2%	17.5%	-4.0%
South Shore Hospital	16.0%	14.4%	-10.1%
Southcoast Hospitals Group	17.6%	16.7%	-4.8%
Steward Carney Hospital, Inc.	19.2%	16.9%	-11.9%
Steward Good Samaritan	17.0%	15.3%	-9.7%
Steward Holy Family Hospital, Inc.	15.1%	13.6%	-9.9%
Steward Norwood Hospital, Inc.	16.0%	14.5%	-9.3%
Steward Saint Anne's Hospital, Inc.	20.0%	18.1%	-9.5%
Steward St. Elizabeth's Medical Center	17.6%	16.9%	-3.7%
Sturdy Memorial Hospital	13.5%	13.0%	-4.2%
Tufts Medical Center	18.7%	17.0%	-9.1%
UMass Memorial Medical Center	16.9%	16.4%	-3.4%
Winchester Hospital	14.8%	14.4%	-3.2%
Wing Memorial Hospital	17.6%	15.6%	-11.1%
Total	15.9%	15.0%	-5.5%

Note: * denotes a specialty hospital. Percentage changes are based on at least 150 discharges for each comparison period. Analyses exclude obstetric and primary psychiatric diagnoses

Data source: Massachusetts Hospital Inpatient Discharge Databases, July 2010 to June 2011 and July 2012 to June 2013.

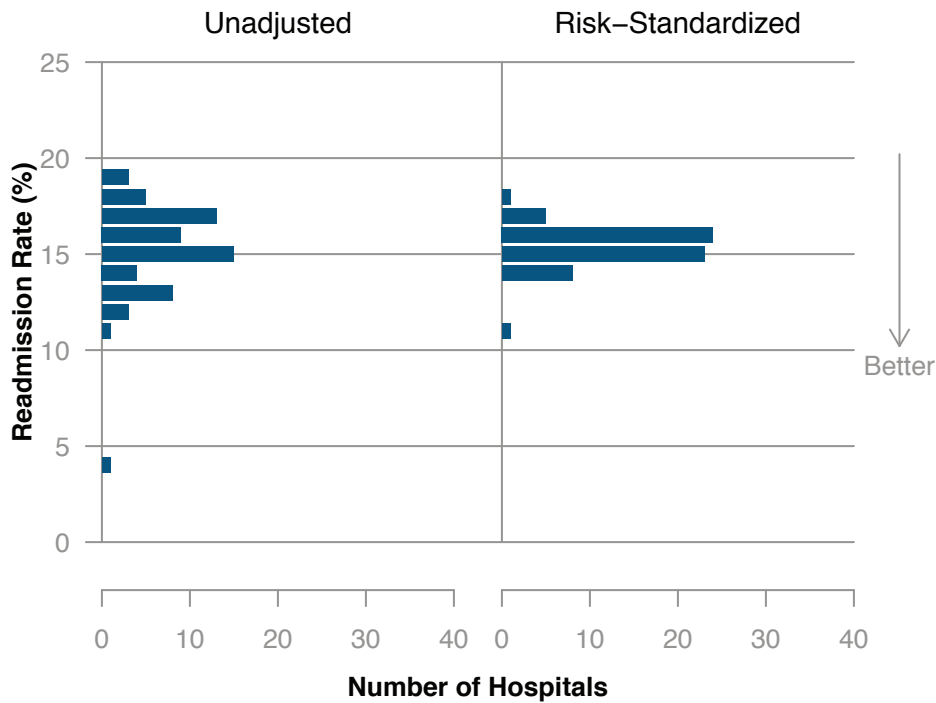
Table 4 shows the readmission rates by hospital for fiscal years 2011 and 2013, and the percentage change from 2011 to 2013. Across all hospitals, the readmission rate has declined by 5.5% from 2011 to 2013, and 10,334 fewer readmissions occurred in 2013 than in 2011. Sixteen hospitals reduced readmissions by more than 10% since 2011¹⁶.

¹⁶ These figures exclude specialty hospitals.

2. RISK-STANDARDIZED READMISSION RATES (RSRRS)

Figure 10: All-Payer Readmission Rates and Risk-Standardized Readmission Rates, July 2012 to June 2013

Standardizing rates by patient case mix and hospital service mix reduces differences among hospitals in readmission rates.



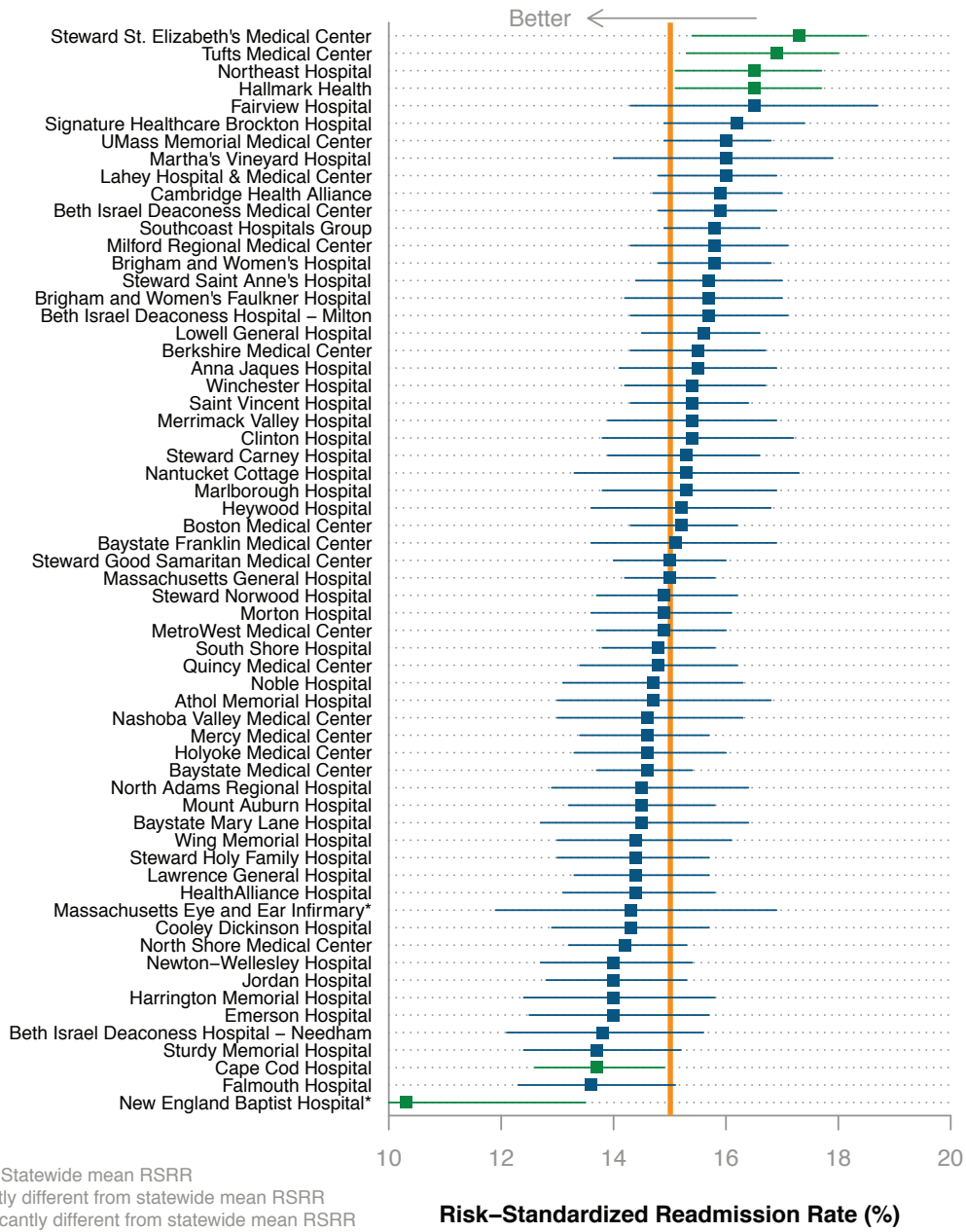
Note: Analyses exclude obstetric and primary psychiatric diagnoses.

Data source: Massachusetts Hospital Inpatient Discharge Databases, July 2012 – June 2013.

Much of the difference among hospitals in the unadjusted readmission rates is due to differences in patient case mix and hospital service mix. While there was a wide range in the unadjusted readmission rates for adults discharged from Massachusetts acute care hospitals, the risk-standardized readmission rates (RSRRs), which account for patient case mix and hospital service mix, had a narrower range (Figure 10).

Figure 11: All-Payer Risk-Standardized Readmission Rates by Hospital, with Confidence Intervals, July 2012 to June 2013

Few hospitals had risk-standardized readmission rates that varied significantly from the state average.



Note: * denotes a Specialty hospital. Analyses exclude obstetric and primary psychiatric discharges.

Data source: Massachusetts Hospital Inpatient Discharge Databases, July 2012 – June 2013.

Few hospitals varied significantly from the state average readmission rate. Figure 11 shows the RSRRs for hospitals and the corresponding 95% confidence intervals. Six hospitals had RSRRs that were significantly different from the state average, four above and two below.

3. READMISSIONS BY HOSPITAL CHARACTERISTICS

Readmissions are influenced by hospital factors such as care transition practices, the quality of clinical care, and the propensity of providers to admit and readmit patients. They are likely to also be influenced by community characteristics such as the degree of collaboration among post-acute providers and community physicians, the timeliness of information exchange, family socioeconomic distress, and community hospital utilization patterns¹⁷.

Table 5: All-Payer Risk-Standardized Readmission Rates by Region, July 2012 to June 2013

	Number of Discharges	Number of Readmissions	Observed Readmission Rate	Weighted Risk-Standardized Readmission Rate
Berkshires	11,418	1,802	15.8%	15.4%
Pioneer Valley / Franklin	48,922	7,090	14.5%	14.6%
Central Massachusetts	50,051	8,003	16.0%	15.2%
West Merrimack / Middlesex	47,539	6,913	14.5%	15.3%
East Merrimack	16,410	2,423	14.8%	14.7%
Upper North Shore	4,489	678	15.1%	15.5%
Metro West	16,812	2,719	16.2%	15.3%
Metro Boston	170,508	25,232	14.8%	15.4%
Lower North Shore	24,964	3,854	15.4%	15.0%
Norwood / Attleboro	12,975	1,812	14.0%	14.4%
Metro South	25,507	4,139	16.2%	15.3%
South Shore	26,301	3,720	14.1%	14.6%
Fall River	5,844	1,055	18.1%	15.7%
New Bedford	27,876	4,669	16.8%	15.8%
Cape and Islands	18,738	2,372	12.7%	14.3%
Total	508,354	76,481	15.0%	15.0%

Note: Analyses exclude obstetric and primary psychiatric discharges.

Data source: Massachusetts Hospital Inpatient Discharge Databases, July 2012 – June 2013.

Table 5 shows the risk-standardized and observed (unadjusted) readmission rates by region¹⁸. There is a small degree of variation in the risk-standardized rates, which range from the Cape and Islands at 14.3% to New Bedford at 15.8%. However, the regions show much larger differences in observed (unadjusted) readmission rates, which likely reflect the diverse characteristics of the Commonwealth's different communities. As displayed in Figure 12, the unadjusted readmission rates vary from 12.7% on the Cape and Islands to 18.0% in Fall River. CHIA has previously documented important regional differences in patient demographics, and regional variation in readmissions may reflect these factors¹⁹.

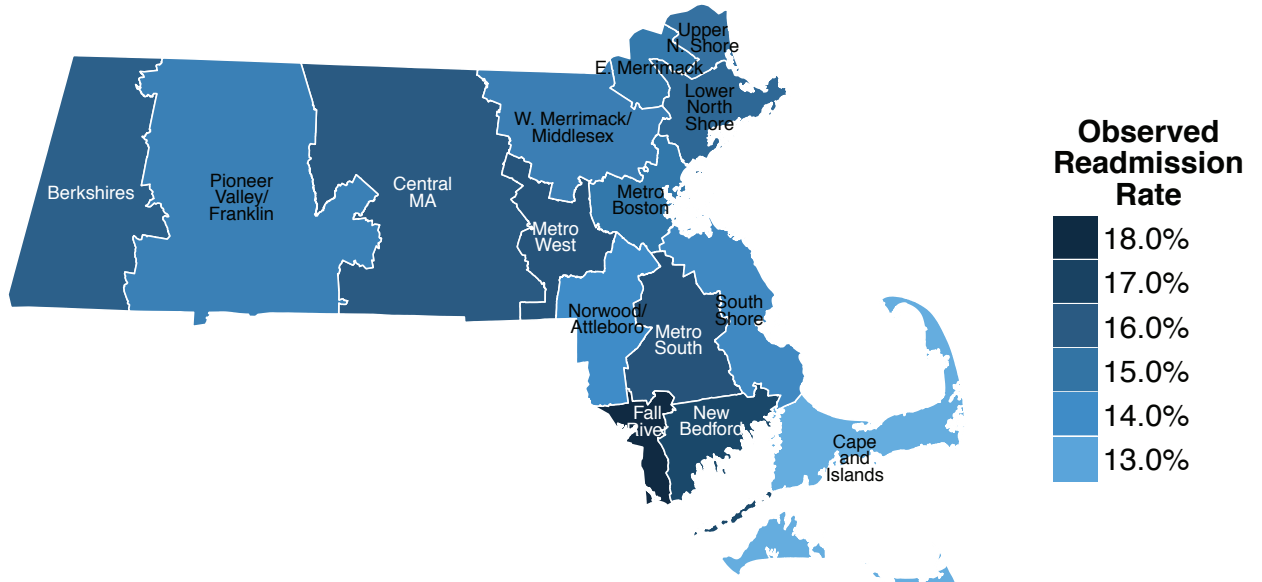
¹⁷ Herrin J., St. Andre, J., Kenward, K., Joshi, M., Audet, A., & Hines, S. (2015). Community factors and hospital readmission rates. *Health Services Research*, 50(1), 20-39.

¹⁸ The regions, defined by the Massachusetts Health Policy Commission, are: Berkshires, Pioneer Valley/Franklin, Central MA, West Merrimack/Middlesex, East Merrimack, Upper North Shore, Metro West, Metro Boston, Lower North Shore, Norwood/Attleboro, Metro South, South Shore, Fall River, New Bedford, and Cape and Islands.

¹⁹ Center for Health Information and Analysis. (2015). Acute hospital utilization trends in Massachusetts FY2009-FY2013. Boston, MA: Center for Health Information and Analysis. Available from: <http://chiamass.gov/utilization-analysis/>.

Figure 12: All-Payer Readmission Rate by Hospital Region, July 2012 to June 2013

Unadjusted readmission rates vary significantly by hospital region, from 12.7% on the Cape and Islands



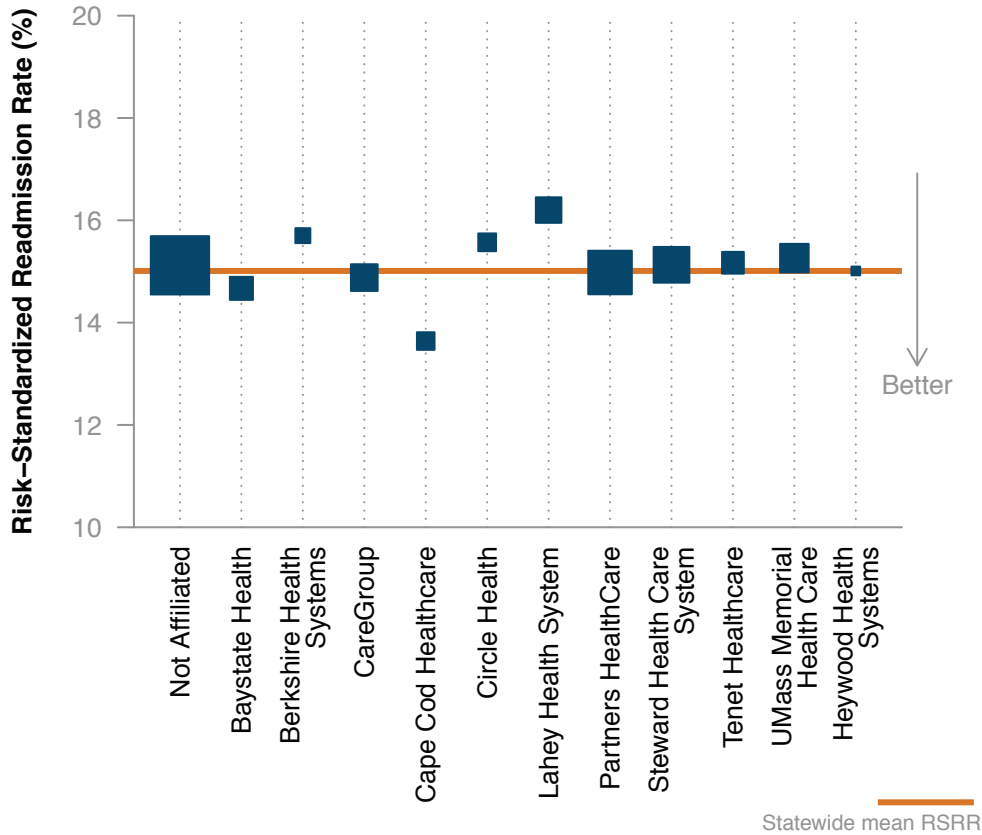
to 18.0% in Fall River.

Note: Analyses exclude obstetric and primary psychiatric diagnoses.

Data source: Massachusetts Hospital Inpatient Discharge Databases, July 2012 – June 2013.

Figure 13: All-Payer Risk-Standardized Readmission Rates by Hospital Affiliation, July 2012 to June 2013

Risk-standardized readmission rates vary by hospital affiliation.



Note: The size of the squares in the figure is proportional to the number of readmissions. Readmission rates are risk-standardized and weighted. Analyses exclude obstetric and primary psychiatric discharges. Affiliation is determined as of the most recent status during state fiscal year 2013²⁰.

Data source: Massachusetts Hospital Inpatient Discharge Databases, July 2012 – June 2013.

Readmission rates varied by hospital affiliation, ranging from a low of 13.6% in the Cape Cod Health Care System to a high of 16.2% at Lahey Health System (Figure 13). Table 6 shows risk-standardized readmission rates by hospital cohort, tax status and disproportionate share status²¹. Average readmission rates for academic medical centers, teaching hospitals, and community hospitals were broadly similar. Specialty hospitals, a category which is comprised of Massachusetts Eye and Ear Infirmary and New England Baptist Hospital in this analysis, treat populations with very different disease profiles, and as a group have low readmission rates. There was little difference in readmission rates between disproportionate share hospitals (DSH) and those without DSH status: 14.8% and 15.3% respectively. Additionally, hospitals showed no difference in readmission rates based on tax status, at 15.1% for both for-profit and non-profit hospital groups.

²⁰ Hospital affiliation information obtained from: Center for Health Information and Analysis (2015). Massachusetts hospital profiles. Boston, MA: Center for Health Information and Analysis. Available from: <http://chiamaass.gov/hospital-profiles/>. This report compiles information submitted by hospitals.

²¹ For each hospital characteristic (region, cohort, affiliation, disproportionate share status, tax status), hospitals were grouped and the risk-standardized readmission rate was calculated by weighting the hospital-specific RSRRs. See Appendix B for details of hospital characteristics.

Table 6: All-Payer Risk-Standardized Readmission Rates by Hospital Characteristics, July 2012 to June 2013

Hospital Characteristic	Number of Discharges	Percentage of Discharges	Number of Readmissions	Percentage of Readmissions	Weighted Risk-Standardized Readmission Rate
Hospital Cohort					
Specialty Hospital	7,440	1.5%	299	0.4%	12.6%
Academic Medical Center	133,883	26.3%	20,817	27.2%	15.6%
Teaching Hospital	94,964	18.7%	14,603	19.1%	15.4%
Community Hospital	272,067	53.5%	40,762	53.3%	14.9%
Disproportionate Share Status					
Disproportionate Share Hospital	153,082	30.1%	23,310	30.5%	14.8%
Non-Disproportionate Share Hospital	355,272	69.9%	53,171	69.5%	15.3%
Tax Status					
Non-Profit Hospital	428,638	84.3%	63,939	83.6%	15.1%
For-Profit Hospital	79,716	15.7%	12,542	16.4%	15.1%
Total	508,354	100.0%	76,481	100.0%	15.0%

Note: Readmission rates are risk-standardized and weighted. Analyses exclude obstetric and primary psychiatric discharges. For each hospital characteristic, hospitals were grouped and the risk-standardized readmission rate was calculated by weighting the hospital-specific RSRRs. See Appendix B for details of hospital characteristics.

Data source: Massachusetts Hospital Inpatient Discharge Databases, July 2012 – June 2013.

IV. CONCLUSIONS

This is the first analysis of readmission rates in the all-payer population in Massachusetts using the Yale/CMS methodology. The analysis provides statewide, regional, and hospital-specific readmission rates. Readmission patterns were examined by diagnosis, payer, discharge disposition, days between discharge and readmission, and among patients with a personal history of four or more hospitalizations in a twelve-month period.

Although the readmission rates for most hospitals did not vary statistically from the state average after adjusting for patient case mix and hospital service mix, this lack of variation does not indicate that there is no need or room for further reductions in readmissions. Massachusetts ranked eighth among the states in the average level of Medicare penalties imposed for readmissions, suggesting the potential to improve²². Hospitals continue to make efforts to reduce the rate of unplanned readmissions and there is variation, and potential opportunity for improvement, in readmission rates across different kinds of patients.

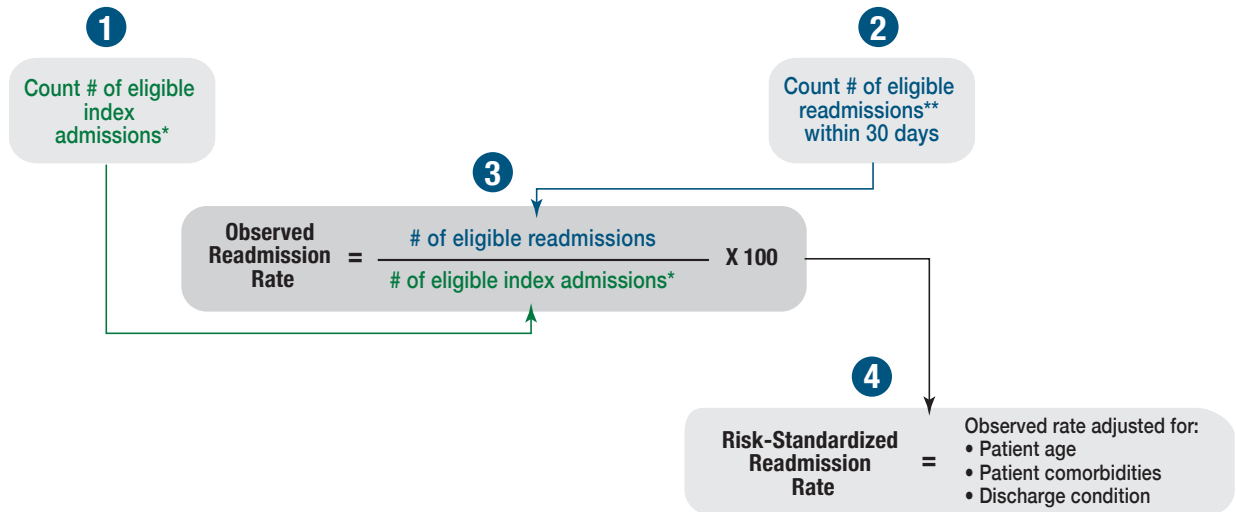
Readmissions rates varied by many of the factors examined, including major payer type, discharge setting, and hospital region. Most notably, a small minority of patients account for a large proportion of admissions and readmissions. By assessing both the clinical and socio-demographic characteristics of frequently hospitalized patients, hospitals may be able to tailor readmission prevention initiatives to address the needs of this group.

CHIA anticipates producing all-payer readmission statistics annually in the future and expanding readmissions reporting to include other population groups such as behavioral health readmissions and pediatric readmissions. CHIA's continued work on readmissions and revisits is designed to inform providers and policy makers as they work to improve health care and reduce wasteful spending in the Commonwealth.

²² Based on FY2009 data from: Massachusetts Health Policy Commission (2014). 2014 Cost Trends Report. Boston, MA: Health Policy Commission. Available from <http://www.mass.gov/anf/budget-taxes-and-procurement/oversight-agencies/health-policy-commission/publications/>.

V. ABOUT THE READMISSIONS METHODOLOGY

Figure 14: Overview of Readmissions Methodology



Notes:

* Eligible index admissions are admissions for adults during the study period to non-Federal acute-care hospitals in Massachusetts during which the patient did not die and which resulted in discharge to a non-acute care setting, and that had valid SSN information. A set of eight further exclusions were applied to this base definition (see Methods)

** Eligible readmissions are admissions for any reason that occur within 30 days of an index admission and are not planned.

CHIA adapted the Hospital-Wide All-Cause Unplanned 30-Day Readmission Measure developed by CMS and the Yale Center for Outcomes Research and Evaluation²³, and applied this measure to CHIA's Hospital Inpatient Discharge Database, which is collected from all acute hospitals in Massachusetts. Figure 14 above gives a high-level overview of how the readmission rates are calculated. First, eligible index admissions are defined. Then, from among this set of admissions, the number of eligible readmissions within 30 days is derived. The latter divided by the former and turned into a percentage gives the readmission rate. In a final step, we use hierarchical statistical models to standardize the readmission rates, accounting for patient age, patient comorbidities, and patient discharge condition, an indicator of hospital service mix.

CHIA included all-payer adult patients aged 18 years or older discharged from all acute care hospitals in Massachusetts. Patient cohorts were formed by Massachusetts fiscal years, which run from July 1 to June 30, for years 2011, 2012, and 2013. For example, the fiscal year 2013 cohort included adults aged 18 and over who were admitted to any acute care hospitals in the Commonwealth from July 1, 2012 to June 30, 2013.

²³ For the original measure technical report see: Horwitz et. al. (2012). Hospital-wide all-cause unplanned readmission measure. Final technical report. New Haven, CT: Yale New Haven Health Services Corporation/Center for Outcomes Research & Evaluation. For the updated 2013 v. 2.0 specification see: Yale New Haven Health Services Corporation/Center for Outcomes Research & Evaluation (YNHHSC/CORE). (2013). 2013 Measure updates and specification report: hospital-wide all-cause unplanned readmission measure (version 2.0). New Haven, CT: YNHHSC/CORE. Both available from: <http://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/HospitalQualityInits/Measure-Methodology.html>.

An index admission is a discharge from an acute care hospital in Massachusetts for a patient aged 18 and over during the study period. From this base set of admissions, we excluded specific defined sets of admissions, including those relating to obstetric care, psychiatric conditions, and rehabilitation care. Also, about 6% of the discharges for adults without a Unique Health Identification Number, usually an encrypted Social Security Number, were excluded from the analysis. For the full specification describing how the study cohort was defined, please see Appendix A: Readmissions Methodology.

Readmission is defined as an unplanned admission that occurred within 30 days of an index admission. A planned readmission is an admission within 30-days of discharge from an acute hospital that is a scheduled part of the patient's plan of care. Planned readmissions are identified using an algorithm developed by the Yale/CMS team and are excluded from the readmission analysis in this report.

Since a patient can have a sequence of multiple admissions, a particular admission may serve in the calculations as both an index admission and as a readmission for a prior index admission.

As mentioned above, CHIA reports two types of rates: observed (unstandardized) readmission rates and risk-standardized readmission rates (RSRRs). The observed readmission rate is defined as the percentage of index admissions with a readmission:

$$\frac{\text{\# of Readmissions}}{\text{\# of Index Admissions}} \times 100$$

We followed the Yale/CMS methodology to calculate risk-standardized rates at the hospital level. There are differences in patient demographics, presenting conditions, comorbidities, and the types of procedures the hospitals typically employ in response to their patients' needs at the hospital level. The goal of the standardization procedure is to control for these differences in case mix and service mix, and allow a more valid and fair comparison among hospitals. CHIA first grouped discharges into condition categories, using the Clinical Classification System (CCS).²⁴ Five cohorts were used: medicine, surgery/gynecology, cardiovascular, cardiorespiratory, and neuropathy. CHIA then employed a hierarchical generalized linear model to adjust for differences in hospital case mix and to account for the clustering of patients within hospitals for each of the five discharge cohorts. Please see Appendix A: Readmissions Methodology for details.

²⁴ Elixhauser A, Steiner C, Palmer L. (2014). Clinical Classifications Software (CCS), 2014. Washington, DC: U.S. Agency for Healthcare Research and Quality. Available at: <http://www.hcup-us.ahrq.gov/toolssoftware/ccs/ccs.jsp>.

APPENDIX A: READMISSIONS METHODOLOGY

HISTORY OF THE HWR MEASURE

Since 2009, CMS has been publicly reporting a set of 30-day disease-specific readmission measures for hospitals. Realizing the need for a broader measure that could capture a greater proportion of readmissions than these disease-specific measures, CMS contracted with the Yale New Haven Health Services Corporation/Center for Outcomes Research and Evaluation (YNHHSC/CORE) to develop a hospital-wide all-cause unplanned readmissions measure (the HWR measure). The Yale team, building on the methodology of the disease-specific measures, in 2011 developed the hospital-wide measure based on claims data for fee-for-service Medicare enrollees age 65 and older. The hospital-wide measure was endorsed by the National Quality Forum (#1789) and CMS started reporting the measure publicly in 2013. For the 2013 public reporting, the Yale team updated the measure slightly (to version 2.0) and released an updated specification report and accompanying SAS software to facilitate measure calculation. The measure used in this report follows this 2013, version 2.0, specification²⁵.

OVERVIEW OF THE METHODOLOGY

The logic of the HWR measure requires the specification of a denominator, the number of eligible hospital admissions during a given time period that might possibly have resulted in a readmission (termed “index” admissions), and a numerator, the number of actual readmissions that occurred during the time period. The first two steps in the calculations are to identify these two sets of records. Dividing the number of readmissions by the number of index admissions and multiplying by 100 gives the readmission rate as a percentage. This rate is called an “observed” readmission rate because it is derived directly from what was observed during the study period. In the fourth step, observed rates calculated for each hospital under study are standardized to control for background factors that might influence readmission rates, but not be indicators of healthcare quality. The risk-standardized readmission rate (RSRR) controls for differences among hospitals in patient age, patient comorbidities, and hospital service mix.

This report includes observed and risk-standardized readmission rates calculated separately by Massachusetts fiscal years, which run from July 1 to June 30, for the 2011, 2012, and 2013 fiscal years (i.e. the 2013 data includes discharges from July 1, 2012 through June 30, 2013). We present observed rates for the 2011, 2012, and 2013 years and risk-standardized rates for 2013.

²⁵ For the original measure technical report see: Horwitz et. al. (2012). Hospital-wide all-cause unplanned readmission measure. Final technical report. New Haven, CT: Yale New Haven Health Services Corporation/Center for Outcomes Research & Evaluation. For the updated 2013 v. 2.0 specification see: Yale New Haven Health Services Corporation/Center for Outcomes Research & Evaluation (YNHHSC/CORE). (2013). 2013 Measure updates and specification report: hospital-wide all-cause unplanned readmission measure (version 2.0). New Haven, CT: YNHHSC/CORE. Both available from: <http://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/HospitalQualityInits/Measure-Methodology.html>.

DATA SOURCE

In the original development of the HWR measure, Mathematica Policy Research (MPR) prepared the required input data from CMS Medicare claims data²⁶. The MPR team developed processing algorithms to produce three types of input data that are required by the HWR measure:

- A main “index” file that contains a record for each index admission (used primarily to calculate the measure’s denominator).
- A “follow-up” file that includes admissions that occurred within 30 days of an index admission and might therefore be deemed to be readmissions if they are not categorized as planned (forms the measure numerator).
- A “history/diagnosis” file that includes information on patients’ diagnoses within the year prior to an index admission, which is used to form measures of comorbidities for the risk-standardization procedure.

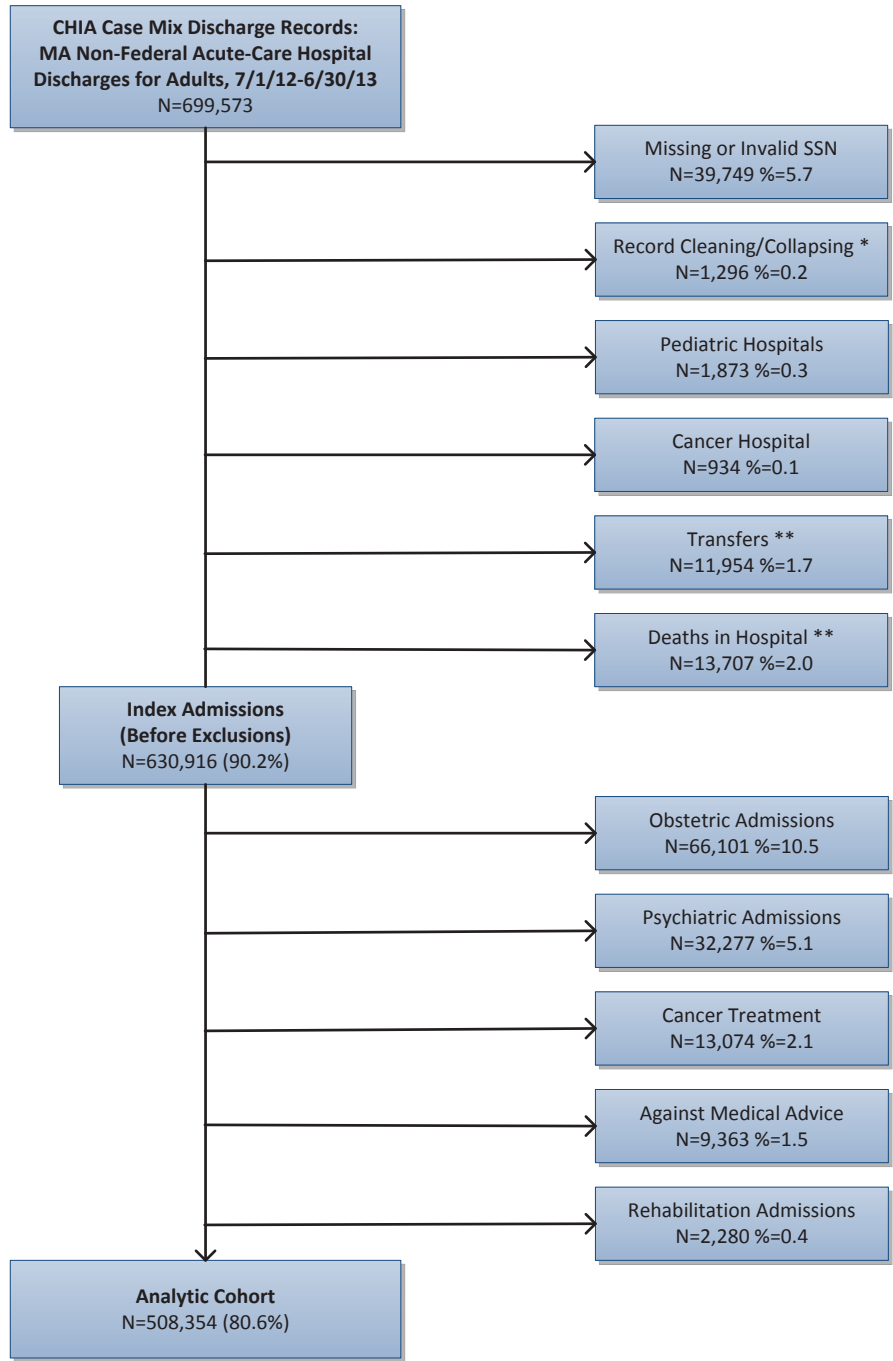
To use the HWR measure for public reporting in Massachusetts, we modified MPR’s processing logic to draw upon discharge summary data from CHIA’s Acute Hospital Case Mix Charge Database as the source data.

This case mix discharge dataset is a stay-level file including patient socio-demographics, diagnostic information, treatment and service information, and hospital charges. The data is submitted quarterly by all Massachusetts acute care hospitals, and undergoes a cleaning and verification process at CHIA that includes the feedback of verification reports to hospitals for confirmation of their information. Once quarterly data has been processed and verified, CHIA produces and makes available annual files.

CHIA modified the MPR processing logic, which was designed for claims and enrollment data, to adapt the measure for use with hospital discharge data as the source data. The primary modifications were around the merging of patient demographic information with visit information. The original CMS data for which the HWR measure was developed included information on Medicare eligibility. The MPR processing logic limits eligible index admissions to those for patients with at least 12 months of enrollment in Medicare Part A before an index admission, so as to have adequate diagnosis data for case mix adjustment, and at least 30 days of enrollment in Medicare after the index admission, so as to have had the possibility of experiencing a readmission that would appear in the data. For the CHIA measure, which is based on hospital discharge summaries, all patients seeking inpatient care at any acute care hospitals in Massachusetts are included in the calculation.

²⁶ The Mathematica Policy Research programs and documentation are available by request from the CMS Readmission Measures Mailbox at cmsreadmissionmeasures@yale.edu.

Figure A1: Construction of the Analytic Cohort



Note:

Exclusions are not mutually exclusive.

* Cleaning/collapsing includes: Removing duplicate records, collapsing overlapping stays, removing stays > 1 year, and combining adjacent admissions.

** The exclusions for transfer and death were implemented after making the exclusions above them in the figure.

CALCULATION STEPS

Calculating the Yale/CMS Hospital-Wide All-Cause Unplanned 30-day Readmission measure involves four steps:

1. Identifying the set of index visits during the designated time period,
2. Identifying readmissions,
3. Calculating observed readmission rates, and
4. Calculating risk-standardized readmission rates.

These steps are described below.

Step 1: Definition of Index Admissions

Figure A.1 illustrates the construction of the readmissions analytic cohort for the July 2012 to June 2013 study period. The processing for the other two study years is parallel. The data preparation involves two conceptual steps, 1) preparation of a base “index admission” cohort (top portion of the figure, originally developed by both the MPR team and the Yale team), and 2) application of a series of exclusions to refine the cohort to a final analytic file used for calculations (bottom portion of the figure, developed by the Yale team).

The base index admission cohort, produced at the end of the first broad step of processing, comprises:

- Discharges from non-federal acute-care hospitals in Massachusetts,
- for adults,
- within the study time period, which is July 1, 2010 to June 30, 2013,
- that had valid SSN information on the record (so that matching across records could be attempted),
- were not from pediatric or cancer hospitals,
- were not transfers to other acute hospitals, and
- in which the patient did not die while in the hospital.

This set of records constitutes the conceptual base on which the measure may be calculated and excludes records which are incompatible with the logic of the measure (e.g. if a patient dies in the hospital they are not at risk of having a subsequent readmission). There were 699,573 discharge records in CHIA’s Acute Hospital Case Mix Charge Database for adults (age 18+) during the time period from July 1, 2012 to June 30, 2013. Of the exclusions applied in this first phase of processing, the exclusion due to the lack of a valid SSN was the most significant (almost 40,000 records, 5.7%). The exclusions because of in-hospital death (n=13,707, 2.0%) and transfer to another acute care hospital (n=11,954, 1.7%) also applied to a sizable number of records. The final base cohort includes 630,916 discharges, or 90.2% of the original adult discharges during the time period.

In the second stage of processing, records meeting any of five specific criteria were excluded from the calculations to produce the final analytic dataset. The five exclusion criteria applied were:

- **Admissions for obstetric care:** The Yale team recommends removing obstetric admissions when working with an all-payer population because the rate of readmission for obstetric cases is substantially lower than that for other admissions, and therefore distorts overall readmission rates. This was the largest exclusion, accounting for 66,101 records (10.5%).
- **Admissions for psychiatric conditions:** Since patients admitted primarily for psychiatric conditions (n=32,277, 5.1%) are typically treated in different types of facilities from acute-care hospitals, they are excluded from the measure.
- **Treatment for cancer:** Because cancer patients’ showed different readmission and mortality profiles from other patients during the preliminary measure development research, the Yale team determined that they should not be included in the final measure. This exclusion resulted in 13,074 (2.1%) records being dropped.

- **Against medical advice:** Patients discharged against medical advice (AMA) are excluded because they did not necessarily receive the full care the hospital intended to provide. This criterion resulted in the exclusion of 9,363 (1.5%) records.
- **Admissions for rehabilitation care:** Patients admitted for rehabilitation (n=2,280, 0.4%) are typically not served in acute-care hospitals and are excluded.

Once these exclusions are applied to the 2012-2013 data, the final resulting analytic cohort includes 508,354 eligible index admissions. The process for constructing the 2010-2011 and 2011-2012 analytic cohorts is identical.

This definition of the analytic cohort differs from the original Yale specification in the following respects:

- The Yale/CMS measure includes admissions for those enrolled in Medicare fee-for-service coverage; the CHIA Massachusetts measure includes admissions covered by all payers.
- The Yale measure includes patients age 65 and older; this measure includes patients age 18 and over.
- The CHIA measure explicitly excludes obstetric cases.
- As described under Data Source above, the Yale measure limits eligible index admissions based on Medicare eligibility; the CHIA measure does not.

Table A1 shows the overall counts and percentages for the dataset creation process for the 2012-2013 data.

Table A1: Formation of Analytic Cohort for 2013

Processing Step	N	% of Adult Discharges	% of Index Admissions Before Exclusions
All discharges for adults in CHIA Case Mix Dataset, 7/1/12 to 6/30/13	699,573	100.0%	--
Index Admissions, Before Exclusions	630,916	90.2%	100.0%
Analytic Cohort	508,354	72.7%	80.6%

Step 2: Definition of Readmissions

The second step of the HWR calculations is to count the number of readmissions. Once the index admissions have been identified, it is relatively simple to quantify the number of readmissions. Under the HWR algorithm, readmissions are defined as any admissions that occur within 30 days of an index admission, excluding those that are deemed to be planned (see below). Note that under this definition a particular hospital stay may count both as an index admission and as a readmission in relation to an earlier index admission. Patients may have multiple readmissions if they cycle in and out of the hospital with a frequency less than or equal to 30 days.

The Yale/CMS methodology includes an algorithm for excluding from the calculations those readmissions that are likely to have been planned. Yale researchers developed a list of inpatient procedures that are usually planned (e.g. knee arthroplasty, hip replacement), and revised the list following a public comment period. A readmission is classified as planned, and therefore excluded from the readmission rate calculations, if it includes one of these procedures and the discharge condition for the readmission is a non-acute condition.

Step 3: Calculation of Observed Readmission Rates

The observed readmission rate for a hospital, or for some other defined group of patients or visits, is simply the number of readmissions that occurred during the designated time period (plus 30 days thereafter), divided by the base number of index admissions within the period, and multiplied by 100 to produce a percentage. The report features readmission rates calculated for hospitals as well as by other patient-level and visit-level characteristics such as patient age, patient gender, payer type, and discharge status.

Step 4: Calculation of Risk-Standardized Readmission Rates (RSRRs)

The Yale team designed the risk-standardization procedure to adjust hospitals' observed readmission rates by potentially confounding background factors that might influence readmissions. The risk-standardized readmission rate (RSRR) accounts for differences in background factors among the patients served by different hospitals so that more meaningful comparisons among hospitals' readmission rates can be made.

Cohort Assignment

The risk-standardization procedure is carried out separately on five clinically-defined cohorts of patients. By standardizing separately for different groups of patients, the procedure allows the adjustments made to be different for different types of patients, rather than assuming that one adjustment works well for all patients. Also, patients who have the same broad category of illness are likely to be treated by the same broad provider team, and care for patients within these groups is likely to be more homogeneous than care provided to patients across groups. The measure assigns patients to one of five clinically-defined cohorts:

- Surgery/gynecology
- Cardiorespiratory
- Cardiovascular
- Neurology
- Medicine

Assignment to these five cohorts is based on the AHRQ Clinical Classifications Software (CCS) grouper that aggregates ICD-9-CM procedure and diagnosis codes into a much smaller number of clinically coherent categories (approximately 230 procedures and 280 diagnoses). Cohort assignment proceeds first by procedure code, and then by diagnosis code. First, patients with a procedure code indicative of having had a major surgery while in the hospital are assigned to the surgery/gynecology cohort. Then, remaining patients are assigned to one of the four other cohorts based on their principal discharge condition. Patients are assigned to the Medicine cohort when their condition does not correspond to any of the three more narrowly defined cohorts (cardiorespiratory, cardiovascular, neurology).

Statistical Models

Once patients are assigned to cohorts, a separate risk-adjustment model is fit for each cohort. The HWR methodology uses hierarchical logistic regression models, with discharges nested within hospitals, to estimate hospitals' impact on readmissions, controlling for patient case mix and hospital service mix.

The hierarchical logistic regression models predict readmission at the discharge level (coded 0/1) from discharge-level and hospital-level factors. At the discharge level, three factors are controlled for:

- **Patient age:** Age is measured in years.
- **Patient case mix:** Patient case mix is operationalized as a set of 31 indicators for comorbid conditions based on diagnosis information from the 12 months preceding the index hospitalization and the index hospitalization itself. The comorbidity indicators are based on the CMS Condition Categories grouper²⁷. The Yale team selected conditions by starting from those used in previous hospital-specific readmissions measures, and then conducting a clinical review and a statistical modeling process to identify conditions that were both predictive of readmission as well as clinically meaningful. The comorbidity indicators include conditions such as metastatic cancer/acute leukemia, diabetes mellitus, end-stage liver disease, drug and alcohol disorders, and congestive heart failure.
- **Hospital service mix:** Hospital service mix is operationalized as a set of variables indicating the patient's specific discharge condition within each of the five clinical cohorts. These measures are based on the AHRQ Clinical Classifications Software (CCS) grouper²⁸, the same classification system used to define overall cohort membership. The Yale team reasoned that different conditions will have different base probabilities of readmission, that hospitals are likely to differ in the mix of conditions that they tend to treat, and therefore specific discharge condition should be controlled.

At the hospital level, a random intercept term for hospital is included in each model. This term allows the predicted probability of readmission for all the patients in a hospital to be increased or decreased by a fixed amount. Inclusion of this term has two important effects. First, it properly accounts for the grouping of patients within hospitals. Without this term, the model would violate one of the statistical assumptions of regression analysis, that cases are independent of one-another. Second, since this term represents an increase or decrease in the probability of readmission for the patients in each hospital, controlling for the above patient factors, it directly indexes the impact of hospital on readmissions. Therefore, it plays a central role in the calculations. Each model produces two numbers for each hospital:

- **The predicted number of readmissions:** This estimate comes from the full model, including both the discharge-level variables and the hospital term. It represents the model-based prediction of the number of readmissions, including both the background characteristics of the patients, and which hospital they attend.
- **The expected number of readmissions:** This estimate is predicted from the model *excluding* the hospital term. It represents the number of readmissions that would be expected given only the patient background factors, and ignoring the effect of hospital.

The ratio of these two numbers, the predicted number divided by the expected number, gives the *standardized risk ratio* (SRR) for each cohort and hospital. This number represents the extent to which a hospital has more (numbers > 1) or fewer (numbers < 1) readmissions for the cohort than one would expect based on the characteristics of the patients they treat.

The final *risk-standardized readmission rate* (RSRR) for a hospital is calculated by combining the standardized risk ratios from the five cohort-specific models. Specifically, the volume-weighted logarithmic mean of the five SRRs is calculated to produce a hospital-wide standardized risk ratio. This weighting procedure allows larger cohorts within a hospital to have a larger impact on the final rate. In a final step, the hospital-wide SRR for each hospital is multiplied by the statewide observed readmission rate to produce the final set of risk-standardized readmission rates (RSRRs).

Calculation of Confidence Intervals for RSRRs

Because the estimated RSRRs are derived by a series of calculations from the output of multiple statistical models, and the variance of the estimates would therefore be difficult to calculate analytically, the HWR measure includes a bootstrapping algorithm for calculating RSRR confidence intervals. Under this algorithm, one draws repeated samples of hospitals, with replacement, from the total population of hospitals under study and calculates the RSRR for each hospital in the sample. A final random sample, with equal number of calculated RSRRs from each hospital, is drawn. The final confidence intervals are found by taking the 2.5% and 97.5% percentiles from the distribution of calculated RSRRs for each hospital.

Weighting of RSRRs for Analyses of Hospital Characteristics

In order to aggregate the risk-standardized readmission rate (RSRRs) across hospitals to larger entities such as geographic regions and hospital systems, we averaged the hospital-specific RSRRs for each group and weighted each hospital's RSRR in the average by the inverse of its variance, obtained from the bootstrapping process²⁹. This weighting scheme allows hospitals with higher volumes, and more precise estimates, to contribute more to the aggregated rate than those with lower volumes.

27 Pope, G. et al. (2000). Diagnostic cost group hierarchical condition category models for Medicare risk adjustment: Final Report. Waltham, MA: Health Economics Research, Inc. Available from: <http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Reports/Research-Reports-Items/CMS023176.html>.

28 Elixhauser A, Steiner C, Palmer L. (2014). Clinical Classifications Software (CCS), 2014. Washington, DC: U.S. Agency for Healthcare Research and Quality. Available at: <http://www.hcup-us.ahrq.gov/toolssoftware/ccs/ccs.jsp>.

29 For an example of this technique see: Krumholz et al. (2009). Patterns of hospital performance in acute myocardial infarction and heart failure 30-day mortality and readmission. *Circulation: Cardiovascular Quality and Outcomes*, 2, 407-413.

APPENDIX B: MASSACHUSETTS ACUTE CARE HOSPITALS AND THEIR CHARACTERISTICS*

Hospital Name	2013 Hospital Affiliation	Hospital Type	Share Status	Tax Status	Notes
Anna Jaques Hospital	Not Affiliated	Community Hospital	Not Disproportionate	Non-Profit	
Athol Memorial Hospital	Heywood Health Systems	Community Hospital	Disproportionate	Non-Profit	
Baystate Franklin Medical Center	Baystate Health System	Community Hospital	Disproportionate	Non-Profit	
Baystate Mary Lane Hospital	Baystate Health System	Community Hospital	Not Disproportionate	Non-Profit	
Baystate Medical Center	Baystate Health System	Teaching Hospital	Not Disproportionate	Non-Profit	
Berkshire Medical Center	Berkshire Health Systems	Teaching Hospital	Not Disproportionate	Non-Profit	Includes Hillcrest and Berkshire campuses
Beth Israel Deaconess Hospital - Needham	Care Group	Community Hospital	Not Disproportionate	Non-Profit	
Beth Israel Deaconess Medical Center	Care Group	Academic Medical Center	Not Disproportionate	Non-Profit	
Beth Israel Deaconess Hospital - Milton	Care Group	Community Hospital	Not Disproportionate	Non-Profit	
Boston Medical Center	Not Affiliated	Academic Medical Center	Not Disproportionate	Non-Profit	
Brigham and Women's Faulkner Hospital	Partners HealthCare System	Teaching Hospital	Not Disproportionate	Non-Profit	
Brigham and Women's Hospital	Partners HealthCare System	Academic Medical Center	Not Disproportionate	Non-Profit	
Cambridge Health Alliance	Not Affiliated	Teaching Hospital	Not Disproportionate	Non-Profit	Includes Cambridge, Somerville, and Whidden campuses; municipal hospital grouped with non-profit hospitals
Cape Cod Hospital	Cape Cod Health Care System	Community Hospital	Disproportionate	Non-Profit	
Clinton Hospital	UMass Memorial Health Care	Community Hospital	Disproportionate	Non-Profit	
Cooley Dickinson Hospital	Partners HealthCare System	Community Hospital	Not Disproportionate	Non-Profit	
Emerson Hospital	Not Affiliated	Community Hospital	Not Disproportionate	Non-Profit	
Fairview Hospital	Berkshire Health Systems	Community Hospital	Disproportionate	Non-Profit	
Falmouth Hospital	Cape Cod Health Care System	Community Hospital	Disproportionate	Non-Profit	

Massachusetts Acute Care Hospitals and Their Characteristics (continued)

Hospital Name	2013 Hospital Affiliation	Hospital Type	Share Status	Tax Status	Notes
Hallmark Health	Not Affiliated	Community Hospital	Not Disproportionate	Non-Profit	Includes Melrose-Wakefield and Lawrence campuses
Harrington Memorial Hospital	Not Affiliated	Community Hospital	Disproportionate	Non-Profit	
HealthAlliance Hospital	UMass Memorial Health Care	Community Hospital	Disproportionate	Non-Profit	Includes Burbank and Leominster campuses
Heywood Hospital	Heywood Health Systems	Community Hospital	Disproportionate	Non-Profit	
Holyoke Medical Center	Not Affiliated	Community Hospital	Disproportionate	Non-Profit	
Jordan Hospital	Not Affiliated	Community Hospital	Not Disproportionate	Non-Profit	A CareGroup Hospital since 2014; Became Beth Israel Deaconess Hospital – Plymouth
Lahey Hospital and Medical Center	Lahey Health System	Teaching Hospital	Not Disproportionate	Non-Profit	Includes North Shore and Burlington campuses
Lawrence General Hospital	Not Affiliated	Community Hospital	Disproportionate	Non-Profit	
Lowell General Hospital	Circle Health	Community Hospital	Not Disproportionate	Non-Profit	Includes Saint's Medical Center
Marlborough Hospital	UMass Memorial Health Care	Community Hospital	Disproportionate	Non-Profit	
Martha's Vineyard Hospital	Partners HealthCare System	Community Hospital	Disproportionate	Non-Profit	
Massachusetts Eye and Ear Infirmary	Not Affiliated	Specialty Hospital	Not Disproportionate	Non-Profit	
Massachusetts General Hospital	Partners HealthCare System	Academic Medical Center	Not Disproportionate	Non-Profit	
Mercy Medical Center	Not Affiliated	Community Hospital	Disproportionate	Non-Profit	Includes Springfield and Providence campuses
Merrimack Valley Hospital	Steward Health Care System	Community Hospital	Disproportionate	For-Profit	A Steward Family Hospital since 2011; merged with Holy Family Hospital in 2014 and became Holy Family Hospital at Merrimack Valley
MetroWest Medical Center	Vanguard Health Systems (Tenet Healthcare)	Community Hospital	Not Disproportionate	For-Profit	Includes Leonard Morse and Framingham campuses
Milford Regional Medical Center	Not Affiliated	Community Hospital	Not Disproportionate	Non-Profit	
Morton Hospital	Steward Health Care System	Community Hospital	Disproportionate	For-Profit	A Steward Family Hospital since 2011
Mount Auburn Hospital	Care Group	Teaching Hospital	Not Disproportionate	Non-Profit	
Nantucket Cottage Hospital	Partners HealthCare System	Community Hospital	Not Disproportionate	Non-Profit	
Nashoba Valley Medical Center	Steward Health Care System	Community Hospital	Not Disproportionate	For-Profit	A Steward Family Hospital since 2011
New England Baptist Hospital	Care Group	Specialty Hospital	Not Disproportionate	Non-Profit	

Massachusetts Acute Care Hospitals and Their Characteristics (continued)

Hospital Name	2013 Hospital Affiliation	Hospital Type	Share Status	Tax Status	Notes
Newton-Wellesley Hospital	Partners HealthCare System	Community Hospital	Not Disproportionate	Non-Profit	
Noble Hospital	Not Affiliated	Community Hospital	Disproportionate	Non-Profit	
North Adams Regional Hospital	Not Affiliated	Community Hospital	Disproportionate	Non-Profit	Closed in 2014
North Shore Medical Center	Partners HealthCare System	Community Hospital	Disproportionate	Non-Profit	Includes Salem and Union campuses
Northeast Hospital	Lahey Health System	Community Hospital	Not Disproportionate	Non-Profit	Includes Beverly and Addison Gilbert campuses
Quincy Medical Center	Steward Health Care System	Community Hospital	Disproportionate	For-Profit	A Steward Family Hospital since 2011; Closed in 2014
Saint Vincent Hospital	Vanguard Health Systems (Tenet Healthcare)	Teaching Hospital	Not Disproportionate	For-Profit	
Signature Healthcare Brockton Hospital	Not Affiliated	Community Hospital	Disproportionate	Non-Profit	
South Shore Hospital	Not Affiliated	Community Hospital	Not Disproportionate	Non-Profit	
Southcoast Hospitals Group	Not Affiliated	Community Hospital	Disproportionate	Non-Profit	Includes Tobey, St. Luke's and Charlton Memorial campuses
Steward Carney Hospital	Steward Health Care System	Teaching Hospital	Not Disproportionate	For-Profit	Formerly Carney Hospital (2010)
Steward Good Samaritan Medical Center	Steward Health Care System	Community Hospital	Disproportionate	For-Profit	Formerly Good Samaritan Medical Center (2010); includes NORCAP Lodge and Brockton campuses
Steward Holy Family Hospital	Steward Health Care System	Community Hospital	Disproportionate	For-Profit	Formerly Holy Family Hospital (2010)
Steward Norwood Hospital	Steward Health Care System	Community Hospital	Not Disproportionate	For-Profit	Formerly Norwood Hospital (2010)
Steward Saint Anne's Hospital	Steward Health Care System	Community Hospital	Disproportionate	For-Profit	Formerly Saint Anne's Hospital (2010)
Steward St. Elizabeth's Medical Center	Steward Health Care System	Teaching Hospital	Not Disproportionate	For-Profit	Formerly St. Elizabeth's Medical Center (2010)
Sturdy Memorial Hospital	Not Affiliated	Community Hospital	Disproportionate	Non-Profit	
Tufts Medical Center	Not Affiliated	Academic Medical Center	Not Disproportionate	Non-Profit	
UMass Memorial Medical Center	UMass Memorial Health Care	Academic Medical Center	Not Disproportionate	Non-Profit	Includes University and Memorial campuses
Winchester Hospital	Not Affiliated	Community Hospital	Not Disproportionate	Non-Profit	
Wing Memorial Hospital	UMass Memorial Health Care	Community Hospital	Disproportionate	Non-Profit	A Baystate Health System Hospital since 2014; Became Baystate Wing Hospital

* Hospital affiliation, hospital type, share status, and tax status are based on their latest status during state fiscal year 2013: July 2012-June 2013.

APPENDIX C: REGIONAL MAPPING OF MASSACHUSETTS ACUTE CARE HOSPITALS*

Hospital Name	Region
Anna Jaques Hospital	Upper North Shore
Athol Memorial Hospital	Central Massachusetts
Baystate Franklin Medical Center	Pioneer Valley / Franklin
Baystate Mary Lane Hospital	Pioneer Valley / Franklin
Baystate Medical Center	Pioneer Valley / Franklin
Berkshire Medical Center	Berkshires
Beth Israel Deaconess Hospital - Needham	Metro Boston
Beth Israel Deaconess Medical Center	Metro Boston
Beth Israel Deaconess Hospital - Milton	Metro Boston
Boston Medical Center	Metro Boston
Brigham and Women's Faulkner Hospital	Metro Boston
Brigham and Women's Hospital	Metro Boston
Cambridge Health Alliance	Metro Boston
Cape Cod Hospital	Cape and Islands
Clinton Hospital	Central Massachusetts
Cooley Dickinson Hospital	Pioneer Valley / Franklin
Emerson Hospital	West Merrimack / Middlesex
Fairview Hospital	Berkshires
Falmouth Hospital	Cape and Islands
Hallmark Health	Metro Boston
Harrington Memorial Hospital	Central Massachusetts
HealthAlliance Hospital	Central Massachusetts
Heywood Hospital	Central Massachusetts
Holyoke Medical Center	Pioneer Valley / Franklin
Jordan Hospital	South Shore
Lahey Hospital & Medical Center	West Merrimack / Middlesex
Lawrence General Hospital	East Merrimack
Lowell General Hospital	West Merrimack / Middlesex
Marlborough Hospital	Metro West
Martha's Vineyard Hospital	Cape and Islands
Massachusetts Eye and Ear Infirmary	Metro Boston
Massachusetts General Hospital	Metro Boston
Mercy Medical Center	Pioneer Valley / Franklin
Merrimack Valley Hospital	East Merrimack
MetroWest Medical Center	Metro West
Milford Regional Medical Center	Metro West

Regional Mapping of Massachusetts Acute Care Hospitals (continued)

Hospital Name	Region
Morton Hospital	Metro South
Mount Auburn Hospital	Metro Boston
Nantucket Cottage Hospital	Cape and Islands
Nashoba Valley Medical Center	West Merrimack / Middlesex
New England Baptist Hospital	Metro Boston
Newton-Wellesley Hospital	Metro Boston
Noble Hospital	Pioneer Valley / Franklin
North Adams Regional Hospital	Berkshires
North Shore Medical Center	Lower North Shore
Northeast Hospital	Lower North Shore
Quincy Medical Center	South Shore
Saint Vincent Hospital	Central Massachusetts
Signature Healthcare Brockton Hospital	Metro South
South Shore Hospital	South Shore
Southcoast Hospitals Group	New Bedford
Steward Carney Hospital	Metro Boston
Steward Good Samaritan Medical Center	Metro South
Steward Holy Family Hospital	East Merrimack
Steward Norwood Hospital	Norwood / Attleboro
Steward Saint Anne's Hospital	Fall River
Steward St. Elizabeth's Medical Center	Metro Boston
Sturdy Memorial Hospital	Norwood / Attleboro
Tufts Medical Center	Metro Boston
UMass Memorial Medical Center	Central Massachusetts
Winchester Hospital	West Merrimack / Middlesex
Wing Memorial Hospital	Pioneer Valley / Franklin

* The regions, defined by the Massachusetts Health Policy Commission, are: Berkshires, Pioneer Valley/Franklin, Central MA, West Merrimack/Middlesex, East Merrimack, Upper North Shore, Metro West, Metro Boston, Lower North Shore, Norwood/Attleboro, Metro South, South Shore, Fall River, New Bedford, and Cape and Islands.

APPENDIX D: DATA CATEGORIZATION AND GROUPING

ALL PAYER REFINED – DIAGNOSIS RELATED GROUPS (APR-DRGS)

The All Patient Refined – Diagnosis Related Groups (APR-DRGs, 3M) are a severity and risk adjusted classification system that provides a more effective means of adjusting for patient differences. The 3M APR-DRGs expand the basic DRG structure by adding four subclasses to each illness and risk of mortality. CHIA utilized version 26.1 of the APR-DRG, which was used to group inpatient discharges over the study period of State FY 2011-2013 (July 1, 2010 through June 30, 2013). The 3M APR-DRG grouper was used to analyze readmissions by top discharge diagnoses for this report.

PAYER TYPE

Payer types are based on the expected primary source of payment for a patient's hospital stay. For this analysis, broad payer type categories were created by grouping payer source codes. For the purposes of this report, we include Commonwealth Care under the broader Medicaid category. Payer type categories were grouped as follows:

- Medicare: Fee-For-Service and Managed Care Medicare
- Medicaid (MassHealth): Medicaid (including Fee-For-Service and Primary Care Clinician Plan), Medicaid Managed Care, and Commonwealth Care
- Commercial: Blue Cross and Blue Cross Managed Care, Commercial Insurance and Commercial Managed Care, HMO, PPO/Other Managed Care plans not elsewhere classified, Point-Of-Service plans, Exclusive Provider Organizations, and other Non-Managed Care plans
- Payer sources included in totals but not reported separately: Self-pay, Free Care, and Health Safety Net, Worker's Compensation, Other Government Payment, Auto Insurance, Dental Plans, and None (for Secondary Payer)

DISCHARGE SETTING

For this analysis, discharge settings were grouped into broader categories. They were grouped as follows:

- Home: home or self-care, rest home, and shelter
- Skilled Nursing Facility (SNF): skilled nursing facilities
- Home with Home Health Agency Care: home under care of organized home health service organization and home under care of a home IV drug therapy provider
- Hospice: home hospice care and hospice medical facility
- Rehabilitation: intermediate care facility, inpatient rehab facility, and Medicare-certified long-term care hospital
- Other: critical access hospital, psychiatric hospital, federal healthcare facility, another short-term general hospital for inpatient care, another type of institution not defined elsewhere, and other discharge settings



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