Final Recommendation for the Readmission Reduction Incentive Program for Rate Year 2022

March 11, 2020

Health Services Cost Review Commission

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This document contains the final staff recommendations for the Readmission reduction Incentive Program for RY 2022.

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List of Abbreviations

ADI	Area Deprivation Index
AMA	Against Medical Advice
APR-DRG	All-patient refined diagnosis-related group
CMS	Centers for Medicare & Medicaid Services
CMMI	Center for Medicare and Medicaid Innovation
CRISP	Chesapeake Regional Information System for Our Patients
CY	Calendar year
eCQM	Electronic Clinical Quality Measure
EDAC	Excess Days in Acute Care
FFS	Fee-for-service
HCC	Hierarchical Condition Category
HRRP	Hospital Readmissions Reduction Program
HSCRC	Health Services Cost Review Commission
HWR	Hospital-Wide Readmission Measure
MCDB	Medical Claims Database
MPR	Mathematica Policy Research
MSA	Metropolitan Statistical Area
NQF	National Quality Forum
PAI	Patient Adversity Index
PMWG	Performance Measurement Workgroup
PQI	Prevention Quality Indicators
RRIP	Readmissions Reduction Incentive Program
RY	Rate Year
SIHIS	Statewide Integrated Healthcare Improvement Strategy
SOI	Severity of illness
TCOC	Total Cost of Care
YTD	Year-to-date

Key Methodology Concepts and Definitions

Diagnosis-Related Group (DRG): A system to classify hospital cases into categories that are similar in clinical characteristics and in expected resource use. DRGs are based on a patient's primary diagnosis and the presence of other conditions.

All Patients Refined Diagnosis Related Groups (APR-DRG): Specific type of DRG assigned using 3M software that groups all diagnosis and procedure codes into one of 328 All-Patient Refined-Diagnosis Related Groups.

Severity of Illness (SOI): 4-level classification of minor, moderate, major, and extreme that can be used with APR-DRGs to assess the acuity of a discharge.

APR-DRG SOI: Combination of diagnosis-related groups with severity of illness levels, such that each admission can be classified into an APR-DRG SOI "cell" along with other admissions that have the same diagnosis-related group and severity of illness level.

Observed/Expected Ratio: Readmission rates are calculated by dividing the observed number of readmissions by the expected number of readmissions. Expected readmissions are determined through case-mix adjustment.

Case-Mix Adjustment: Statewide rate for readmissions (i.e., normative value or "norm") is calculated for each diagnosis and severity level. These statewide norms are applied to each hospital's case-mix to determine the expected number of readmissions, a process known as indirect standardization.

Prevention Quality Indicator (PQI): a set of measures that can be used with hospital inpatient discharge data to identify quality of care for "ambulatory care sensitive conditions." These are conditions for which good outpatient care can potentially prevent the need for hospitalization or for which early intervention can prevent complications or more severe disease.

Area Deprivation Index (ADI): A measure of neighborhood deprivation that is based on the American Community Survey and includes factors for the theoretical domains of income, education, employment, and housing quality.

Patient Adversity Index (PAI): HSCRC developed composite measure of social risk incorporating information on patient race, Medicaid status, and the Area Deprivation Index.

Excess Days in Acute Care (EDAC): Capture excess days that a hospital's patients spent in acute care within 30 days after discharge. The measures incorporate the full range of post-discharge use of care (emergency department visits, observation stays, and unplanned readmissions).

Recommendations

These are the final recommendations for the Maryland Rate Year (RY) 2022 Readmission Reduction Incentives Program (RRIP):

1. Update 30-day, all-cause readmission measure with the following changes:
    a. Exclude all discharges with discharge disposition “left against medical advice”
    b. Include oncology discharges based on logic adapted from NQF 3188 - 30-day unplanned readmissions for cancer patients
2. Establish statewide 5-year Improvement target of -7.5 percent from 2018 base period, which would reduce Maryland Readmissions to approximately ~75th percentile of like geographies
3. Attainment Target - maintain attainment target methodology as currently exists, whereby hospitals at or better than the 65th percentile statewide receive scaled rewards for maintaining low readmission rates
4. For improvement and attainment, set the maximum reward hospitals can receive at 1 percent of inpatient revenue and the maximum penalty at 2 percent of inpatient revenue
5. Establish additional payment incentive (up to 0.50 percent of inpatient revenue) for reductions in within-hospital readmission disparities:
    a. Provide reward of 0.25 percent of IP revenue for hospitals on pace for 25 percent reduction in disparity gap measure over 8 years (>=6.94 percent reduction in disparity gap measure 2018 to 2020)
    b. Provide reward of 0.50 percent of IP revenue for hospitals on pace for 50 percent reduction in disparity gap measure over 8 years (>=15.91 percent reduction in disparity gap measure 2018 to 2020)
    c. Limit disparity reduction rewards to hospitals that have demonstrated improvement in the casemix adjusted, 30-day, all-cause readmission measure for the general population
6. Explore development of an all-payer Excess Days in Acute Care measure in order to account for severity of readmission and emergency department and observation revisits

Introduction

Since 2014, Maryland hospitals have been funded under a global budget system, which is a fixed annual revenue cap that is adjusted for inflation, quality performance, reductions in potentially avoidable utilization, market shifts, and demographic growth. Under the global budget system, hospitals are incentivized to transition services to the most appropriate setting and may keep savings that they achieve via improved health care delivery (e.g., reduced avoidable utilization, readmissions, hospital-acquired infections). It is important that the Commission ensure that any incentives to constrain hospital expenditures do not result in declining quality of care. Thus, the Maryland Health Services Cost Review Commission's (HSCRC's or Commission's) Quality programs reward quality improvements that reinforce the incentives of the global budget system, while penalizing poor performance and guarding against unintended consequences.

The Readmissions Reduction Incentive Program (RRIP) is one of several pay-for-performance initiatives that provide incentives for hospitals to improve patient care and value over time. The RRIP currently holds up to 2 percent of hospital revenue at-risk in penalties and up to 1 percent at risk in rewards based on improvement and attainment in case-mix adjusted readmission rates.

With the commencement of the Total Cost of Care (TCOC) Model Agreement with CMS on January 1, 2019, the performance standards and targets in HSCRC's portfolio of quality and value-based payment programs are being reviewed and updated. In CY 2019, staff focused on the RRIP program and convened a subgroup with clinical and measurement experts who made recommendations that were then further evaluated by the Performance Measurement Workgroup (PMWG). The RRIP subgroup and PMWG considered updated approaches for reducing readmissions in Maryland to support the goals of the TCOC Model. Specifically, the workgroup evaluated Maryland hospital performance relative to various opportunity analyses, including external national benchmarks, and staff developed a within-hospital disparities metric for readmissions in consultation with the workgroup. The details of the subgroup work and their recommendations are outlined in the sections below.

Background

Brief History of RRIP program

Maryland made incremental progress each year throughout the All-Payer Model (2014-2018), ultimately achieving the Model goal for the Maryland Medicare FFS readmission rate to be at or below the unadjusted national Medicare readmission rate by the end of Calendar Year (CY) 2018. Maryland had historically performed poorly compared to the nation on readmissions; it ranked 50th among all states in a study examining Medicare data from 2003-2004.[1] In order to

[1] Jencks, S. F. et al., "Hospitalizations among Patients in the Medicare Fee-for-Service Program," *New England Journal of Medicine* Vol. 360, No. 14: 1418-1428, 2009.

meet the All-Payer Model requirements, the Commission approved the RRIP program in April 2014 to further bolster the incentives to reduce unnecessary readmissions.

As recommended by the Performance Measurement Work Group, the RRIP is more comprehensive than its federal counterpart, the Medicare Hospital Readmission Reduction Program (HRRP), as it is an all-cause measure that includes all patients and all payers.[2]

In Maryland, the RRIP methodology evaluates all-payer, all-cause inpatient readmissions using the CRISP unique patient identifier to track patients across Maryland hospitals. The readmission measure excludes certain types of discharges (such as planned readmissions) from consideration, due to data issues and clinical concerns. Readmission rates are adjusted for case-mix using all-patient refined diagnosis-related group (APR-DRG) severity of illness (SOI), and the policy determines a hospital's score and revenue adjustment by the better of improvement or attainment, with scaled rewards of up to 1 percent of inpatient revenue and scaled penalties of up to 2 percent.[3]

RRIP Subgroup

As part of the ongoing evolution of the All-Payer Model's pay-for-performance programs to further bring them into alignment under the Total Cost of Care Model, HSCRC convened a work group to evaluate the Readmission Reduction Incentive Program (RRIP). The work group consisted of stakeholders, subject matter experts, and consumers, and met six times between February and September 2019. The work group focused on the following six topics, with the general conclusions summarized below:

1. Analysis of Case-mix Adjustment and trends in Eligible Discharges over time to address concern of limited room for additional improvement;
    - Case-mix adjustment acknowledges increased severity of illness over time
    - Standard Deviation analysis of Eligible Discharges suggests that further reduction in readmission rates is possible
2. National Benchmarking of similar geographies using Medicare and Commercial data;
    - Maryland Medicare and Commercial readmission rates and readmissions per capita are on par with the nation
3. Updates to the existing All-Cause Readmission Measure;
    - Remove Eligible Discharges that left against medical advice (~7,500 discharges)
    - Include Oncology Discharges with more nuanced exclusion logic
    - Analyze out-of-state ratios for other payers as data become available
4. Statewide Improvement and Attainment Targets under the TCOC Model;
    - 7.5 percent Improvement over 5 years (2018-2023)
    - Ongoing evaluation of the attainment threshold at 65th percentile
5. Social Determinants of Health and Readmission Rates; and
    - Methodology developed to assess within-hospital readmission disparities

[2] For more information on the HRRP, please see: https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/Readmissions-Reduction-Program

[3] See Appendix I for further details of the current RRIP methodology.

6. Alternative Measures of Readmissions
    - Further analysis of per capita readmissions as broader trend; not germane to the RRIP policy because focus of evaluation is clinical performance and care management post-discharge
    - Observation trends under the All-Payer Model to better understand performance given variations in hospital observation use; future development will focus on incorporation of Excess Days in Acute Care (EDAC) measure in lieu of including observations in RRIP policy
    - Electronic Clinical Quality Measure (eCQM) may be considered in future to improve risk adjustment

Literature Review from MPR

As part of the initial work to establish the Readmission work group, staff contracted with Mathematica Policy Research (MPR) to conduct a literature review covering the following topics: optimal readmission rates, alternative readmission measures, and early evaluations of the federal Hospital Readmission Reduction Program (HRRP). The literature review is provided in Appendix II. Ultimately, MPR's literature review was used to inform the RRIP policy but highlighted the lack of consensus around these issues.

Optimal readmission rate: MPR found that there was no agreed upon optimal readmissions rate in the literature. Target readmission rates vary based on study specifics, conditions studied, and interventions analyzed. Using algorithms and chart review, the literature suggested that avoidable readmissions constituted between 5 to 79 percent of experienced readmissions. However, the definition of "avoidable" varied between studies, as did the patient-mix and conditions evaluated. Based on this, as discussed in the assessment section, staff relied on other types of opportunity analyses to suggest an optimal readmission rate.

Alternative readmission metrics: MPR examined other metrics of readmissions outside of 30-day inpatient readmissions, including outpatient revisits, readmissions within a different time window, and population-based readmissions. MPR identified a difference in short-term and long-term readmissions, where short-term readmissions are more closely tied to hospital care quality and discharge planning, while longer-term readmissions are more representative of population and community health. In addition, MPR found that population-based measures of readmissions, such as per capita readmissions or excess days in acute care (EDAC), may provide additional information linked to community and population health. Based on this review, it may be worthwhile for HSCRC to examine performance on multiple readmission metrics that capture different information. However, staff did not revise the RRIP methodology to incorporate long term readmissions or per capita readmissions at this time, because the focus of the policy remains evaluating clinical performance outcomes and care management post discharge.

Impact of Federal HRRP: Finally, MPR analyzed the literature published on the federal HRRP. The federal HRRP has been in place since FFY2013, and MPR concluded that the

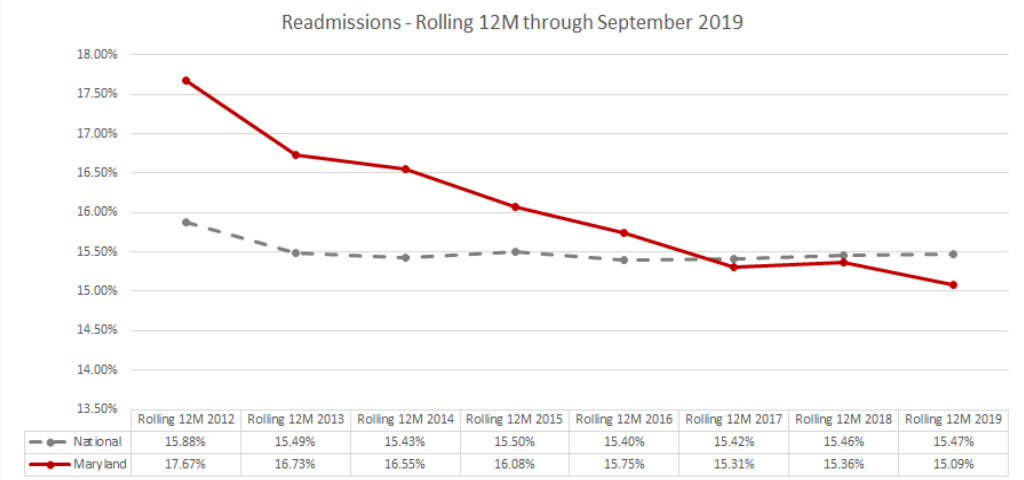
preponderance of the evidence suggests HRRP has contributed to a reduction in readmissions nationally. While some studies identified a negative impact of HRRP on mortality, other studies have found a beneficial relationship between HRRP and mortality. Based on this mixed evidence for such an important issue, HSCRC will continue to follow and monitor studies between HRRP and mortality. Additionally, the literature appears to show an increase in ED revisits and observation stays in concert with HRRP; however, this may be due to a concurrent Medicare payment change resulting in fewer short inpatient stays. Overall, MedPAC found that increases in spending due to ED and observation stays were smaller than the cost of readmissions they may have replaced.[4]

Assessment

Current Statewide Year To Date Performance

At the end of 2018, Maryland had a Medicare readmission rate of 15.40 percent, which was below the national rate of 15.45 percent. The most recent readmission data show Maryland has continued its improvement on Medicare FFS readmissions relative to the nation; with the most recent 12 months of data (through September 2019), Maryland's Medicare readmission rate was 15.09 percent compared to the national Medicare readmission rate of 15.47 percent (Figure 1). This is the measure that CMMI will use to assess Maryland's performance on readmissions under the TCOC Model.

Figure 1. Maryland and National Medicare FFS Unadjusted Readmission Rates



	Rolling 12M 2012	Rolling 12M 2013	Rolling 12M 2014	Rolling 12M 2015	Rolling 12M 2016	Rolling 12M 2017	Rolling 12M 2018	Rolling 12M 2019
National	15.88%	15.49%	15.43%	15.50%	15.40%	15.42%	15.46%	15.47%
Maryland	17.67%	16.73%	16.55%	16.08%	15.75%	15.31%	15.36%	15.09%

Maryland hospitals have also performed well on the RY 2021 RRIP performance standards as shown in Figure 2, with 33 of 47 hospitals on target to achieve the -3.90 percent improvement

[4] See: MedPAC June 2018 Report Chapter 1, "Mandated Report: The Effects of the Hospital Readmission Reduction Program", http://www.medpac.gov/docs/default-source/reports/jun18_ch1_medpacreport_rev_nov2019_v2_note_sec.pdf?sfvrsn=0

required in 2019 relative to a 2016 base, and 21 of 47 hospitals on target to be at or below the 11.12 percent attainment threshold.

Figure 2. RY 2021 By Hospital Improvement in Case-Mix Adjusted Readmission Rates

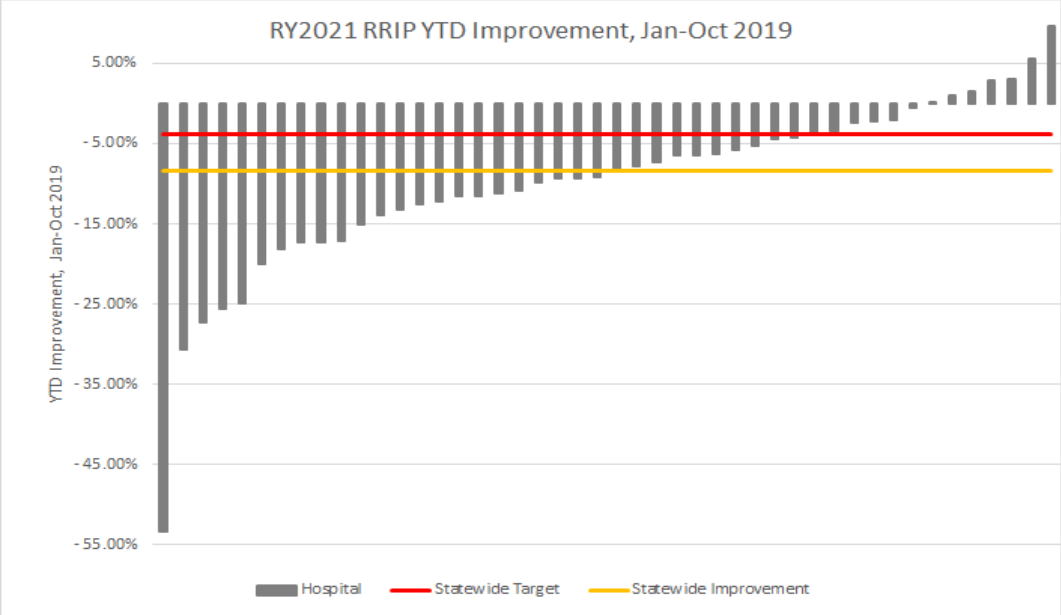
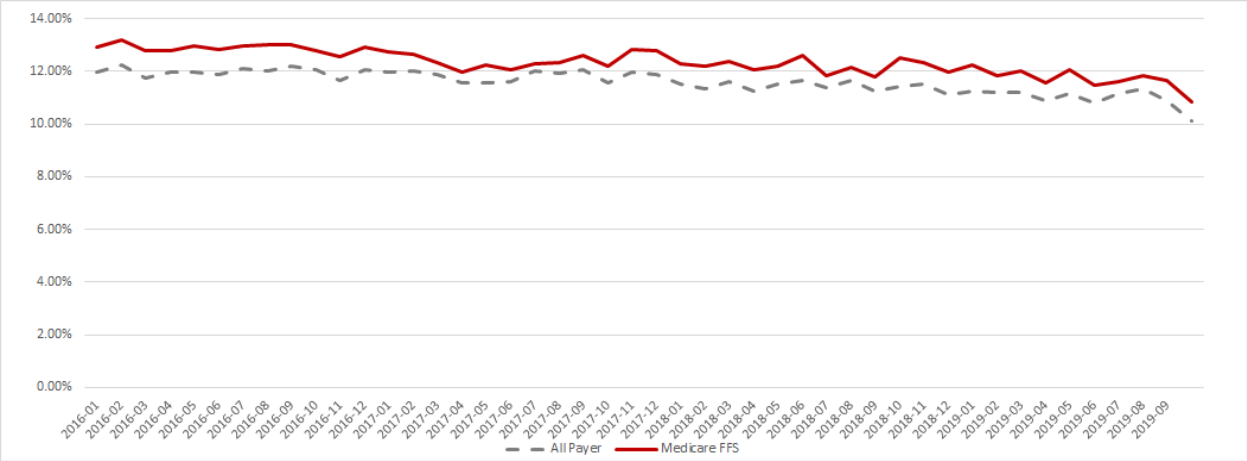


Figure 3 shows that since 2016 Maryland has maintained statewide improvements in case-mix adjusted readmissions for both All-Payer and Medicare FFS populations. Compared to CY 2016 YTD, the all-payer and Medicare FFS case-mix adjusted readmission rate have declined by 8.38 percent and 9.29 percent, respectively.

Figure 3. Maryland All-Payer and Medicare FFS Case-Mix-Adjusted Readmission Rates



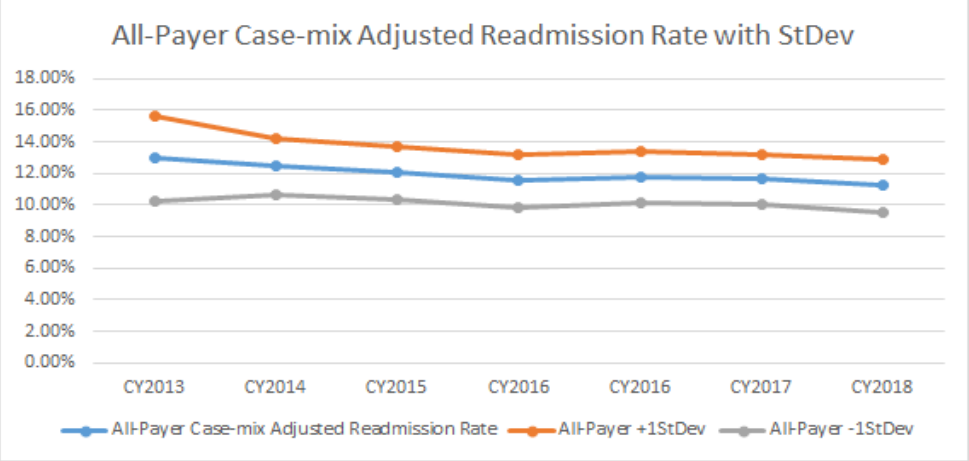
For further information on Maryland hospital current (RY 2021 YTD) performance, please see Appendix III.

Shrinking Denominator of Eligible Discharges

To update the RRIP program, one of the initial areas that the subgroup wished to explore was the impact of the dramatic reduction in inpatient hospital utilization during the All-Payer Model, from over 685,000 annual admissions in 2013 to just over 610,000 annual admissions in 2018. Expressed in terms of admissions that are discharges eligible for a readmission, the decrease is 538,603 to 472,385, with a 4.37 percent decrease from 2016 to 2018. At the same time, the severity of illness (SOI) of admitted patients increased. Stakeholders were concerned that, having removed potentially preventable readmissions from the system, the remaining readmissions were less preventable. However, the concurrent 2016-2018 decrease in the number of expected readmissions was just 0.2 percent (compared to 4.37 percent decrease of eligible discharges) suggesting that the increased severity of illness/complexity of remaining eligible discharges is acknowledged in the normative values used to generate the case-mix adjusted readmission rate.

Additionally, staff trended the case-mix adjusted readmissions across the All-Payer Model, both All-Payer and by-payer, and calculated the standard deviation from the state average. If Maryland hospitals were approaching an asymptote of preventable readmissions—that is, a finite point by which readmissions could not be reduced further—the standard deviation would similarly converge around the state average rate. However, staff analysis showed that the standard deviation remained at a steady distance from the state average rate, as seen in Figure 4, suggesting continued variations in performance and room for additional improvement.

Figure 4: All-Payer Case-Mix Adjusted Readmission Rate and Standard Deviation



Finally, staff analyzed the relationship between a hospital's decrease in eligible discharges and their readmission rate in a given year and found that there was no correlation, suggesting that as discharges have been reduced due to the incentives of the model it is not associated with worse RRIP performance.

Staff and stakeholders were initially concerned that the reduction of eligible discharges achieved during the All-Payer Model was inadvertently making it challenging for hospitals to further reduce their readmission rates; however, staff believes these analyses suggest that Maryland maintains the capacity to further reduce readmissions.

Benchmarking of Similar Geographies using Medicare and Commercial Data

The Commission and stakeholders wish to understand Maryland's performance on readmissions relative to National benchmarks beyond the Medicare FFS national rate. Previously, the Commission did not have data for benchmarking commercial readmission rates. Furthermore, stakeholders requested that Maryland be compared to peers, in addition to the aggregate national trends.

Thus, HSCRC staff worked throughout 2019 to generate a peer geographic group to compare Maryland charges and quality metrics to comparable non-Maryland geographies. The MEDA center acquired a detailed dataset for Medicare FFS beneficiaries and a separate dataset for Commercial beneficiaries. Commercial beneficiaries were compared using Milliman's Consolidated Health Cost Guidelines Score Database (CHSD), as well as MHCC's Medical Claims Database (MCDB).[5] Data availability necessitated that comparable entities be at the county-level for Medicare and at the Metropolitan Statistical Area (MSA) for Commercial, as zip code or hospital primary service area was too granular to be feasible.

Maryland geographies were first compared to potential peer geographies with a similar level of urbanization. After an extensive process comparing multiple factors, Maryland geographies were then further compared to non-Maryland geographies based on the following four main characteristics: median income, deep poverty, regional price parity, and risk score (Hierarchical Condition Category (HCC) for Medicare and HHS Platinum Risk Score for Commercial). For Medicare, each urban county in Maryland was compared to 20 urban counties nationwide, and each non-urban county in Maryland was compared to 50 non-urban counties nationwide.[6] All Commercial MSAs were compared to 20 peer MSAs. Maps of selected peer geographies are included in Appendix IV.

Figure 5 below shows the results from the Medicare FFS and Commercial benchmarking to like geographies. Using the peer counties, the MEDA center analyzed 2018 Medicare FFS readmissions for Maryland and Peer Counties using the unadjusted readmission rate logic used in the All-Payer Model Waiver Test. In 2018, Maryland Medicare FFS readmission rates were on par with (slightly better than) national peer counties at 15.47 percent and 15.57 percent, respectively. Two top performing benchmarks are also provided: 1. the readmission rate at the

[5] The MCDB was previously known as the All-Payer Claims Database (APCD).

[6] In the Commercial dataset, non-Maryland entities were designated at the metropolitan statistical area (MSA) level, the HHS Platinum Risk score was substituted for the Medicare HCC, and Maryland was matched to 20 non-Maryland MSAs due to the smaller number of total MSAs.

75h percentile of peer counties, and 2. the statewide readmission rate if all counties in MD were at or below the 75th percentile of peer counties. These two benchmarks provide an estimate of the opportunity for Maryland under the TCOC model.

Separately, the MEDA center compared 2017 Maryland MCDB Commercial beneficiary readmission rates to Peer MSAs using the Milliman data. The Commercial readmission rates were analyzed on both an unadjusted and case-mix adjusted basis, but the unadjusted rates are included below. In 2017, Maryland Commercial beneficiary readmission rates were on par with (slightly better than) national peer MSAs, at 6.84 percent and 6.98 percent respectively. The two top performing benchmarks are also provided for the Commercial data. This commercial benchmarking analysis is the first analysis completed for non-Medicare data, and it is reassuring that the Commercial results also show favorable performance that is consistent with Medicare FFS analyses

Figure 5. Unadjusted Readmissions Rates and Top Performing Benchmarks, MEDA Center Benchmarking

Payer (year)	Maryland	Peer Geographies	Top Performing Benchmark: 75th Percentile of Peer Geographies	Top Performing Benchmark: All MD Counties at or below the 75th Percentile of Peer Geographies
Medicare FFS (2018)	15.47%	15.57%	14.72%	14.53%
Commercial (2017)	6.84%	6.98%	6.53%	6.44%

This analysis further solidifies Maryland's understanding that, at the conclusion of the All-Payer Model, Maryland achieved the All-Payer Model Waiver Test to be at or below the National Medicare FFS Readmission Rate. Staff also analyzed the peer group readmission trends to calculate readmission rates at the 75th percentile (25th percentile lowest readmission rate) to approximate an improvement opportunity, as well as analyzed per capita readmission rates, which will be discussed further below. Further information from the Benchmarking Results can be found in Appendix IV.

Measure Updates

Removal of Patients who Leave Against Medical Advice (AMA)

Stakeholders, including Commissioners, requested that the HSCRC consider removing patients whose discharge disposition is "left against medical advice", reasoning that this patient population is unlikely to receive hospital interventions to reduce readmissions—and these patients are excluded from the national readmission measures. To make the decision on whether to exclude these patients from RRIP, the subgroup reviewed literature and data on the

impact and types of patients who leave AMA. One Maryland study involving focus group interviews of patients and providers at an academic medical center suggested the following reasons that patients may leave AMA: pain management, other family or work obligations, wait time, doctor's bedside manner, teaching-hospital status, and communication.[7] The subgroup also reviewed analyses of the distribution of patients who leave AMA by hospital, as well as the data showing that the majority of patients who leave AMA have a primary or secondary behavioral health diagnosis (72 percent) and have Medicaid as their payer (52 percent). Removing patients who leave against medical advice would result in a statewide reduction of approximately 7,500 eligible discharges. Given the complexity of patients who leave AMA and the fact that they may do so regardless of hospitals' quality of care, albeit unknown in terms of the total share of why patients leave AMA, staff concurs with stakeholder recommendations to remove them from the RRIP program.

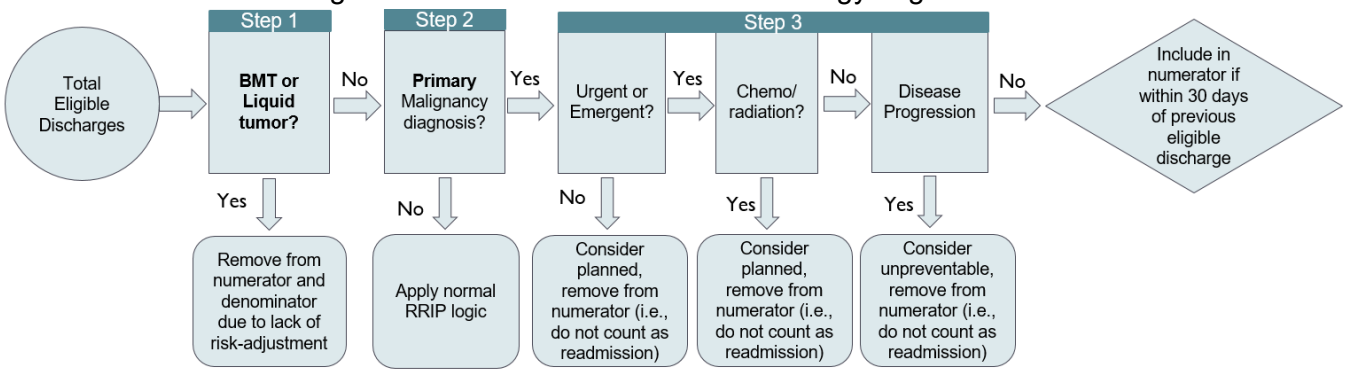
Inclusion of Oncology Patients

The current RRIP readmission measure excludes oncology patients due to industry concerns that the planned admission logic did not appropriately identify planned admissions for oncology patients. When staff agreed to this exclusion, it was intended to be temporary pending development of planned admission logic that better accounted for planned oncology admissions. Thus, as part of the RRIP redesign, staff and stakeholders developed an approach for including oncology patients in the RRIP program. This work was based on an NQF-endorsed readmission measure for cancer hospitals that staff brought to the subgroup and other stakeholders for consideration.[8] The developers of this measure state in their measure rationale that "for many cancer patients, readmission following hospitalization may be preventable and should be addressed to potentially lower costs and improve patient outcomes" and that "using this measure, hospitals can better identify and address preventable readmissions for cancer patients."[9]

Staff made minor changes to the measure to integrate it into the RRIP program and render it suitable for measuring quality at acute care hospitals, as opposed to cancer hospitals. Figure 6 shows a flow chart for the denominator and the numerator as adapted by the HSCRC.

[7] Onukwugha. E., et. al. Reasons for discharges against medical advice: a qualitative study. Qual Saf Health Care. 2010 October
[8] Additional information on this measure can be found here: https://cmit.cms.gov/CMIT_public/ReportMeasure?measureRevisionId=2296
[9] Ibid.

Figure 6: Flow Chart for Revised Oncology Logic



*Items that are **bolded** are adaptations from NQF measure

Appendix I provides in greater detail the measure logic steps for the inclusion of oncology patients with notations of the changes and rationale from the original NQF cancer hospital measure.

The overall impact of the oncology change results in only a small increase in the readmission rate statewide for CY 2018 (Case-mix Adjusted Readmission Rate: 12.06 percent under old logic and 12.09 percent under new logic). In total, nine acute care hospitals had decreases in their readmission rates (median decrease of 0.05 percent; largest decrease was for Johns Hopkins at 0.14 percent) and 38 hospitals had increases (median increase of 0.05; largest increase 0.22 percent). These changes will be reflected in the improvement and attainment targets, and thus staff feels that inclusion of oncology patients is not detrimental to hospital performance. In fact, including oncology patients may provide hospitals the opportunity to receive credit for readmission improvements that they achieve for cancer patients.

Out-of-State Ratio Assessment

Since the advent of including credit for attainment in the RRIP policy, HSCRC has adjusted case-mix adjusted readmission rates to account for readmissions occurring outside of Maryland. These readmissions will not appear in the Maryland Case-mix data, and to date have been approximated using cross-border readmissions provided by CMS using Medicare FFS data. The ratio of “Total Medicare FFS Readmissions: In-State Medicare FFS Readmissions” (100 percent or greater) is then used to increase the Case-mix Adjusted Readmission rate to approximate cross-border readmissions. While ideally Maryland would have more data to corroborate the cross-border ratios, the Medicare FFS is the data that is readily available, and staff notes that the majority of readmissions (over 52 percent) are Medicare FFS, meaning that out-of-state ratios based on Medicare FFS remain the most relevant to approximating an accurate readmission rate for attainment.

Throughout 2019, staff worked with the MEDA Center and Medicaid partners to generate out-of-state ratios for Commercial and Medicaid beneficiaries as well. Given that there are fewer

Commercial and Medicaid readmissions, these data needed to be aggregated across multiple years for analysis. Staff will continue to analyze these data to understand the accuracy of Medicare ratios applied to the all-payer readmission rate and, if warranted, will work with stakeholders to see if there is a way to incorporate this data into the generation of out-of-state ratios moving forward.

Updating the Performance Targets under the TCOC Model

Improvement

Maryland hospitals achieved the All-Payer Model Waiver test for Medicare readmissions, to be at or below the nation by 2018. Analysis suggests that Maryland can further improve, and the TCOC Model contract states that Maryland must maintain a readmission rate below the National average.

Subgroup members agreed that further reductions in readmissions were possible, but recommended they be at a more modest improvement target, acknowledging sustained and substantial improvement under the All-Payer Model. As the literature has not generated an asymptote of acceptable readmissions, HSCRC generated a range of potential improvement scenarios, yielding readmission rate reductions of approximately 5-15 percent from existing CY 2018 levels (see Figure 7 below). As discussed in the Literature Review, it is challenging to ascertain an acceptable level of readmission rates given different methodologies and patient populations in different studies. Two of the scenarios use past trends to forecast future improvement, two use benchmarks based on recent performance, and two posit potential improvement in readmissions based on reductions in PQIs and disparities.

Figure 7. Improvement Target Estimates

Estimating Method	Percent Improvement	Resulting Readmission Rate (2023)*
1 Actual Compounded Improvement, 2013-2018	-14.94%	9.73%
2 Actual Improvement 2016-2018, Annualized to 5 Years	-11.48%	10.13%
3 All Hospitals to 2018 Median	-6.5%	10.70%
4 Benchmarking - Peer County/MSA to 75th Percentile	-4.63% to -6.20%	10.73% to 10.91%
5 Reduction in Readmission-PQIs	-9.36%	10.19%
6 Reduction in Disparities	-4.2%	10.96%

* Assuming a constant CY 2018 readmission rate of 11.44 percent (under RY 2021 logic with specialty hospitals included)

For the first estimating method (Row 1), staff analyzed the improvement achieved under the All-Payer Model and assumed that that improvement could be repeated under the TCOC Model. This ~15 percent reduction represents the higher end of the improvement estimates. The

second method (Row 2) uses the (slightly slower) improvement achieved in the final two years of the model and annualizes this two-year improvement to five years, resulting in a slightly less aggressive improvement target of ~11.5 percent.

The third and fourth estimating methods derive targets by assuming that hospitals currently performing worse than the statewide median or other peer geographies could improve to these rates. The third method (Row 3) calculates the statewide improvement if all hospitals reduced to the CY 2018 median readmission rate. The fourth estimating method (Row 4) uses the national benchmarks of like geographies previously presented to generate improvement targets for Maryland hospitals to reduce to the 75th percentile of similar geographies. Based on 2018 data, Maryland Medicare FFS readmission rates would need to improve by 5.11 percent to reach the Peer county 75th best percentile (15.47 percent to 14.72 percent), or 6.07 percent to ensure that all Maryland counties were at or below the 75th percentile (15.47 percent to 14.53 percent).[10] Based on 2017 data, Maryland Commercial readmission rates would need to improve 4.63 percent to reach the Peer MSA 75th best percentile (6.84 percent to 6.53 percent), or 6.20 percent to ensure that all Maryland MSAs were at or below the 75th percentile (6.84 percent to 6.44 percent). The improvement targets presented in the Figure 7 are the upper and lower estimates across Medicare FFS and Commercial from the geographical benchmarking analysis.

The fifth method estimated what the readmission rate would be if 50 percent of readmissions that are also PQIs (i.e., avoidable admissions for conditions such as diabetes, COPD, and hypertension) are prevented. The last method on the chart estimated what the readmission rate would be if hospitals in the state with higher than average disparities reduced their readmission disparity gap to the statewide average, which will be discussed in greater detail in the next section.

These scenarios identify a range of reasonable targets but do not determine a specific readmission goal. Staff and stakeholders agree generally with the range of potential improvement targets and support the generation of a five-year target rather than annual targets based on previously used methods. Stakeholders also support including both improvement and attainment in building a revenue adjustment. Reviewing the range of potential targets, the improvement from CY 2018 experienced to-date in CY 2019, and the additional information from the benchmarking, staff feels comfortable to recommend an improvement target of 7.5 percent reduction from 2018 levels across five years, but reserves the right to revisit and revise should this target prove too aggressive or too lenient such that the state creates unintended consequences or risks not meeting the continued goal of remaining at or below that national Medicare rate.[11]

[10] The second scenario is lower as there are Maryland counties already better than the 75th percentile.
[11] For reference on a 2018 readmission rate of 11.44 percent a 7.5 percent improvement would result in a readmission rate of 10.58 percent, or a reduction of 0.86 percentage points.

Attainment

Historically, the HSCRC has used the 75th percentile of best performers as the threshold to begin receiving rewards for attainment. In RY 2021, this was amended to the 65th percentile to allow hospitals in the top-third of Maryland performance to earn financial rewards for attainment, which acknowledged that Maryland (historically a poor performer on readmissions) had accomplished substantial improvement during the All-Payer Model. Staff analyzed the historical policy of the 65th percentile and compared this to the improvement targets suggested by the MEDA Center Peer Group national benchmarking analysis and the various opportunity analyses discussed above in the *Improvement Section*. Ultimately, staff calculated the statewide CY 2018 case mix-adjusted rate inclusive of 7.5% improvement, as recommended above, and compared individual hospital CY 2018 readmission rates to this attainment benchmark. Staff determined that at the 65th percentile of current performance, hospitals have rates equivalent to the targeted statewide readmission rate. Therefore, staff will start rewarding hospitals at the 65th percentile in line with the recommended improvement target. Staff reserves the right to revisit the percentile cutoff for attainment rewards in future years, especially if hospital performance generally exceeds overall improvement goals.

Please see Appendix V for additional modeling of improvement and attainment under the proposed measure updates. This modeling is currently under v36 of the 3M APR-DRG grouper but will be updated under v37 for the policy memo sent to hospitals after recommendations are approved.

Reducing Disparities in Readmissions

Racial and socioeconomic differences in readmission rates are well documented[12,13] and have been a source of significant concern among healthcare providers and regulators for years. In Maryland, the 2018 readmission rate for blacks was 2.6 percentage points higher than for whites, and the rate for Medicaid enrollees was 3.4 points higher than for other patients. A recent Annals of Internal Medicine paper co-authored by HSCRC staff[14] reported a 1.6 percent higher readmission rate for patients living in neighborhoods with increased deprivation. Many Maryland hospitals, as well as the Maryland Hospital Association, identify reduction in readmission disparities as a key priority over the near term. Thus, staff vetted with the subgroup and PMWG an approach for measuring and incentivizing reduction in disparities for readmissions.

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[12] Tsai TC, Orav EJ, Joynt KE. Disparities in surgical 30-day readmission rates for Medicare beneficiaries by race and site of care. *Ann Surg*. 2014;259(6):1086–1090. doi:10.1097/SLA.0000000000000326;
[13] Calvillo–King, Linda, et al. "Impact of social factors on risk of readmission or mortality in pneumonia and heart failure: systematic review." *Journal of general internal medicine* 28.2 (2013): 269-282.
[14] Jencks, Stephen F., et al. "Safety-Net hospitals, neighborhood disadvantage, and readmissions under Maryland's all-payer program: an observational study." Annals of internal medicine 171.2 (2019): 91-98.

Readmissions within Statewide Integrated Healthcare Improvement Strategy (SIHIS)

The newly signed memorandum between the HSCRC and the Center for Medicare and Medicaid Innovation calls for the State to identify one or more targets for improvement in hospital quality, referred to as the Statewide Integrated Health Improvement Strategy (SIHIS). This agreement is intended to spur improvement in areas related to population health that are not currently addressed by the agency's hospital quality programs. The longstanding racial and socioeconomic disparity in readmissions represents a barrier to continued progress in reducing Maryland's hospital readmission rate. If each Maryland hospital with an above average gap in readmission rates based on social factors (race, Medicaid status and Area Deprivation Index) improved to the state average, the State would experience a drop in the readmission rate of 4.2 percent. Accordingly, staff identified readmission disparities as an area of focus under the SIHIS and proposed a preliminary improvement of 50 percent in readmission disparities over the eight-year term of the Total Cost of Care model in the draft policy. As discussed in more detail in the stakeholder comment section, staff now propose that only a 3-year target be set for SIHIS. Staff proposes that this 3 year target will be more of a process metric and not include a specific improvement goal. However, staff may link the performance improvement under this policy to a SIHIS improvement goal in the future and still believes that this policy needs to set an improvement goal for rewards that is meaningful and in line with the proposed rewards. Thus staff has developed a methodology for incorporating improvement in disparities into payment policy.

Staff is not aware of other programs in the United States that provide hospitals with financial incentives for progress on disparities. Because the program breaks new ground, staff sought to minimize unintended consequences during the rollout of the policy by focusing initially on rewards for disparity improvement, rather than on penalties or on attainment.

Development of Disparity Metric

Making progress on readmission disparities requires staff to develop a methodology for: 1) identifying socioeconomic risk among patients; 2) measuring hospital-level disparities in readmission rates based on those risks; and 3) determining how disparities, or change in disparities, will be incorporated into hospital payment.

There are several options for measuring disparities that were considered by stakeholders. One approach would involve estimating differences in readmission rates across categories of race, Medicaid status, and potentially other variables. While straightforward, this process would provide hospitals with multiple estimates of disparities, which could lead to conflicting messages regarding performance, and would also add to the complexity of incorporating disparities into payment methodology.

To address those issues, staff developed the Patient Adversity Index (PAI), a composite social risk index incorporating information on patient race, Medicaid status, and the Area Deprivation

Index (ADI) for the area surrounding the patient's address (as recorded in claims). Staff chose, and vetted with stakeholders, these three variables because they are among the few available in claims that capture social determinants of health. Medicaid status is often used as a proxy for income. Race is included, not to reflect biological differences across races, but rather as a proxy for exposure to structural racism.[15] The ADI reflects exposure to diminished access to neighborhood resources, such as health care providers, pharmacies, transportation, and gainful employment, which may impact health outcomes. Staff evaluated methods to measure disparities among the Hispanic patient population, but determined this was not feasible for the first year of the program due to data quality and risk-adjustment issues.

The PAI for each patient and discharge is calculated by regressing readmission status (yes or no) against Medicaid status, race (black vs. other), and ADI percentile, along with terms for interactions between each of these three variables. The result is a value reflecting the patient's social exposures, weighted by the degree to which each of them is associated with readmissions (See Appendix VI). The PAI value is then converted to a standardized score, which sets the statewide mean at zero and the scale such that a one-unit change is equal to a change of one standard deviation. While stakeholders initially expressed concerns about the distribution of PAI scores at each hospital, staff presented to them analyses that showed that despite the distribution of PAI varying from hospital to hospital, all hospitals serve patients at or very close to the smallest and largest values of PAI. Because of this, all hospitals have an opportunity to reduce readmissions for patients with higher PAI scores.

The goal of the disparity program is to reduce the effect that PAI has on hospital readmission rates. In other words, if a hospital's readmission rate was identical across all values of PAI, it would have a disparity of zero, as social determinants would no longer impact readmission rates.

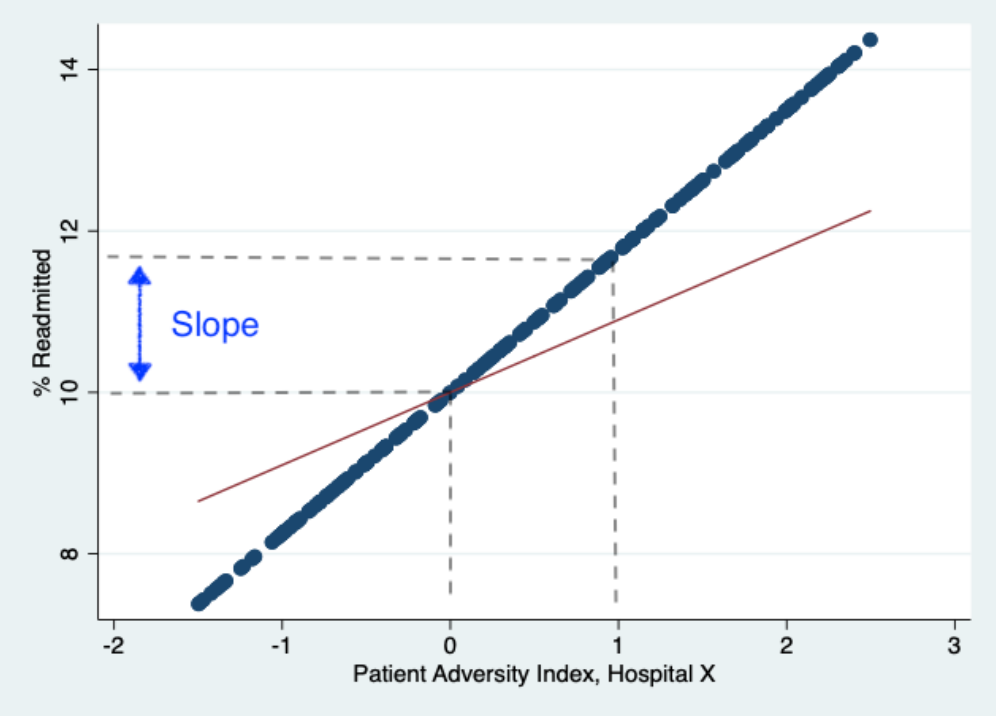
To measure the effect of PAI, staff developed a regression model that estimates the slope of PAI at each hospital, after controlling for patient age, gender, and APR-DRG readmission risk. Additionally, staff controlled for the average PAI value for patients at the hospital, as hospitals serving higher proportions of disadvantaged patients may face heightened challenges in reducing readmission rates. The PAI slope, or disparity gap measure, is interpreted as the difference in readmission rates at a given hospital between patients at a base (lower) level of PAI, and patients with PAI one unit higher than the base. The change in disparity gap measure from the base year to a given performance year is the performance metric.

Figure 8 shows the relationship between PAI and readmission rate for a hypothetical hospital in two years: Base (blue dots) and Performance (red line). The disparity gap for the base year is the slope of the line, calculated as rise over run, or difference between readmission rates at two

[15] Structural racism is defined as the macro-level systems, social forces, institutions, ideologies, and processes that interact with one another to generate and reinforce inequities among racial and ethnic groups (Powell JA. Structural Racism: Building upon the Insights of John Calmore. North Carolina Law Review. 2008;86:791–816.)

levels of PAI separated by a distance of one unit. Here, we see that the rate for patients with a PAI value of 1 is ~11.75%, while the rate for patients with PAI=0 is 10%, so the disparity is 1.75%. In the performance year, the hospital has succeeded in improving on disparities, which is reflected in a line with a flatter slope.

Figure 8. Hypothetical Example of Relationship between PAI and Readmission Rates



Appendix VI provides additional details on the statistical methods used to generate the PAI score and disparity gap measure. Appendix VII additionally provides hospital distribution of PAI scores and the by hospital disparity gap measure for 2018. These data are preliminary and will be updated with the latest readmission measure and grouper version.

Financial Incentive for Disparity Improvement

As the intent of the program is to encourage a reduction in disparities over the life of the TCOC model, 2018 serves as the base year. Improvement will be assessed annually beginning with RY2022 performance period (i.e., CY 2020). The PAI weighting coefficients generated from the 2018 model will be applied to patient demographic information in each performance year to calculate patient PAI score.

Staff recommends restricting rewards under the disparities component of RRIP to hospitals with an overall improvement in their readmission rates from the base period, in order to avoid the

possibility that a hospital with an unchanged readmission rate for high-PAI patients and a worsening rate for low-PAI patients would qualify for a reward. The financial incentive for reducing disparities is above the incentives under the existing RRIP model. While stakeholders were generally supportive of addressing disparities within the RRIP policy, and indicated that they considered the proposed methodology to be sound, there was some concern among hospitals that the HSCRC would move quickly to institute penalties for hospitals that do not improve on the disparities metric.

For RY2022, the proposed reward structure is:

- 0.25 percent of IP revenue for hospitals on pace for 25 percent reduction in 8 years, >=6.94 percent reduction in disparity gap measure
- 0.50 percent of IP revenue for hospitals on pace for 50 percent reduction in 8 years, >=15.91 percent reduction in disparity gap measure

Staff considered scaling the reward available to hospitals between 6.94 percent and 15.91 percent reduction. However, given that this is a new policy and we have no historical data on which to base estimates of potential change, staff concluded that a two-level policy minimized potential for unintended consequences and created clear incentives for hospitals. Staff may revisit this aspect of the policy with stakeholders in subsequent rate years. Staff will also work with stakeholders in coming months to develop hospital reporting on the disparity gap measure that allows hospitals to gauge their progress toward the improvement reward and allocate resources accordingly.

Alternative Readmission Measures

The subgroup also considered alternative readmission measures that could supplement RRIP in the future. Below is a discussion of per capita readmission, excess days in acute care, and the electronic clinical quality measure for readmissions. While other readmission measures exist, stakeholders were concerned about the use of proprietary measures (e.g., 3M Potentially Preventable Readmissions) and measures that varied significantly from the CMMI readmission measure.

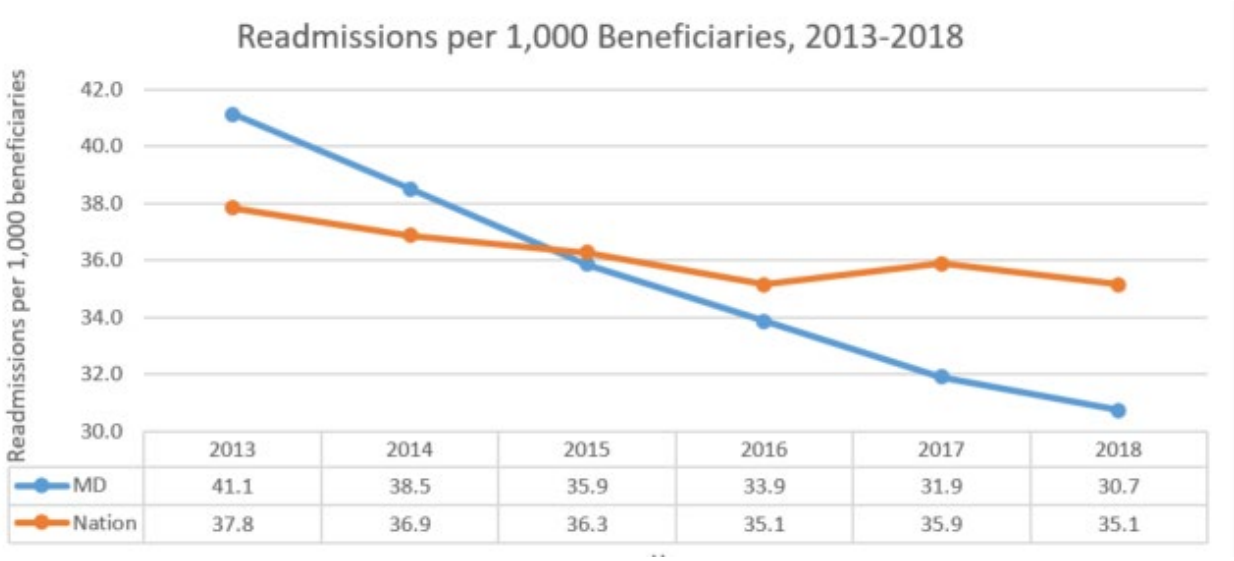
Per Capita Readmission

To date, the RRIP measures readmissions out of total eligible hospital discharges; however, staff has also explored the use of per capita readmissions to understand Maryland's performance overall. Ultimately, staff kept RRIP measurement focused on readmissions from hospital discharges to keep the measure focused on the quality of hospital care and follow-up that could precipitate or prevent a readmission. A per capita measure might obscure the rates by including the impact of admission information. As an example, a low per capita readmission rate might be reflective of a low per capita admission rate, while the per discharge readmission rate may still be high for the smaller number of admitted patients. However, staff also recognize

that per capita readmissions can be a valuable source of population health information and are often used across disparate datasets.

While not used to evaluate hospitals under the RRIP, per capita readmission rates are analyzed by staff and have been used to comment on utilization trends more generally. Most recently, both the Maryland Hospital Association and the HSCRC have presented per capita readmission rates during the All-Payer Model, comparing Maryland and the Nation. As shown in Figure 9, Maryland performs favorably compared to the nation.

Figure 9. Maryland and National Medicare FFS Per Capita Readmissions



The MEDA Center also evaluated per capita readmissions (readmissions per 1000 beneficiaries) in the benchmarking exercise detailed earlier in the policy. These analyses similarly conclude that Maryland performs on par with (slightly better than) per capita readmission rates of peer counties and peer MSAs (see Figure 10).

Figure 10. Readmissions per 1000 Beneficiaries, MEDA Center Benchmarking

Readmissions per 1000	Maryland	Peer County/MSA	Peer County/MSA 75th Percentile
Medicare FFS (2018)	38.2	39.8	34.1
Commercial (2017)	2.48	3.17	2.14

Nevertheless, looking at the distribution of peer county/MSA per capita readmissions per 1,000 suggests that Maryland's overall performance, while commendable, has not reached the optimal readmission rate, as comparable peer groups are experiencing lower per capita readmissions per 1,000. This statement is in further support of staff recommendation to include an improvement factor in the overall RRIP policy.

Excess Days in Acute Care (EDAC)

Stakeholders remain concerned about emergency department and observation revisits, especially given the global budget incentives to avoid admissions. Thus, staff analyzed the impact of observation stays on readmission rates and found that while readmission rates increased when observation stays were included, the correlation between the readmission rates with and without observation stays was 0.986 in 2018. This analysis, and the fact that the national program does not include observation stays, led the staff to recommend that the RRIP readmission measure remain an inpatient only measure. However, staff did recommend that the Commission consider adapting the Medicare Excess Days in Acute Care (EDAC) three condition-specific measures to a measure addressing an all-payer population, and if possible all conditions, for potential program adoption in future years. The EDAC measures capture the number of days that a patient spends in the hospital within 30 days of discharge, and include emergency department and observation stays by assigning ED visits a half-day length of stay and assigning observation hours rounded up to half-day units.[16] The subgroup reviewed Medicare data for the EDAC measures, which indicated that Maryland performs worse than the nation on all three measures, with variation in performance across hospitals. Staff believes an adapted measure would be a valuable addition to the RRIP policy, since the condition-specific measures as currently specified assess severity of readmission and examine multiple types of revisits that are important to patients. Currently staff is working with MPR to determine:

- The feasibility of adapting the EDAC measures to all-payers; and,
- Whether the EDAC measurement methodology has validity beyond the three conditions that Medicare currently specifies (Acute Myocardial Infarction, Heart Failure, Pneumonia) when extended to all conditions within a single measure.

Hybrid Hospital-Wide Readmission Measure

As alluded to earlier, CMS requires reporting of a Hospital Wide Readmission (HWR) measure, NQF #1789, currently derived from claims data. CMS has piloted a Hybrid HWR measure during CY 2018 that incorporates data elements from the encounter claim as well as laboratory and vital sign data from the electronic health record (EHR). CMS findings from the measure pilot include:

- Electronic Health Record (EHR) data elements add significant power to existing methods of risk standardization and risk adjustment in claims-based outcome measures.
- Core clinical data elements are feasible for extraction from existing EHRs and reporting for quality measures.

CMS is proposing to remove the claims-based HWR measure with the July, 1 2023-June 30, 2024 mandatory reporting for FFY 2026 payment year, and to replace this measure with the Hybrid HWR measure. HSCRC staff will track progress on further development of the Hybrid

[16] Additional information on the EDAC measures and methodology can be found here: https://www.qualitynet.org/inpatient/measures/edac/methodology

measure and will consider options for augmenting the RRIP all-payer measure with EHR data elements in the future.

Future Considerations

The RRIP redesign sets TCOC Model improvement and attainment targets for readmissions based on new benchmarks, and proposes a methodology to measure and incentivize reductions in disparities in readmissions. Staff would like to thank the subgroup, PMWG, and other stakeholders for their time and input on this redesign. Over the coming years, the Commission will need to continue to monitor performance on readmissions to ensure that Maryland continues to perform better on Medicare readmissions than the national average, monitor for unintended consequences of the current improvement target, and adjust the attainment target as there are statewide improvements. In terms of disparities, the state must finalize a SIHIS goal on reducing disparities in readmissions (current goal is set at 50 percent over 8 years) and adjust annual targets if a different goal is established. This work will be accomplished through collaboration with the Office of Minority Health and Health Disparities and other stakeholders. Furthermore, staff will work with hospitals and other stakeholders to monitor the impact of the disparity gap methodology and adjust the measurement and incentives as warranted. Lastly, as mentioned previously, staff may recommend to supplement the RRIP with additional measures in future years such as excess days in acute care or the hybrid quality measure for readmissions.

Stakeholder Feedback and Responses

Comment letters on the draft RRIP recommendations were submitted by the Maryland Hospital Association (MHA), the Johns Hopkins Health System (JHHS), and CareFirst BlueCross BlueShield (CF). These comments and suggestions are summarized by topic below along with staff's responses.

Improvement and Attainment Target

Stakeholders commented on the targets staff proposed in the draft recommendation as well as on Maryland's relative performance. The three letters received all agreed that the 7.5 percent improvement target was reasonable based on the staff modeling and benchmarks. JHHS did state that they expect staff to maintain their commitment to revisit and revise the target if it proves to be too aggressive, to monitor that hospitals who are doing well are not negatively impacted by the policy, and monitor for unintended consequences to patient care. The MHA letter also raised concerns that a statewide improvement goal does not mean that all hospitals, in particular well performing hospitals, have the same opportunity to improve, and that the attainment target thus may need to be eased. The CF letter noted that they appreciated the external benchmarking analysis performed by staff to evaluate Maryland's progress and current

performance. Commissioner Colmers also commented that Maryland's state ranking on performance over time would be helpful information on gauging our progress.

> **Staff Response**: Staff appreciates the support of the 7.5 percent 5-year improvement goal since it provides a longer term TCOC target and based on various opportunity analyses appears reasonable. This being said, staff agrees with the need to monitor whether this target is too aggressive or lenient and any unintended consequences. Also, staff notes that the recommendation to base the attainment target on anticipated statewide improvement of 7.5% was intended to alleviate concerns that hospitals with limited ability to reduce readmissions further are recognized for higher performance levels. Moreover, staff agrees that as the state improves, the attainment target will need to be adjusted to ensure that Maryland hospitals that are performing well compared to National benchmarks are not unduly penalized. Finally, staff agrees that analysis of Maryland performance over time relative to external benchmarks, and including overall state ranking compared with other states, would be valuable. Staff notes that in 2012, Maryland ranked 52 out of 53 states/territories on a per discharge readmission measure rate based on data received from the CMS QIO National Coordinating Center. In CY 2017, on a different measure of Medicare unadjusted 30-day per capita readmission rates per 1,000 beneficiaries, Maryland ranked 29 of 53 states/ territories based on data from Health Quality Innovators, the former Maryland QIO. While the measures used for the rankings in 2012 versus 2017 are different, staff analyses have shown that per discharge and per capita readmission rates are highly correlated (correlation coefficient >0.85). Currently staff are working to redo state rankings using the CCW data, which will allow us to compare the same measure overtime and get more recent data.

Modifications to Readmission Measure

The comment letters support the recommendations to remove discharges where the patient left against medical advice from being eligible for a readmission, as well as the inclusion of oncology patients. The MHA letter, however, recommends that staff evaluate the new oncology provision after one year to ensure there are no unintended consequences.

> **Staff Response:** Staff appreciates the support for these changes to the readmission measure and is open to hospitals bringing cases to us where there are concerns regarding the adapted oncology logic. In addition, staff would like to reiterate that we will be monitoring trends in the use of the AMA discharge status. Since the draft policy, HSCRC reviewed a report from our case-mix auditing contractor regarding an AMA case in which the auditor did not agree with the hospital's decision to code the case as AMA, noting that the hospital documentation did not justify a discharge disposition of AMA. Concerns on the criteria for appropriate use of AMA and administratively discharged patient disposition were raised in the subgroup and shared by staff. To monitor this concern, staff will analyze changes in the use of AMA code, and if there are significant increases in patients leaving AMA for specific hospitals, staff may consider a special audit of these discharges.

Excess Days in Acute Care (EDAC)

The CF letter supports the incorporation of the EDAC measure on an all-payer basis, especially given Maryland's poor performance on the Medicare condition-specific EDAC measures. While the MHA letter did not specifically comment on the use of the EDAC measure, the JHHS letter encouraged more discussion of the use of this measure and raised concerns on the validity of the measure and the factors that result in ED and observation revisits.

> **Staff Response**: The recommendation to explore development of an all-payer, all condition EDAC measure was based on the subgroup discussion and review of the existing Medicare condition-specific measures. Staff believes there is general support for this analysis, and notes that this analysis can more holistically examine revisits beyond readmissions. Analysis and discussion will be needed on the adaptation of the Medicare specifications to an all-payer, all-condition measure versus other options, such as adapting our current readmission measure to include other types of revisits. However, staff believes the concept of excess days in acute care is a more nuanced measure since it captures a fuller picture of post-discharge outcomes.

Disparity Gap Measure

The CF letter supports incorporation of the disparity measure. The JHHS letter is supportive of the disparity measure, and suggests that the measure could be refined to recognize progress some hospitals have already made in reducing disparities. JHHS additionally suggested the HSCRC should explore ways for hospitals to share best practices in reducing disparities. MHA indicated that more time is necessary to determine what degree of change would represent meaningful improvement in disparities. The MHA letter suggested monitoring the disparity measure for at least a year prior to incorporating rewards or penalties into payment policy and raised concerns that it is premature to set a SIHIS goal. Additional discussion on the measure during the February Commission meeting focused on the risk of unintended consequences, specifically the possibility that the policy could encourage hospitals to avoid treating patients with high PAI scores.

> **Staff Response**: Staff faced two challenges in setting incentives for the disparity measure: 1) There are no large-scale examples of disparity programs that provide guidance on how incentives might affect disparities; 2) For the past three years, hospital-level disparity scores have remained virtually unchanged, which means there is no empirical information available on how much change over time is feasible. It is unlikely that monitoring the disparity measure for a year would ameliorate either of these challenges. Thus, monitoring would potentially delay progress on disparities for a year without offering any insight one how to improve the draft policy. The draft policy addresses the uncertainty around setting appropriate rewards and targets for a new performance measure by restricting the incentive to reward only and setting the reward at a lower level compared to the main RRIP program. With regard to unintended consequences, the gap measure includes an adjustment for the average PAI value at

each hospital, so if hospitals were to attempt to shift their mix of patients toward the lower end of the PAI scale, they would not benefit. Staff plans to carefully track progress on the disparity measure and the effect of rewards, as well as evidence of unintended consequences, and to recommend changes to the measurement methodology and incentive structure as required.

Staff has had conversations recently with CMMI about concerns in setting a longer term disparity gap reduction goal, given this is a new measure and it is unclear what rate of improvement is feasible. Based on these conversations staff has confirmed that as long as another goal within the hospital domain has a 3, 5 and 8 year target, at this time the state only needs to submit a three year SIHIS target. The proposed 3 year target could be to have a disparity gap methodology that has been used in payment. . In terms of the RY 2022 disparity gap incentive, staff maintains that the gap improvement goals proposed in the recommendations are still reasonable given the reward.

Staff also agrees that the state should support and encourage the sharing of best practices on disparity reductions across the state. The HSCRC staff has been in discussions with the Office of Minority Health and Health Disparities, and believes that they can play an important role because of their expertise in this area. Also staff notes that while the HSCRC does not normally engage in running forums for sharing best practices, the MHA has often filled this role based on areas of focus that are approved in HSCRC policies.

Recommendations

1. Update 30-day, all-cause readmission measure with the following changes:
    a. Exclude all discharges with discharge disposition “left against medical advice”
    b. Include oncology discharges based on logic adapted from NQF 3188 - 30-day unplanned readmissions for cancer patients
2. Establish statewide 5-year Improvement target of -7.5 percent from 2018 base period, which would reduce Maryland Readmissions to approximately ~75th percentile of like geographies
3. Attainment Target - maintain attainment target methodology as currently exists, whereby hospitals at or better than the 65th percentile statewide receive scaled rewards for maintaining low readmission rates
4. For improvement and attainment, set the maximum reward hospitals can receive at 1 percent of inpatient revenue and the maximum penalty at 2 percent of inpatient revenue
5. Establish additional payment incentive (up to 0.50 percent of inpatient revenue) for reductions in within-hospital readmission disparities:
    a. Provide reward of 0.25 percent of IP revenue for hospitals on pace for 25 percent reduction in disparity gap measure over 8 years (>=6.94 percent reduction in disparity gap measure 2018 to 2020)

    b. Provide reward of 0.50 percent of IP revenue for hospitals on pace for 50 percent reduction in disparity gap measure over 8 years (>=15.91 percent reduction in disparity gap measure 2018 to 2020)
    c. Limit disparity reduction rewards to hospitals that have demonstrated improvement in the casemix adjusted, 30-day, all-cause readmission measure for the general population
6. Explore development of an all-payer Excess Days in Acute Care measure in order to account for severity of readmission and emergency department and observation revisits

Appendix I. RRIP Readmission Measure and Revenue Adjustment Methodology

1) Performance Metric

The methodology for the Readmissions Reduction Incentive Program (RRIP) measures performance using the 30-day all-payer all hospital (both intra- and inter-hospital) readmission rate with adjustments for patient severity (based upon discharge all-patient refined diagnosis-related group severity of illness [APR-DRG SOI]) and planned admissions.[17] Unique patient identifiers from CRISP are used to be able to track patients across hospitals for readmissions.

The measure is similar to the readmission rate that is calculated by CMMI to track Maryland performance versus the nation, with some exceptions. The most notable exceptions are that the HSCRC measure includes psychiatric patients in acute care hospitals, and readmissions that occur at specialty hospitals. In comparing Maryland's Medicare readmission rate to the national readmission rate, the Centers for Medicare & Medicaid Services (CMS) will calculate an unadjusted readmission rate for Medicare beneficiaries. Since the Health Services Cost Review Commission (HSCRC) measure is for hospital-specific payment purposes, an additional adjustment is made to account for differences in case-mix. See below for details on the readmission calculation for the RRIP program.

2) Inclusions and Exclusions in Readmission Measurement

- Planned readmissions are excluded from the numerator based upon the CMS Planned Readmission Algorithm V. 4.0. The HSCRC has also added all vaginal and C-section deliveries and rehabilitation as planned using the APR-DRGs, rather than principal diagnosis.[18] Planned admissions are counted as eligible discharges in the denominator, because they could have an unplanned readmission.
- Discharges for newborn APR-DRG are removed.[19]
- Proposed for RY 2022: Remove DRG oncology exclusion but continue to exclude bone marrow transplants and liquid tumor patients by making these discharges not eligible to have an unplanned readmission or count as an unplanned readmission.[20]
- Proposed for RY 2022: Exclude patients with a discharge disposition of Left Against Medical Advice (PAT_DISP = 71, 72, or 73 through FY 2018; 07 FY 2019 onward)
- Rehabilitation cases as identified by APR-860 (which are coded under ICD-10 based on type of daily service) are marked as planned admissions and made ineligible for readmission after readmission logic is run.
- Admissions with ungroupable APR-DRGs (955, 956) are not eligible for a

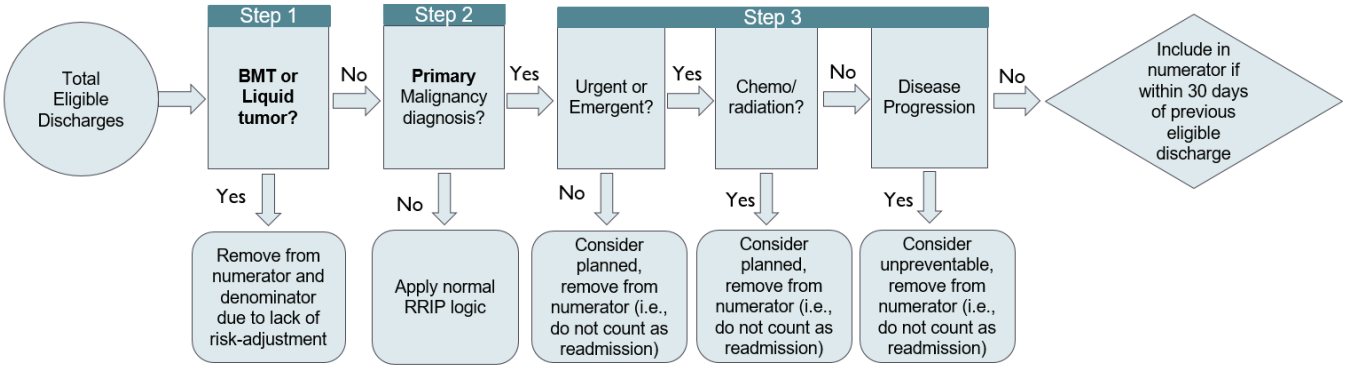
17 Planned admissions defined under [CMS Planned Admission Logic version 4 – updated March 2018].
18 **Rehab** DRGs: 540, 541, 542, 560, and 860; **OB Deliveries and Associated DRGs**: 580, 581, 583, 588, 589, 591, 593, 602, 603, 607, 608, 609, 611, 612, 613, 614, 621, 622, 623, 625, 626, 630, 631, 633, 634, 636, 639, 640, and 863.
19 **Newborn APR-DRGs:** 580, 581, 583, 588, 589, 591, 593, 602, 603, 607, 608, 609, 611, 612, 613, 614, 621, 622, 623, 625, 626, 630, 631, 633, 634, 636, 639, 640, and 863.
20 **Bone Marrow Transplant:** Diagnosis code Z94.81 or CCS Procedure code 64; **Liquid Tumor:** Diagnosis codes C81.00-C96.0. See section below for additional details on the oncology logic.

readmission, but can be a readmission for a previous admission.

- APR-DRG-SOI categories with less than two discharges statewide are removed.
- Hospitalizations within 30 days of a hospital discharge where a patient dies is counted as a readmission; however, the readmission is removed from the denominator because the case is not eligible for a subsequent readmission.
- Admissions that result in transfers, defined as cases where the discharge date of the admission is on the same or next day as the admission date of the subsequent admission, are removed from the denominator. Thus, only one admission is counted in the denominator, and that is the admission to the transfer hospital (unless otherwise ineligible, i.e., died). It is the second discharge date from the admission to the transfer hospital that is used to calculate the 30-day readmission window.
- Beginning in RY 2019, HSCRC started including discharges from chronic beds within acute care hospitals.
- In addition, the following data cleaning edits are applied:
    - Cases with null or missing CRISP unique patient identifiers (EIDs) are removed.
    - Duplicates are removed.
    - Negative interval days are removed.
      HSCRC staff is revising case-mix data edits to prevent submission of duplicates and negative intervals, which are very rare. In addition, CRISP EID matching benchmarks are closely monitored. Currently, hospitals are required to make sure 99.5 percent of inpatient discharges have a CRISP EID.

Additional Details on Oncology Logic:

Flow Chart for Revised Oncology Logic



*Items that are **bolded** are adaptations from NQF measure

This updated logic replaces the RY 2021 measure logic that removes all oncology DRGs from the dataset, such that an admission with an oncology DRG cannot count as a readmission or be eligible to have a readmission.

Step 1: Exclude discharges where patients have a bone marrow transplant procedure, bone marrow transplant related diagnosis code, or liquid tumor diagnosis. This logic varies from the NQF cancer hospital measure that risk-adjusts for bone marrow transplant and liquid tumors. HSCRC staff recommended removing these discharges

(similar to current DRG exclusion) because the current indirect standardization approach did not allow for additional risk-adjustment but based on conversations with clinicians staff agreed these cases were significantly more complicated and at-risk for an unpreventable readmission.

Step 2: Flag discharges with a primary malignancy diagnosis to apply cancer specific logic for determining readmissions. This varies from the NQF cancer hospital measure that flags patients with primary or secondary malignancy diagnosis being treated in a cancer specific hospital. Staff think we should only flag those with a primary diagnosis since in a general acute care hospital there may be differences in the types of patients with a secondary malignancy diagnosis. Further, we remove the bone marrow and liquid tumor discharges regardless of malignancy diagnosis, thus ensuring the most severe cases are removed. Last, our initial analyses did not show a large impact on overall hospital rates when primary vs primary and secondary malignancies were flagged. It should be noted however that the current modeling in this policy uses readmission rates where both primary and secondary are flagged.

Step 3: Flag planned admissions using additional criteria beyond the CMS planned admission logic:

a) Nature of admission of urgent or emergent considered unplanned, all other nature of admission statuses are planned
b) Any admission with primary diagnosis of chemotherapy or radiation is considered planned
c) Any admission with primary diagnosis of metastatic cancer is not considered preventable, and thus gets excluded from being a readmission

In step 3, admissions are deemed not eligible to be a readmission but they are eligible to have a subsequent unplanned readmission.

3) Details on the Calculation of Case-Mix Adjusted Readmission Rate

Data Source:

To calculate readmission rates for RRIP, inpatient abstract/case-mix data with CRISP EIDs (so that patients can be tracked across hospitals) are used for the measurement period, with an additional 30 day runout. To calculate the case-mix adjusted readmission rate for CY 2018 base period and CY 2020 performance period, data from January 1 through December 31, plus 30 days in January of the next year are used. The base period data are used to calculate the normative values, which are used to determine a hospital's expected readmissions, as detailed below, as well as the estimated CY 2018 readmission rates.

Please note that, the base year readmission rates are not "locked in", and may change if there are CRISP EID or other data updates. The HSCRC does not anticipate changing the base period data, and does not anticipate that any EID updates will change the base period data significantly; however, the HSCRC has decided the most up-to-date data should be used to

measure improvement. For the performance period, the CRISP EIDs are updated throughout the year, and thus, month-to-month results may change based on changes in EIDs.

SOFTWARE: APR-DRG Version 37 for CY 2018-CY 2020.

Calculation:

$$\text{Case-Mix Adjusted Readmission Rate} = \frac{\text{(Observed Readmissions)}}{\text{(Expected Readmissions)}} * \text{Statewide Base Year Readmission Rate}$$

Numerator: Number of observed hospital-specific unplanned readmissions.

Denominator: Number of expected hospital specific unplanned readmissions based upon discharge APR-DRG and Severity of Illness. See below for how to calculate expected readmissions, adjusted for APR-DRG SOI.

Risk Adjustment Calculation:

Calculate the Statewide Readmission Rate without Planned Readmissions.

- Statewide Readmission Rate = Total number of readmissions with exclusions removed / Total number of hospital discharges with exclusions removed.

For each hospital, enumerate the number of observed, unplanned readmissions.

For each hospital, calculate the number of expected unplanned readmissions at the APR-DRG SOI level (see Expected Values for description). For each hospital, cases are removed if the discharge APR-DRG and SOI cells have less than two total cases in the base period data.

Calculate at the hospital level the ratio of observed (O) readmissions over expected (E) readmissions. A ratio of > 1 means that there were more observed readmissions than expected, based upon a hospital's case-mix. A ratio of < 1 means that there were fewer observed readmissions than expected based upon a hospital's case-mix.

Multiply the O/E ratio by the base year statewide rate, which is used to get the case-mix adjusted readmission rate by hospital. Multiplying the O/E ratio by the base year state rate converts it into a readmission rate that can be compared to unadjusted rates and case-mix adjusted rates over time.

Expected Values:

The expected value of readmissions is the number of readmissions a hospital would have experienced had its rate of readmissions been identical to that experienced by a reference or normative set of hospitals, given its mix of patients as defined by discharge APR-DRG category and SOI level. Currently, HSCRC is using state average rates as the benchmark.

The technique by which the expected number of readmissions is calculated is called indirect standardization. For illustrative purposes, assume that every discharge can meet the criteria for having a readmission, a condition called being “eligible” for a readmission. All discharges will either have zero readmissions or will have one readmission. The readmission rate is the proportion or percentage of admissions that have a readmission.

The rates of readmissions in the normative database are calculated for each APR-DRG category and its SOI levels by dividing the observed number of readmissions by the total number of eligible discharges. The readmission norm for a single APR-DRG SOI level is calculated as follows:
Let:

N = norm
P = Number of discharges with a readmission
D = Number of eligible discharges
i = An APR DRG category and a single SOI level

$$N_i = \frac{P_i}{D_i}$$

For this example, the expected rate is displayed as readmissions per discharge to facilitate the calculations in the example. Most reports will display the expected rate as a rate per one thousand.

Once a set of norms has been calculated, the norms are applied to each hospital’s DRG and SOI distribution. In the example below, the computation presents expected readmission rates for a single diagnosis category and its four severity levels. This computation could be expanded to include multiple diagnosis categories, by simply expanding the summations.

Consider the following example for a single diagnosis category.

Expected Value Computation Example – Individual APR-DRG

A Severity of Illness Level	B Eligible Discharges	C Discharges with Readmission	D Readmissions per Discharge (C/B)	E Normative Readmissions per Discharge	F Expected # of Readmissions (A*E)
1	200	10	.05	.07	14.0
2	150	15	.10	.10	15.0
3	100	10	.10	.15	15.0
4	50	10	.20	.25	12.5
Total	**500**	**45**	**.09**		**56.5**

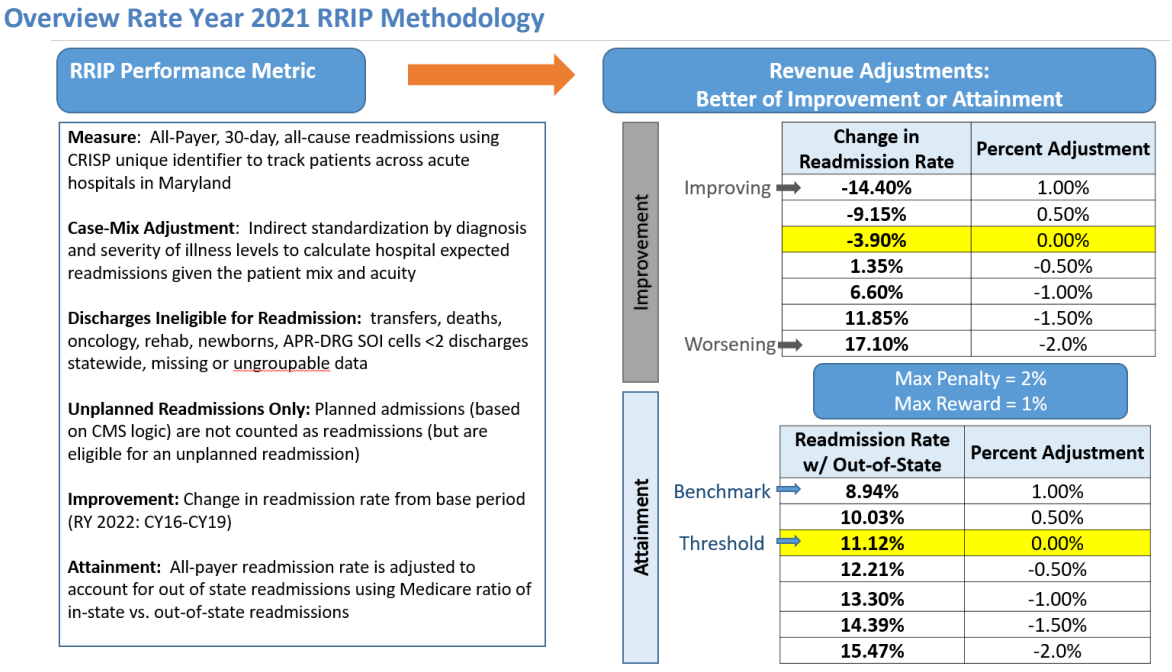
For the diagnosis category, the number of discharges with a readmission is 45, which is the sum of discharges with readmissions (column C). The overall rate of readmissions per discharge,

0.09, is calculated by dividing the total number of eligible discharges with a readmission (sum of column C) by the total number of discharges at risk for readmission (sum of column B), i.e., 0.09 = 45/500. From the normative population, the proportion of discharges with readmissions for each severity level for that diagnosis category is displayed in column E. The expected number of readmissions for each severity level shown in column F is calculated by multiplying the number of eligible discharges (column B) by the normative readmissions per discharge rate (column E) The total number of readmissions expected for this diagnosis category is the sum of the expected numbers of readmissions for the 4 severity levels.

In this example, the expected number of readmissions for this diagnosis category is 56.5, compared to the actual number of discharges with readmissions of 45. Thus, the hospital had 11.5 fewer actual discharges with readmissions than were expected for this diagnosis category. This difference can also be expressed as a percentage or the O/E ratio.

4) Revenue Adjustment Methodology

The RRIP assesses improvement in readmission rates from base period, and attainment rates for the performance period with an adjustment for out-of-state readmissions. The policy then determines a hospital's revenue adjustment for improvement and attainment and takes the better of the two revenue adjustments, with scaled rewards of up to 1 percent of inpatient revenue and scaled penalties of up to 2 percent of inpatient revenue. The figure below provides a high level overview of the RY 2021 RRIP methodology for reference and will be updated for RY 2022 once the policy is approved.



Appendix II. MPR Literature Review

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MEMORANDUM

TO: Alyson Schuster, Andrea Zumbrum, and Geoff Dougherty

FROM: Kristin Maurer and Eric Schone **DATE:** 2/28/2019

SUBJECT: Readmission Literature Survey Findings

To help the Maryland Health Services Cost Review Commission plan the evolution of its performance-based payments programs, Mathematica surveyed recent scholarly publications and gray literature related to readmission. In particular, we reviewed literature on the following subjects:

- Per capita or population-based readmission measures
- The relation of readmissions to emergency department (ED) use or observation stays
- The significance of different follow-up periods for readmission
- Alternative measures of post-discharge health care use
- Identifying a target readmission rate
- The impact of declining readmission rates
- The impact of CMS's Hospital Readmission Reduction Program (HRRP)

This memo describes the current state of our literature search and summarizes findings for each of these areas.

Methods

Our search contained two parts. One part was a systematic MEDLINE search of original articles, review articles, and technical reports. We screened articles identified by the keywords for relevance and then reviewed them. We describe keywords and search results in Table 1 below. For the topic of declining admissions, a keyword search did not yield any useful results. However, we attempted to address that topic by reviewing publications identified in the course of reviewing publications identified in our reviews of other topics. The second part was a non-

systematic review of articles and reports on the subject of the HRRP. This review includes articles cited in the Medicare Payment Advisory Commission's (MedPAC's) report on the HRRP and recent articles on the effects of the program.

Table 1. Search strategy summary

Search engines	MEDLINE
Years	2010–present
Article types	Original article, report, review article, journal article, meta-analysis, systematic review, technical report
Mesh	Patient readmission or hospitalization and United States
RQ1	**"Redefining" readmission measures**
Question	Is there evidence to support changes to readmission measures or measures in use or under development that consider the following: 1. Per capita readmissions (or other population-health based measures) 2. Time spent at home versus in hospital or skilled nursing facility (quality of life functional status post-discharge) 3. Window for readmissions 4. Emergency department, observation visits, and other unplanned care
Keywords	1. readmission* and hospital* and (rate* or measure*) and (population or community or "referral region") 2. (rate* or measure*) and (time home or home time)[1] 3. readmission* and hospital* and (rate* or measure*) and (window* or interval*) 4. readmission* and hospital* and (rate* or measure*) and (ED or "emergency department" or "emergency room" or observation)
Examples	<u>Per capita readmissions (or other population-health based measures)</u> 1. Herrin, Jeph, Justin St Andre, Kevin Kenward, Maulik S. Joshi, Anne-Marie J. Audet, and Stephen C. Hines. "Community Factors and Hospital Readmission Rates." *Health Services Research,* vol. 50, no. 1, 2015, pp. 20–39. <u>Quality of life after discharge</u> 1. Greene, S.J., E.C. O'Brien, R.J. Mentz, N. Luo, N.C. Hardy, W.K. Laskey, P.A. Heidenreich, C.L. Chang, S.J. Turner, C.W. Yancy, A.F. Hernandez, L.H. Curtis, P.N. Peterson, G.C. Fonarow, and B.G. Hammill. "Home-Time After Discharge

[1] We did not apply the MeSH restrictions to this search.

	Among Patients Hospitalized With Heart Failure." *Journal of the American College of Cardiology*, vol. 71, no. 23, 2018, pp. 2643–2652. 2. Greysen, S.R., I.S. Cenzer, A.D. Auerbach, and K.E. Covinsky. "Functional Impairment and Hospital Readmission in Medicare Seniors." *JAMA Internal Medicine*, vol. 175, no. 4, 2015, pp. 559–565. 3. Welsh, R.L., J.E. Graham, A.M. Karmarkar, N.E. Leland, J.G. Baillargeon, D.L. Wild, and K.J. Ottenbacher. "Effects of Postacute Settings on Readmission Rates and Reasons for Readmission Following Total Knee Arthroplasty." *Journal of the American Medical Directors Association*, vol. 18, no. 4, 2017, pp. 367.e1–367.e10. <u>Window for readmissions</u> 1. Chin, David L., Heejung Bang, Raj N. Manickam, and Patrick S. Romano. "Rethinking Thirty-Day Hospital Readmissions: Shorter Intervals might be Better Indicators of Quality of Care." *Health Affairs,* vol. 35, no. 10, 2016, pp. 1867–1875. <u>Emergency department/observation visits</u> 1. Zuckerman, R.B., S.H. Sheingold, E.J. Orav, J. Ruhter, and A.M. Epstein. "Readmissions, Observation, and the Hospital Readmissions Reduction Program." *New England Journal of Medicine,* vol. 374, no. 16, 2016, pp. 1543–1551. 2. Gerhardt, Geoffrey, Alshadye Yemane, Keri Apostle, Allison Oelschlaeger, Eric Rollins, and Niall Brennan. "Evaluating Whether Changes in Utilization of Hospital Outpatient Services Contributed to Lower Medicare Readmission Rate." *Medicare & Medicaid Research Review,* vol. 4, no. 1, 2014.
Number of hits	1. 156; post screening = 8 2. 68; post-screening=6 3. 184; post screening = 21 4. 93; post screening = 11
RQ2	**Benchmarks**
Question	What is an "acceptable level" of readmissions or the "optimal" readmission rate? Are there initiatives that define benchmarks or thresholds at the payer level?

	Title, abstract, keywords	"readmission" AND ("preventable" OR "avoidable" OR "optimal level" OR "acceptable level") AND "quality"
	Examples	1. van Walraven, Carl, Carol Bennett, Alison Jennings, Peter C. Austin, and Alan J. Forster. "Proportion of Hospital Readmissions Deemed Avoidable: A Systematic Review." *Canadian Medical Association Journal,* vol. 183, no. 7, 2011, pp. E391–E402. 2. Donzé, J., D. Aujesky, D. Williams, and J.L. Schnipper. (2013). "Potentially Avoidable 30-day Hospital Readmissions in Medical Patients: Derivation and Validation of a Prediction Model." *JAMA Internal Medicine*, vol. 173, no. 8, 2013, pp. 632–638.
	Number of hits	222 (in MedLINE) Post screening = 29
RQ3		**Decline in admissions**
	Question	What is the impact of the decline of admission rates on readmission measures (that is, shrinking denominator), particularly with regard to HRRP?
	Keywords	NA
	Examples	1. Cram, P., X. Lu, S.L. Kates, J.A. Singh, Y. Li, and B.R. Wolf. "Total Knee Arthroplasty Volume, Utilization, and Outcomes Among Medicare Beneficiaries, 1991-2010." *JAMA,* vol. 308, no. 12, 2012, pp. 1227–1236. 2. Kulkarni, V.T., S.J. Shah, S.M. Bernheim, Y. Wang, S.L.T. Normand, L.F. Han, M.T. Rapp, E.E. Drye, and H.M. Krumholz. (2012). Regional Associations Between Medicare Advantage Penetration and Administrative Claims-Based Measures of Hospital Outcome." *Medical Care*, vol. 50, no. 5, 2012, pp. 406.

HRRP = Hospital Readmissions Reduction Program; RQ = research question.

Findings

Population-based readmission measures

One definition of the denominator of the readmission rate is the number of index admissions at a given hospital. An alternative denominator definition is the size of the population over which readmissions are identified. Readmissions might be defined across the admissions of all hospitals serving a particular population with a denominator of their combined index discharges; the denominator might also be defined as the total population of the geographic area served by a hospital or hospitals. Thus, the per capita readmission rate would be defined as the product of the admission rate and of the readmission rate conditional on admission. However, readmission rates in population-based measures are generally part of a more broadly defined measure, such as an admission rate. Population-based measures can be used to assess quality across different populations, such as a health plan, accountable care organization, hospital market, or hospital referral region.

Epstein et al. (2011) found that all-cause admission rates were a strong predictor of regional variations in readmission rates, suggesting that the factors leading to high hospital utilization rates in a community might weaken the impact on readmission rates of transitional care and care coordination. Herrin et al. (2015) found that 58 percent of the national variation in readmission rates could be explained by the county in which a hospital was located, with the strongest association for measures related to access, such as the supply of general practitioners and specialists in the county. These studies indicate that a per capita approach might be the best way to identify variation in the factors most responsible for affecting readmissions.

MedPAC recommended in its June 2018 Report to Congress that Medicare incorporate population-based measures for Medicare Advantage plans, accountable care organizations, and fee-for-services (FFS) beneficiaries in defined market areas when assessing quality in incentive programs (MedPAC 2018a). A potentially preventable admission (PPA) measure treats the readmission as one type of PPA. MedPAC recommended implementing a PPA measure to assess hospitalizations that could be preventable if ambulatory care occurs in a timely and effective manner. It thus favors community investments that promote efficient use and high quality care without discriminating between patients who have previously been hospitalized and those who have not. MedPAC describes 3-M's PPAs, Agency for Healthcare Research and Quality Prevention Quality Indicators (PQIs), and Healthcare Effectiveness Data and Information Set (HEDIS) PPA measures as examples of PPA measures, but without recommending one in particular. They assessed market-level variation in the HEDIS measure and concluded that about 8 percent of admissions of FFS beneficiaries older than 67 were preventable by this definition and that market-level variation was sufficient to make the measure analytically useful.

MedPAC also tested a home and community day (HCD) measure to assess how well health care markets and service areas keep people out of health care institutions. MedPAC assessed market-level variation in the ratio of days not spent in a short- or long-term rehabilitation hospital, psychiatric facility, nursing home, observation status, ED, or death to days in the year.

When it evaluated market-level variation in this measure for FFS beneficiaries older than 65, MedPAC found that it differed by only 1 percent between the 90th percentile and 10th percentile. It concluded that variations in the measure were too small to identify market-level variation in performance.

Although neither PPA nor HCD is focused on readmissions, both measures take a population-based approach to assessing avoidable hospital use, which includes readmission. Blue Cross Blue Shield of Minnesota and the Wisconsin Medicaid Hospital Quality Program use measures related to potentially preventable readmissions to assess readmissions at the commercial and Medicare Advantage plan level and for Medicaid managed care plans.

ED use and observation stays

The literature on ED and observation stays assesses the relationship of ED visits and observation stays to readmissions. This literature recognizes that inpatient stays are part of a continuum of care that patients can receive when returning to the hospital following an index stay. Because of incentives to avoid admissions, deficiencies in hospitals' care, or in care provided within the community that result in a return to the hospital, might become less likely to result in an inpatient admission. Consequently, the readmission rate would fall but the share of ED and observation stays without an inpatient admission would rise. The literature assesses whether reductions in readmissions are associated with increases in other acute care contacts not followed by inpatient admission.

Most studies have found that the reduction in readmission rates occurring in recent years has been accompanied by increases in ED and observation stays not resulting in admission. The reduction in readmissions has also been accompanied by reductions in inpatient admission rates. MedPAC's review found that reductions in readmissions that it attributed to the HRRP were accompanied by increases in ED visits and observation stays not resulting in admissions that may also be due to HRRP. However, several other studies have found that the implementation of the HRRP was not associated with an increase in either observation visits or ED use post-discharge (Gerhardt et al 2014; Horwitz et al. 2018; Zuckerman et al. 2016; Ibrahim et al. 2017). Factors other than the HRRP could explain the reduction in inpatient admissions. For example, the increase in observation stays and ED visits and decreases in admissions might be explained by changes in the Medicare recovery audit contractor (RAC) review of the medical necessity of short stays. Because of the increased likelihood they would not be reimbursed, hospitals might have responded by decreasing the number of short stay admissions that could be subject to recovery audit contractor review. Doing so would therefore have reduced readmissions and increased ED and observation stays that do not result in admission.

Different follow-up periods

Evaluating follow-up periods over which readmissions are calculated has two foci: (1) identifying the periods over which hospital discharge practices and quality efforts affect results and (2) identifying the share of readmissions and associated resource use for which readmissions during different follow-up periods are responsible.

To assess hospital quality, public reporting and value-based payment programs have primarily adopted 30-day all-cause, unplanned readmissions measures. A 30-day window theoretically limits quality measurement to the period in which a hospital might have more control over care coordination post-discharge, but limited empirical evidence supports the use of a 30-day interval to detect readmissions attributable to hospital variation (Chin et al. 2016; Vaduganathan et al. 2013).

One study testing the optimal interval for assessing readmission rates as a measure of hospital quality found that measuring readmission rates at shorter intervals (five to seven days) was a better signal of hospital-level quality than a longer period but that the optimal timing varies across conditions (Chin et al. 2016). Another study analyzing the risk of readmissions following hospitalization for acute myocardial infarction (AMI), heart failure (HF), and pneumonia found that the extent and timing of readmission risk varied by readmission diagnosis, but risk generally peaked within two to ten days after discharge (Krumholz et al. 2016).

Overall, the appropriate interval for readmissions measures depends on the goal of the measure or associated public reporting or value-based payment program. Readmissions that occur within the first few days after discharge might reflect poor care coordination on the part of the hospital. A short interval, such as seven days, might be more appropriate than a long one if the goal is to detect readmissions that could be directly avoided through efforts taken by hospitals at the time of discharge. Adjusting the existing 30-day all-cause readmission measures by weighting readmissions according to their timing could help to account for the concerns that variations in readmissions at the 30-day interval cannot be attributed to the hospital (Joynt and Jha, 2013).

Several studies of readmissions at longer intervals compared the share of all readmissions within 30 days to the share of those within longer intervals and compared the share of resources that the readmission groups represent. One study of pediatric readmissions found that 30 percent of readmissions occurring within a year occurred during the first month, and a similar analysis of unstable angina patients found that 40 percent of those readmitted within a year were readmitted within 30 days. Others found that 40 to 50 percent of readmissions occurring within 90 days occurred after 30 days. Readmissions that occur weeks or months after discharge might be indirectly related to the index hospitalization, but these readmissions could also be indicators of a patient's overall health status, socioeconomic status (SES), and ability to have health care needs met in a non-hospital setting. Measuring readmissions at longer intervals might be more appropriate when taking a population-based perspective to assess the quality across the continuum of care in a community (Jencks and Brock 2013).

One study comparing the timing of readmissions for AMI, HF, and pneumonia among high-, average-, and low-performing hospitals found no notable differences in the timing of readmissions based on hospital performance within the first 30 days (Dharmarajan et al. 2013). In other words, high-performing hospitals tended to have fewer readmissions regardless of the point at which they were measured. The high-performing hospitals identified for this study, however, were those with low 30-day readmission rates for conditions measured by the HRRP. Thus, the argument is circular: by this definition, high-performing hospitals are likely to be those with good community support as well as high quality discharge planning.

Alternative measures of post-discharge health care use

The topics reviewed here introduce several different options for measures of health care use following discharge. The population-based measures above include the full range of inpatient and institutional care. Measures based on initial inpatient encounters that incorporate ED use and observation stays along with readmissions might be considered measures of discharge quality that account for the incentives to avoid inpatient care of patients that would otherwise be admitted (Baier et al. 2013). Readmission measures with different periods of follow-up have different implications. Short intervals measure the quality of the index stay and its associated discharge planning; long intervals capture the impact of community support.

Several empirical studies have examined measures that incorporate post-acute care in addition to readmission. One option is to use a measure of ED visits following discharge analogous to readmission rates. This measure reflects the need for post-acute care but is not sensitive to the admitting decision of the ED. One study analyzing variations in ED admission rates and examining 30-day post-discharge hospital utilization patterns in three states found that stays beginning with ED visits accounted for 40 percent of all hospital-based care (Vashi et al. 2013). Another study analyzed a measure of post-acute days as a share of post-admission days. The study found that this measure did a better job of distinguishing hospital performance than the readmission rate did. The Centers for Medicare & Medicaid Services (CMS) developed measures for AMI, HF, and pneumonia of excess days in acute care after hospitalizations to more fully capture acute care after hospitalization (Horwitz et al. 2018). Population-based measures, such as the HCD measure tested by MedPAC, could reflect the ability of the population to avoid institutional care and could be converted to a measure of post-discharge care by excluding those without a prior hospitalization. We present alternative measures in an appendix below.

Some have proposed measuring the number of days patients spend alive and outside of the hospital or a skilled nursing facility as an indicator of patients' quality of life (Green et al., 2018; Lee et al., 2018). This measure is also known as "home time". Although our literature search did not identify efforts to use a home time measure for payment, public reporting or other quality improvement initiatives, researchers have constructed home time measures for analytic purposes. Several studies have focused on home time following stroke, but recently home time has been studied as a patient-centered outcome for a broader array of conditions. These studies suggest that home time can be calculated from administrative claims data and associated with other quality of life indicators and outcome measures.

One study of Medicare claims found that reduced home time was associated with poor self-rated health, mobility impairment, depressed mood, limited social activity, and difficulty with self-care (Lee et al., 2018). In two other studies, home time following hospitalization for stroke was significantly associated with measures of disability (Quinn et al., 2008; Fonarow et al., 2016). Greene et al. (2018) found that home time following HF hospitalization was highly correlated with both time-to-death and hospitalization. In a study examining hospital-level variation in home-time following stroke, O'Brien et al. (2016) found significant variation in 90-day and 1-year home time at the hospital level, suggesting that a home time measure may help to identify and reduce variations across providers. Because of findings like these, some have

concluded that home time measures could be made suitable for use in value-based purchasing or similar programs.

However, one of the challenges in developing a home time measure as a patient-centered outcome is that hospitalizations and SNF stays can be beneficial for a patient to subsequently maintain independence rather than simply a signal of low quality of life. Additional research is needed to understand how information about patient outcomes and quality of life post hospitalization contained in home time measures could complement or replace readmission measures.

Target readmission rate

The literature relating to a target or appropriate readmission rate approaches the subject by distinguishing avoidable and unavoidable readmissions. An appropriate target might be the level of readmissions that would result if all readmissions were unavoidable. Literature distinguishing avoidable readmissions is based on two methodological approaches: (1) chart review and (2) algorithms using information contained in administrative data. Both methods result in substantial variation in the share of readmissions classed as avoidable. The proportion of readmissions classified as avoidable ranged from 5 to 79 percent in a review of these studies (van Walraven et al. 2011).

Studies based on physicians' chart reviews in our survey produced estimates of avoidable readmissions ranging from about 5 percent to 47 percent of readmissions reviewed (Cakir and Gammon 2010; Feigenbaum et al. 2012).The studies that we reviewed used two algorithm-based methods: SQLape and 3-M's avoidable readmission measure. These methods tend to identify a greater proportion of readmissions as preventable than do chart reviews. SQLape's avoidable readmission algorithm is part of a publicly available classification system based on International Statistical Classification of Diseases and Related Health Problems, 10th revision (ICD-10) diagnosis codes and ICD-9 procedure codes (Donzé et al. 2016). 3-M's algorithm is part of a proprietary set of quality improvement tools that identify preventable adverse events, including potentially preventable complications (McCoy et al. 2018).

Identifying the share of readmissions that is avoidable implicitly defines a share that is unavoidable. The rate of unavoidable readmission, however, is not a proxy for a target rate. Depending on the method used to define avoidable readmissions, the definition might include readmissions that could be prevented by better ambulatory care. The optimal readmission rate is also affected by the admission rate.

An alternative approach is to consider interventions intended to reduce readmissions. Such a program will reduce readmission rates by investing in hospital discharge planning and use of community resources to reduce avoidable admissions. The readmission rates resulting from interventions of this type is an alternative indication of an optimal rate. Investigators evaluating a quality improvement program estimated that 20 percent to 30 percent of readmissions at the subject hospital were preventable. A quality improvement program at that hospital reduced readmissions by 28 percent (Ryan et al. 2014). A care transition program targeting avoidable

readmissions using 3-M's algorithm reduced that readmission rate by 44 percent without affecting other readmissions (McCoy et al. 2018).

Implications of declining admission rates

In its June 2018 Report to Congress, MedPAC noted that Medicare per capita admissions declined by 17 percent between 2010 and 2016. This change in admission patterns could be the result of technological improvements, changes in care, or policy changes discouraging short-stay admissions. MedPAC attempted to identify the role of falling admission rates in reducing the readmission rate. They found that heart failure admissions dropped by 14 percent per capita and that the readmission rate among this smaller group of heart failure admissions fell by 16 percent, producing a 25 percent fall in readmissions. This result suggests that the source of the falling readmission rate could be found in reduced admissions (though that was not MedPAC's conclusion). They also found that the magnitude of the change in inpatient admission rates varied by condition and procedure included in the HRRP, and that the per capita admission rate increased for THA/TKA. However, readmission declines among these patients were similar to those affecting other conditions, lending support to the conclusion that at least some of the decline in readmission rates is due to a focus on reducing readmissions in particular (Cram et al., 2012).

A related factor that may affect readmission rates is the shift to managed care. Among Medicare patients, readmissions of FFS patients are measured under HRRP but patients enrolled in Medicare Advantage (MA) managed care plans are excluded. MA enrollment has increased steadily over time, although this growth has been distributed unevenly across states and health care markets. As patients shift to MA, declining FFS admissions may affect readmission measures. Although one study suggests that 30-day risk-standardized mortality and readmission rates do not systematically differ with MA penetration (Kulkarni et al., 2012) other evidence suggests that MA patients have lower risk than FFS patients, particularly unmeasured risk. If MA patients are lower risk, their shift out of FFS may increase measured readmission rates among FFS. However, this increase in risk would affect both admission and readmission rates. Instead both have declined during this time, suggesting that the shift to managed care has not had a large impact on readmission rates.

The impact of HRRP

HRRP reduces reimbursement for hospitals with higher-than-average readmission rates for any of six conditions. Researchers have reviewed the impact of the program in a number of areas: effect on readmissions, effect on ED care and observation stays, effect on admissions, and effect on mortality. The effort to analyze these impacts is complicated by the fact that the program was initiated for all acute care prospective payment hospitals at the same time. Thus, treatment effects such as those listed previously are difficult to measure because no control similar to the subjects of the treatment was created. Research has attempted to identify comparison groups by distinguishing conditions subject to the program from those that were not and by distinguishing eligible hospitals likely to be penalized from those that are not. Most research has indicated that the program reduced readmission rates, though even that finding is not without controversy. Similarly, observation stays and ED treatments have been found to substitute for readmission, though the increase in this treatment setting is less than observed

declines in readmission rates. The increase in ED and observation stays might also be explained by factors other than the HRRP. Findings concerning both admission rates and mortality rates have also been mixed.

Readmission rates

Both unadjusted and risk-adjusted 30-day readmission rates declined after HRRP was established and implemented. To establish that readmission rate decreases were attributable to HRRP, the decreases for conditions included in HRRP, for Medicare patients, and for hospitals subject to HRRP were compared with other groups. Some researchers found that the decreases for groups affected by HRRP were greater, lending support to the finding that HRRP led to a decrease in readmission rates (Zuckerman et al. 2016; Desai et al. 2016; Ibrahim et al. 2017; MedPAC 2018b). Ody et al. (2019) cast doubt on this finding. They suggested that the observed decline in readmissions is attributable to an increase in data available for risk adjustment because of the change in electronic transaction standards implemented between 2010 and 2012 that increased the number of diagnosis codes recorded on claims. They found that after accounting for the effect of this additional diagnostic information by stripping diagnoses from later records, the change in risk-adjusted readmission rate was reduced and differences in readmission rate changes between targeted and non-targeted conditions and hospitals were no longer statistically significant. MedPAC addressed this finding by comparing trends in unadjusted readmission rates for AMI patients that would not have been effected by the changes in coding practices. MedPAC found that these unadjusted readmission rates for AMI beneficiaries decreased significantly, which suggests that increased diagnostic information explains only part of the drop in readmission rates and thus that readmissions for conditions affected by HRRP were reduced by the program.

Mortality

Results of several studies have suggested that the change in admitting policies produced by the HRRP has resulted in increased mortality. Other studies have supported the interpretation that the HRRP has not affected mortality or has even improved mortality outcomes. Differences in findings can be explained in part by differences in the analytic approach. Wadhera et al. (2018) and Gupta et al. (2018) measured aggregate readmission and mortality for conditions targeted by HRRP and other conditions. They found that, after the implementation of HRRP, aggregate readmissions rate reductions in targeted conditions were associated with aggregate increases in mortality for Medicare FFS patients. Wadhera et al. accounted for patients' clinical risk factors by matching pre-HRRP and post-HRRP patients based on clinical characteristics. Further, they found that the increase in mortality occurred among patients who were not readmitted. Conversely, MedPAC (2018b) and Dharmarajan et al. (2017) compared changes in mortality for hospitals that have decreasing readmission rates with mortality changes of hospitals that have increasing readmissions. Both found small but statistically significant positive correlations (0.05 and 0.06) between changes in HF readmission rates and mortality rates, suggesting that hospitals' reductions in readmission rates are weakly associated with reductions in mortality. MedPAC also compared raw and risk-adjusted mortality before and after HRRP. It found that aggregate risk-adjusted mortality for target conditions decreased during that time.

The aggregate approach described above captures the total effect of HRRP (that is, the findings are not confounded by sorting of patients among hospitals or by hospital-level variation in unmeasured patient risk factors). However, this approach measures only an association. It cannot demonstrate a causal relation between HRRP, readmissions, and mortality—only a temporal one, from which causality is inferred. Hospital-level correlations measure the relation of reducing readmissions to mortality within the hospital experiencing the reduction, attributing that relation to causality. Hospital-level correlations, however, do not account for the impact of unmeasured patient risk factors on mortality and readmissions. For instance, a decrease in unmeasured patient risk at a hospital would reduce both its risk-adjusted mortality and risk-adjusted readmission rate, creating a spurious association of reduced mortality and readmission rates. Similarly, risk adjusted readmissions and mortality and the aggregate relation between them might be affected by the coding intensity increase cited by Ody et al.

In response to the problem of identifying the relationship between HRRP and hospitals' outcomes, one approach is to measure the association between the likelihood of being penalized under HRRP with changes in mortality and readmission. Hospitals more likely to be penalized under the program are more likely to reduce their readmissions, but random fluctuations in unmeasured risk do not affect that likelihood. Thus, the change in readmissions and mortality associated with the likelihood of a penalty can be interpreted as a response to HRRP. Gupta (2017) measures the predicted likelihood of a penalty as a function of a patient's SES and finds that hospitals that are more likely to be penalized experience significantly greater reductions in readmission rates for HRRP conditions, including a significantly reduced likelihood of readmitting their own patients when they present at the ED. His findings indicate that HRRP has reduced readmissions, and because these hospitals do not exhibit significant increases in mortality, the evidence suggests that the program is reducing readmissions without increasing mortality.

The findings of these studies differ according to the condition resulting in the index stay. As MedPAC observed, AMI is less likely to be affected by changes in coding practice or admission policies than other measures. MedPAC (2018b) found that both raw and risk-adjusted AMI mortality fell, Wadhera et al. found no mortality effect for AMI, and Gupta found a significant reduction in mortality for penalized hospitals. Wadhera, however, found increased mortality for HF, and Gupta found no significant change for HF or pneumonia at 30 days but a significant increase at one year.

ED and observation stays

Studies of the impact of HRRP on ED and observation stays have addressed whether the decrease in hospital readmissions accompanying HRRP is attributable to the replacement of readmissions by observation stays and ED use without admission promoted by the program (Weaver et al. 2015). MedPAC assessed the impact of HRRP by comparing changes for focal conditions with those not covered by HRRP. It found that observation stays and ED visits increased and admissions decreased both for conditions included in HRRP as well as for conditions not included. MedPAC also found that observation stays for patients without a recent admission (that is, patients who would not be counted as a readmission) increased similarly to patients with admissions. As a result, MedPAC concluded that the reduction in readmission rates

reflects changes in practice that reduced admissions rather than shifting of short-stay admissions into observation stays to avoid readmission penalties. Zuckerman et al. also found no significant within-hospital association between changes in observation stays and readmissions after implementation of the Affordable Care Act. Both MedPAC and Zuckerman et al. noted concurrent policy changes that could explain the increase in observation stays and ED visits and decreases in admissions. For example, RAC audits, as described above, might have reduced admission rates.

MedPAC also evaluated the financial impact of HRRP and reductions in readmission rates that it attributed to the program. It found that increases in expenditures because of ED and observation stays were much smaller than the expenditures for the readmissions that they may have replaced.

Admission rates

MedPAC (2018b) noted the large national drop in initial inpatient admissions and a shift in the type of patients treated by hospitals from 2010 to 2014. This change in admission patterns could be the result of inpatient care being restricted increasingly to severely sick patients. Similar to its finding for ED and observation stays, MedPAC found that admission rates for HRRP-targeted conditions were reduced by less than rates for other conditions. It concluded that most of the change in admission rates was caused by factors other than HRRP. Gupta (2018), however, found that hospitals likely to be penalized were significantly less likely to admit patients for three HRRP conditions. The effect was smallest (but still statistically significant) for AMI and largest for HF.

Other HRRP affects

Many additional avenues by which HRRP might have affected treatment and outcomes remain unexplored. For example, because readmission rates were not adjusted for SES until fiscal year 2018, the program disadvantaged hospitals with low-SES patients who were more likely to be readmitted and thus caused hospitals treating these patients to be penalized more heavily. If admission rates for low-SES patients were reduced as a consequence, the result might have been an increase in mortality that would not be captured by inpatient or post-discharge mortality rates. In addition, the change in the program to stratify hospitals by patient SES has produced changes in its distributional impact and effect on low-SES patients that should be the subject of future research.

Conclusions

Our review resulted in conclusions concerning target rates; alternative measures of post-acute care quality, including population measures and readmissions measured at different intervals; and the impact of the HRRP.

Target rates

Identification of avoidable readmissions by chart review could provide valuable insight into readmission reduction goals, but it is subject to subjective variation. Alternatively, algorithms to identify avoidable readmissions based on administrative data are a less costly and more

consistent way to evaluate interventions. Readmission targets should consider diagnoses and follow-up periods rather than a raw 30-day readmission rate.

Alternative measures

Readmissions at a short interval represent the quality of initial care and post-discharge planning, and a target rate of 0 is desirable. Long-term readmissions are the result of care in the community, and the readmission goal should be based on population-based approach. A hospital's readmission rate should approach the community admission rate and that rate should exclude PPAs such as those measured by AHRQ's Prevention Quality Indicators.

To produce a complete picture of the impact of readmissions reduction efforts, particularly in the short run, measures that include other inpatient contacts, such as ED or observation stays, are necessary. For example, a measure of days of post-acute care possesses more discriminant power than the readmission rate, but this measure still compounds population effects and hospital quality effects. Population-based measures should be included to address community factors.

HRRP

Our findings suggest considerable controversy about the impact of readmission reduction under CMS's HRRP. The preponderance of the evidence suggests that it has contributed to the reduction in readmissions during the time period surrounding its implementation and that it has reduced the cost of inpatient care. However, other changes in practice and data collection occurring at the same time prevent this conclusion from being definitive. Several avenues deserve more investigation: evidence of unintended consequences of the program, particularly mortality effects for HF, and its effect on admission rates and on other post-acute care. These unintended consequences should be considered in the light of their potential impact on disadvantaged patients and their hospitals. The impact of changes in the program to account for these impacts should also be investigated.

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APPENDIX: ALTERNATIVE POST-ACUTE CARE MEASURES

Measure type	Description	Measure steward
Home and community days	Ratio of days not spent in a short- or long-term rehabilitation hospital, psychiatric facility, nursing home, observation status, ED, or death to days in the year	MedPAC
Potentially preventable admissions	Admissions that could be avoided by good ambulatory care	AHRQ/HEDIS
Potentially preventable readmissions	Based on proprietary clinical logic, readmissions that could be avoided by good care	3M[c]
30-day Post-Hospital AMI Discharge Care Transition Composite Measure	This measure scores a hospital on the incidence among its patients, during the month following discharge from an inpatient stay, having a primary diagnosis of AMI for three types of events: readmissions, ED visits, and evaluation and management services.	CMS (NQF #0698- not endorsed)
30-day Post-Hospital HF Discharge Care Transition Composite Measure	This measure scores a hospital on the incidence among its patients, during the month following discharge from an inpatient stay, having a primary diagnosis of HF for three types of events: readmissions, ED visits, and evaluation and management services.	CMS (NQF #0699- not endorsed)
30-day Post-Hospital HF Discharge Care Transition Composite Measure	This measure scores a hospital on the incidence among its patients, during the month following discharge from an inpatient stay, having a primary diagnosis of pulmonary nodular amyloidosis for three types of events: readmissions, ED visits and evaluation, and management services.	CMS (NQF#0707- not endorsed)
Excess Days in Acute Care after Hospitalization for AMI	This measure assesses days spent in acute care within 30 days of discharge from an inpatient hospitalization for AMI to provide a patient-centered assessment of the post-	CMS (NQF#2881-endorsed)

	discharge period. This measure aims to capture the quality of care transitions provided to discharged patients hospitalized with AMI by collectively measuring a set of adverse acute care outcomes that can occur after discharge: ED visits, observation stays, and unplanned readmissions at any time during the 30 days after discharge. To aggregate all three events, we measure each in terms of days. In 2016, CMS began annually reporting the measure for patients who are 65 and older, enrolled in fee-for-service Medicare, and hospitalized in nonfederal hospitals.	
Excess Days in Acute Care after Hospitalization for HF	This measure assesses days spent in acute care within 30 days of discharge from an inpatient hospitalization for HF to provide a patient-centered assessment of the post-discharge period. This measure aims to capture the quality of care transitions provided to discharged patients hospitalized with HF by collectively measuring a set of adverse acute care outcomes that can occur after discharge: ED visits, observation stays, and unplanned readmissions at any time during the 30 days after discharge. To aggregate all three events, we measure each in terms of days. In 2016, CMS began annually reporting the measure for patients who are 65 and older, enrolled in Medicare fee-for-service, and hospitalized in nonfederal hospitals.	CMS (NQF#2880-endorsed)
Excess Days in Acute Care after Hospitalization for Pneumonia	This measure assesses days spent in acute care within 30 days of discharge from an inpatient hospitalization for pneumonia, including aspiration pneumonia or for sepsis (not severe sepsis) with a secondary diagnosis of pneumonia coded in the claim as present on admission. This measure aims to capture the quality of care transitions provided to discharge patients hospitalized with	CMS (NQF#2882-endorsed)

	pneumonia by collectively measuring a set of adverse acute care outcomes that can occur after discharge: ED visits, observation stays, and unplanned readmissions at any time during the 30 days after discharge. To aggregate all three events, we measure each in terms of days. In 2018, CMS began annually reporting the measure for patients who are 65 and older, enrolled in Medicare fee-for-service, and hospitalized in nonfederal hospitals.	
30-day PCI readmission measure[d]	This measure estimates a hospital-level risk-standardized readmission rate following PCI for Medicare fee-for-service patients who are 65 and older. The outcome is defined as unplanned readmission for any cause within 30 days following hospital stays. The measure includes patients who are admitted to the hospital (inpatients) for their PCI and patients who undergo PCI without being admitted (outpatient or observation stay).	American College of Cardiology (NQF #0695)

[a]Please see https://www.bluecrossmn.com/sites/default/files/DAM/2019-01/FINAL_Medicare_Preventable_Readmissions_Bulletin_P3-19_0.pdf?ReturnTo=/.

[b]Please see https://www.forwardhealth.wi.gov/wiportal/content/provider/medicaid/hospital/resources_01.htm.spage.

[c]Please see https://multimedia.3m.com/mws/media/849903O/3m-ppr-grouping-software-fact-sheet.pdf and https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/Post-Acute-Care-Quality-Initiatives/Downloads/Potentially-Preventable-Readmissions-TEP-Summary-Report.pdf.

[d]NQF

AHRQ = Agency for Healthcare Research and Quality; AMI = acute myocardial infarction; CMS = Centers for Medicare & Medicaid Services; ED = emergency department; HEDIS = Healthcare Effectiveness Data and Information Set; HF = heart failure; MedPAC= Medicare Payment Advisory Commission; NQF = National Quality Forum; PCI = percutaneous coronary intervention.

Appendix III. RY 2021 YTD Results

Hospitals		CY2016 Base Period (YTD, Jan-Oct 2016)						CY2019 Performance Period (YTD, Jan-Oct 2019)								
A	B	C	D	E = D/C	F	G = D/F	H = D/F * 11.99%	I	J	K = J/I	L	M = J/L	N = J/L * 11.99%	O = N/H - 1	P	Q = N*P
CMS ID	Hospital Name	Eligible Disch	Readm	Percent Readm	Expected Readm	Readm Ratio	Case-mix Adj Readm Rate	Eligible Disch	Readm	Percent Readm	Expected Readm	Readm Ratio	Case-mix Adj Readm Rate	Change in Case-mix Adj Rate from CY2016 YTD	OOS Ratio (Oct 18-Sep 19)	Case-mix Adj Readm Rate, Adj for OOS
210001	Meritus	11,406	1,293	11.34%	1,340	0.965	11.57%	11,420	1,256	11.00%	1,471	0.854	10.24%	- 11.50%	1.05	10.77%
210002	UMMC	18,751	2,707	14.44%	2,454	1.103	13.23%	18,261	2,525	13.83%	2,482	1.017	12.20%	- 7.79%	1.04	12.70%
210003	UM-PGHC	9,063	1,026	11.32%	1,113	0.922	11.06%	7,964	924	11.60%	1,106	0.836	10.02%	- 9.40%	1.20	11.99%
210004	Holy Cross	20,295	1,782	8.78%	1,804	0.988	11.85%	19,635	1,644	8.37%	1,767	0.930	11.16%	- 5.82%	1.09	12.11%
210005	Frederick	11,752	1,140	9.70%	1,383	0.824	9.88%	11,511	1,163	10.10%	1,371	0.848	10.17%	2.94%	1.05	10.66%
210006	UM-Harford	3,392	536	15.80%	505	1.061	12.72%	2,983	406	13.61%	467	0.869	10.42%	- 18.08%	1.04	10.79%
210008	Mercy	10,710	888	8.29%	845	1.051	12.60%	10,363	891	8.60%	896	0.995	11.93%	- 5.32%	1.03	12.26%
210009	Johns Hopkins	32,813	4,801	14.63%	4,291	1.119	13.42%	30,702	4,533	14.76%	4,226	1.073	12.86%	- 4.17%	1.07	13.75%
210010	UM-Dorchester	1,824	291	15.95%	267	1.089	13.06%	1,022	124	12.13%	164	0.755	9.06%	- 30.63%	1.06	9.56%
210011	St. Agnes	12,320	1,470	11.93%	1,449	1.015	12.17%	9,959	1,230	12.35%	1,259	0.977	11.72%	- 3.70%	1.01	11.79%
210012	Sinai	13,147	1,756	13.36%	1,675	1.048	12.57%	10,502	1,195	11.38%	1,377	0.868	10.41%	- 17.18%	1.01	10.52%
210013	Bon Secours	2,948	680	23.07%	511	1.331	15.96%	2,335	541	23.17%	401	1.350	16.20%	1.50%	1.01	16.40%
210015	MS Franklin Sq	15,820	2,132	13.48%	1,977	1.078	12.93%	14,811	2,003	13.52%	1,986	1.009	12.10%	- 6.42%	1.01	12.18%
210016	White Oak	7,573	874	11.54%	918	0.952	11.41%	7,348	671	9.13%	852	0.787	9.44%	- 17.27%	1.16	10.97%
210017	Garrett	1,603	85	5.30%	169	0.502	6.02%	1,215	55	4.53%	150	0.366	4.38%	- 27.24%	1.68	7.34%
210018	MS Montgomery	5,320	636	11.95%	683	0.931	11.17%	4,503	496	11.01%	613	0.809	9.70%	- 13.16%	1.07	10.39%
210019	Peninsula	12,723	1,335	10.49%	1,512	0.883	10.59%	11,475	1,126	9.81%	1,453	0.775	9.30%	- 12.18%	1.08	10.08%
210022	Suburban	10,054	1,198	11.92%	1,249	0.959	11.51%	9,974	1,117	11.20%	1,330	0.840	10.07%	- 12.51%	1.11	11.16%
210023	Anne Arundel	20,633	1,729	8.38%	1,802	0.959	11.51%	19,901	1,884	9.47%	2,004	0.940	11.28%	- 2.00%	1.03	11.67%
210024	MS Union	8,651	1,220	14.10%	1,120	1.090	13.07%	8,071	1,000	12.39%	1,033	0.968	11.61%	- 11.17%	1.01	11.76%
210027	Western MD	8,721	1,083	12.42%	1,129	0.959	11.50%	7,884	953	12.09%	1,094	0.871	10.44%	- 9.22%	1.14	11.94%
210028	MS St. Mary's	6,209	628	10.11%	678	0.926	11.10%	5,308	529	9.97%	624	0.847	10.16%	- 8.47%	1.17	11.87%
210029	JH Bayview	14,553	2,275	15.63%	1,865	1.220	14.63%	14,046	2,010	14.31%	1,862	1.080	12.95%	- 11.48%	1.02	13.21%
210030	UM-Chester	1,165	180	15.45%	152	1.182	14.18%	494	44	8.91%	80	0.550	6.60%	- 53.46%	1.16	7.66%
210032	Union Cecil	4,482	504	11.24%	572	0.881	10.56%	3,751	449	11.97%	510	0.881	10.57%	0.09%	1.22	12.95%
210033	Carroll	7,590	904	11.91%	928	0.974	11.69%	7,991	1,012	12.66%	1,028	0.985	11.81%	1.03%	1.02	11.99%
210034	MS Harbor	5,158	600	11.63%	596	1.006	12.07%	5,362	763	14.23%	692	1.103	13.23%	9.61%	1.01	13.31%
210035	UM-Charles	4,895	514	10.50%	615	0.836	10.03%	4,821	561	11.64%	674	0.832	9.98%	- 0.50%	1.18	11.80%
210037	UM-Easton	5,524	546	9.88%	596	0.917	11.00%	4,251	364	8.56%	496	0.734	8.80%	- 20.00%	1.06	9.29%
210038	UMMC Midtown	3,312	714	21.56%	549	1.302	15.61%	3,530	678	19.21%	584	1.160	13.92%	- 10.83%	1.01	14.12%
210039	Calvert	4,120	403	9.78%	507	0.796	9.54%	4,436	547	12.33%	605	0.904	10.85%	13.73%	1.11	12.04%
210040	Northwest	8,408	1,322	15.72%	1,234	1.072	12.85%	6,739	854	12.67%	1,061	0.805	9.65%	- 24.90%	1.02	9.84%
210043	UM-BWMC	12,978	1,883	14.51%	1,730	1.089	13.06%	13,499	1,731	12.82%	1,921	0.901	10.81%	- 17.23%	1.02	10.98%

Hospitals		CY2016 Base Period (YTD, Jan-Oct 2016)						CY2019 Performance Period (YTD, Jan-Oct 2019)								
A	B	C	D	E = D/C	F	G = D/F	H = D/F * 11.99%	I	J	K = J/I	L	M = J/L	N = J/L * 11.99%	O = N/H - 1	P	Q = N*P
CMS ID	Hospital Name	Eligible Disch	Readm	Percent Readm	Expected Readm	Readm Ratio	Case-mix Adj Readm Rate	Eligible Disch	Readm	Percent Readm	Expected Readm	Readm Ratio	Case-mix Adj Readm Rate	Change in Case-mix Adj Rate from CY2016 YTD	OOS Ratio (Oct 18-Sep 19)	Case-mix Adj Readm Rate, Adj for OOS
210044	GBMC	12,511	1,020	8.15%	1,132	0.901	10.81%	13,546	1,167	8.62%	1,324	0.882	10.58%	- 2.13%	1.02	10.75%
210045	McCready	223	28	12.56%	28	0.987	11.84%	109	12	11.01%	13	0.895	10.74%	- 9.29%	1.00	10.74%
210048	Howard	13,323	1,385	10.40%	1,437	0.964	11.56%	11,315	1,198	10.59%	1,340	0.894	10.72%	- 7.27%	1.02	10.89%
210049	UMUCH	8,908	993	11.15%	1,053	0.943	11.31%	8,085	947	11.71%	1,029	0.920	11.04%	- 2.39%	1.03	11.33%
210051	Doctors	7,760	1,127	14.52%	1,133	0.994	11.93%	8,180	916	11.20%	1,238	0.740	8.87%	- 25.65%	1.19	10.60%
210056	MS Good Sam	6,306	986	15.64%	948	1.040	12.47%	5,345	938	17.55%	876	1.071	12.85%	3.05%	1.01	12.93%
210057	Shady Grove	15,957	1,440	9.02%	1,650	0.873	10.47%	14,241	1,183	8.31%	1,503	0.787	9.44%	- 9.84%	1.05	9.93%
210058	UMROI	462	33	7.14%	36	0.917	11.00%	359	27	7.52%	31	0.860	10.31%	- 6.27%	1.00	10.31%
210060	Ft Wash	1,772	210	11.85%	256	0.820	9.83%	1,441	174	12.07%	220	0.791	9.49%	- 3.46%	1.42	13.46%
210061	Atlantic General	2,569	253	9.85%	348	0.728	8.73%	2,187	234	10.70%	305	0.768	9.21%	5.50%	1.10	10.14%
210062	MS Southern MD	8,153	1,007	12.35%	1,062	0.948	11.37%	8,266	911	11.02%	1,116	0.816	9.79%	- 13.90%	1.29	12.59%
210063	UM-St. Joe	12,031	1,136	9.44%	1,211	0.938	11.25%	10,969	1,040	9.48%	1,185	0.878	10.53%	- 6.40%	1.01	10.67%
210064	Levindale	946	141	14.90%	144	0.980	11.76%	809	101	12.48%	121	0.833	9.99%	- 15.05%	1.00	9.99%
210065	HC-Germantown	3,582	398	11.11%	420	0.948	11.37%	3,942	426	10.81%	470	0.906	10.87%	- 4.40%	1.06	11.52%

Appendix IV. Modeling of Benchmarking

Below please find slides presenting findings from the Benchmarking for readmissions project:

Medicare Benchmarking (Revised)

	Unadjusted Rates	2018 Readmissions Rate			2018 Readmissions per 1000	
		Maryland	Nation	Peer County BM[1]	Maryland	Peer County BM[1]
Performance	Overall (Per CMMI)	15.40%	15.45%			
	MD % Above (Below) National	*(0.32%)*				
	HSCRC Calculated (CCW)	15.47%		15.57%	38.2	39.8
	MD % Above (Below) Benchmark	*(0.64%)*			*(4.07%)*	
	Benchmark 25th Percentile (CCW)	15.47%		14.72%	38.2	34.1
	MD % Above (Below) Benchmark	*5.11%*			*11.97%*	
Opportunity	Benchmark if all MD counties were at or below **benchmark average**	15.47%		15.16%	38.2	37.1
	MD improvement opportunity	*1.98%*			*2.83%*	
	Benchmark if all MD counties were at or below **benchmark 25th percentile**	15.47%		14.53%	38.2	33.1
	MD improvement opportunity	*6.07%*			*13.26%*	

1. Benchmark reflects the straight average of each county's peer counties blended to a state average based on MD admits or beneficiaries

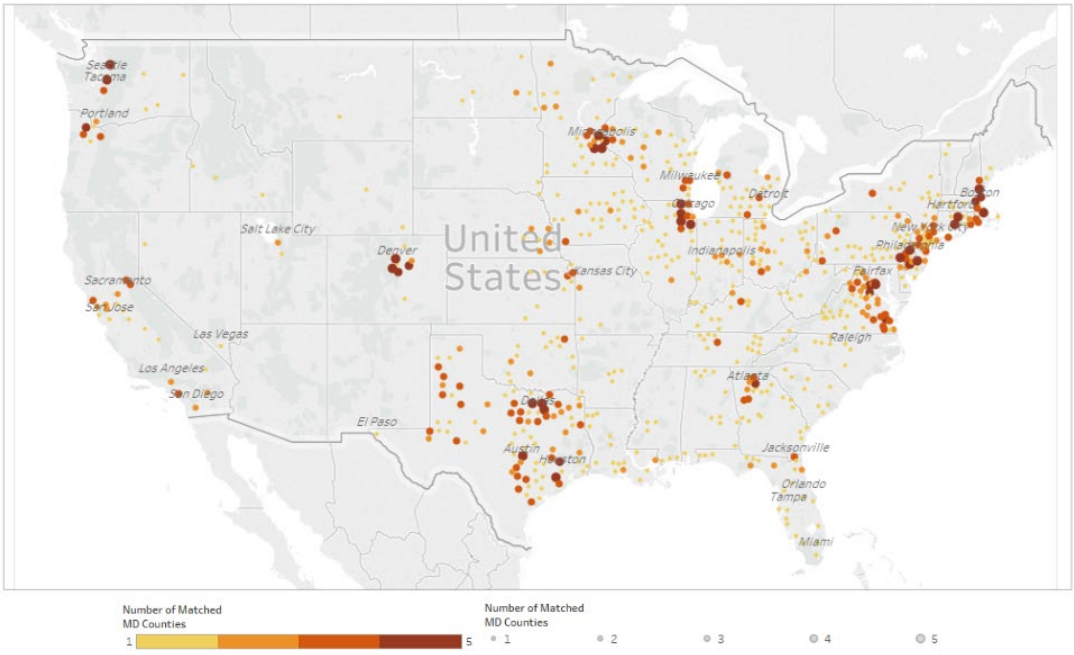
Commercial Benchmarking

	Unadjusted Rates	2017 Readmissions Rate			2017 Readmissions per 1000			
		MD MCDB	Nation[1]	Peer MSA BM[2]	MD MCDB	MD CSHD	Nation[1]	Peer MSA BM[2]
Performance	Overall (Casemix = 6.40%)	6.84%	6.82%	6.98%	2.48	2.64	2.91	3.17
	MD % Above (Below) Nation	*0.23%*			*(14.82%)*	*(9.34%)*		
	MD % Above (Below) Benchmark	*(2.06%)*			*(21.71%)*	*(16.68%)*		
	Benchmark 25th Percentile (CHSD)	6.84%	5.63%	6.53%	2.48	2.64	2.02	2.14
	MD % Above (Below) Benchmark	*4.63%*			*15.93%*	*23.38%*		
Opportunity	Benchmark if all MD MSAs were at or below benchmark average	6.84%		6.72%/	2.48	2.64		2.49/ 2.58
	MD improvement opportunity	*1.76%*			*(0.47%)*	*(2.40%)*		
	Benchmark if all MD MSAs were at or below benchmark 25th percentile	6.84%		6.44%	2.48	2.64		2.14/ 2.11
	MD improvement opportunity	*6.20%*			*16.93%*	*25.34%*		

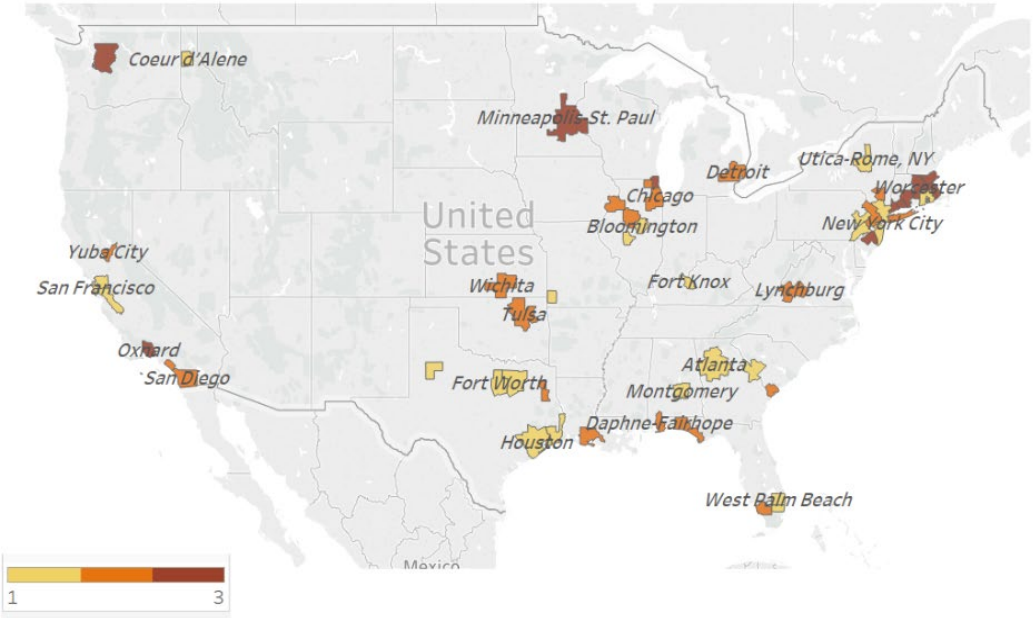
1. Nation reflects the total of the data in the CSHD and may not reflect an accurate balance of national experience
2. Benchmark reflects the straight average of each Modified MSA's peers blended using MCDB admissions or beneficiaries by modified MSA

Below please find maps illustrating the peer counties and peer MSAs for the Benchmarking for Readmissions project:

Medicare - Distribution of Peer Counties for All Maryland Counties



Commercial - Distribution of Peer MSAs



Appendix V. Modeling of Improvement - Attainment by-Hospital

Improvement Column
Improved to Greater than RY 2022 Proposed Target (-3.07%)
Improved to Greater than TCOC Five-Year Proposed Target (-7.5%)
Attainment Column
Achieved readmission rate lower than RY 2022 Proposed Target (65th Percentile, currently 11.23% - subject to change in v37)

		Observed Readm		Expected Readm		Case-Mix Adj Readm Rate				
CMS ID	Hospital Name	2017-10 to 2018-09	2018-10 to 2019-09	2017-10 to 2018-09	2018-10 to 2019-09	2017-10 to 2018-09	2018-10 to 2019-09	Current 12M Improvement	OOS Ratio	Oct18-Sep19 Attainment
210001	MERITUS MEDICAL CENTER	1513	1429	1555	1589	10.94%	10.11%	-7.57%	1.05	10.63%
210002	UNIVERSITY OF MARYLAND	3269	2927	2876	2740	12.78%	12.01%	-6.02%	1.04	12.50%
210003	UM-PRINCE GEORGE'S	1252	1106	1335	1216	10.54%	10.22%	-3.02%	1.20	12.23%
210004	HOLY CROSS HOSPITAL	1983	1987	1923	1975	11.59%	11.31%	-2.44%	1.09	12.27%
210005	FREDERICK	1556	1314	1669	1515	10.48%	9.75%	-6.97%	1.05	10.22%
210006	UM-HARFORD	533	467	556	507	10.78%	10.35%	-3.91%	1.04	10.72%
210008	MERCY MEDICAL CENTER	1120	1100	1026	1021	12.27%	12.11%	-1.30%	1.03	12.45%
210009	JOHNS HOPKINS HOSPITAL	5260	5182	4725	4689	12.51%	12.42%	-0.73%	1.07	13.28%
210010	UM- DORCHESTER	188	142	238	177	8.88%	9.02%	1.56%	1.06	9.52%
210011	ST. AGNES HOSPITAL	1570	1440	1566	1404	11.27%	11.53%	2.30%	1.01	11.59%
210012	SINAI HOSPITAL	1667	1453	1679	1541	11.16%	10.60%	-5.03%	1.01	10.71%
210013	BON SECOURS HOSPITAL	588	540	458	403	14.43%	15.06%	4.37%	1.01	15.25%
210015	MEDSTAR FRANKLIN SQ	2666	2354	2335	2230	12.83%	11.87%	-7.55%	1.01	11.94%
210016	WASHINGTON ADVENTIST	867	831	965	944	10.10%	9.89%	-2.02%	1.16	11.50%
210017	GARRETT COUNTY	122	83	213	177	6.44%	5.27%	-18.13%	1.68	8.83%
210018	MEDSTAR MONTGOMERY	724	619	739	667	11.01%	10.43%	-5.27%	1.07	11.17%
210019	PENINSULA REGIONAL	1643	1346	1730	1598	10.67%	9.47%	-11.31%	1.08	10.27%
210022	SUBURBAN HOSPITAL	1462	1359	1484	1457	11.07%	10.48%	-5.32%	1.11	11.62%
210023	ANNE ARUNDEL	2042	2250	2062	2215	11.13%	11.42%	2.58%	1.03	11.81%
210024	MEDSTAR UNION	1212	1220	1125	1146	12.11%	11.97%	-1.18%	1.01	12.12%
210027	WESTERN MARYLAND	1143	1115	1226	1213	10.48%	10.33%	-1.40%	1.14	11.82%

		Observed Readm		Expected Readm		Case-Mix Adj Readm Rate				
CMS ID	Hospital Name	2017-10 to 2018-09	2018-10 to 2019-09	2017-10 to 2018-09	2018-10 to 2019-09	2017-10 to 2018-09	2018-10 to 2019-09	Current 12M Improvement	OOS Ratio	Oct18-Sep19 Attainment
210028	MEDSTAR ST. MARY'S	615	613	633	666	10.92%	10.35%	-5.26%	1.17	12.09%
210029	JOHNS HOPKINS BAYVIEW	2374	2258	1943	1964	13.73%	12.92%	-5.90%	1.02	13.18%
210030	UM-SHORE CHESTERTOWN	93	49	131	89	7.98%	6.19%	-22.45%	1.16	7.19%
210032	UNION HOSPITAL OF CECIL	512	503	563	542	10.22%	10.43%	2.05%	1.22	12.78%
210033	CARROLL HOSPITAL	1115	1180	1090	1119	11.50%	11.85%	3.09%	1.02	12.04%
210034	MEDSTAR HARBOR	941	816	770	740	13.74%	12.39%	-9.77%	1.01	12.47%
210035	UM-CHARLES REGIONAL	653	656	729	720	10.07%	10.24%	1.72%	1.18	12.11%
210037	UM-SHORE EASTON	537	415	622	543	9.70%	8.59%	-11.48%	1.06	9.07%
210038	UMMC MIDTOWN	744	731	586	595	14.27%	13.81%	-3.23%	1.01	14.00%
210039	CALVERT HEALTH	540	620	608	640	9.98%	10.89%	9.07%	1.11	12.08%
210040	NORTHWEST	1311	1096	1307	1198	11.27%	10.28%	-8.79%	1.02	10.48%
210043	UM-BWMC	1804	2038	1838	2109	11.03%	10.86%	-1.55%	1.02	11.03%
210044	GBMC	1309	1433	1470	1495	10.01%	10.77%	7.64%	1.02	10.94%
210045	MCCREADY	19	13	21	15	10.17%	9.74%	-4.21%	1.00	9.74%
210048	HOWARD COUNTY	1363	1443	1431	1463	10.71%	11.09%	3.55%	1.02	11.27%
210049	UM-UPPER CHESAPEAKE	996	1119	1065	1149	10.51%	10.95%	4.14%	1.03	11.23%
210051	DOCTORS	1045	1103	1196	1340	9.82%	9.25%	-5.79%	1.19	11.05%
210056	MEDSTAR GOOD SAM	1062	1090	942	962	12.67%	12.74%	0.50%	1.01	12.81%
210057	SHADY GROVE ADVENTIST	1543	1433	1725	1648	10.05%	9.77%	-2.79%	1.05	10.28%
210058	UMROI	26	28	37	28	7.90%	11.24%	42.31%	1.00	11.24%
210060	FORT WASHINGTON	194	209	267	252	8.17%	9.32%	14.14%	1.42	13.23%
210061	ATLANTIC GENERAL	311	271	363	335	9.63%	9.09%	-5.58%	1.10	10.01%
210062	MEDSTAR SOUTHERN MD	945	1065	1132	1193	9.38%	10.03%	6.94%	1.29	12.91%
210063	UM-ST. JOSEPH	1257	1307	1353	1328	10.44%	11.06%	5.94%	1.01	11.21%
210064	LEVINDALE	144	112	144	140	11.24%	8.99%	-20.00%	1.00	8.99%
210065	HC-GERMANTOWN	462	509	440	518	11.80%	11.04%	-6.42%	1.06	11.71%

Appendix VI. Statistical Methodology for PAI and Disparity Gap Measure

The below includes a write-up of the methodology, written by Mathematica with edits by the HSCRC.

Overview

This document outlines the key steps required to calculate the Patient Adversity Index (PAI) and the hospital-level disparity gap, which are proposed to be used with the Readmissions Reduction Incentive Program (RRIP). Mathematica implemented this code in SAS, and results were validated and compared with the results HSCRC produced in STATA. The following information gives a summary of the major sections of the SAS program and how to use it.

The PAI is a metric that reflects the association of race, insurance source, and area socio-economic factors with the probability of readmission. As it is operationalized in this code, the PAI is the predicted probability of readmission, calculated for each inpatient record across the universe of eligible discharges. The disparity gap measures the difference in readmission rates between “low” and “high” PAI patients within each hospital. The remainder of this document provides additional details on how these calculations are performed.

Step 1: Data Cleaning

In the Step 1 section of the program, there are multiple input data checks and indicator variables set up to apply exclusions for year, readmission denominator, race, gender, and certain hospital identifiers. At the end of Step 1, the exclusions are applied and saved to a new temporary dataset, which gets used in Step 2.

Step 2: Calculate PAI and Other Model Covariates

At the beginning of the Step 2 section of the program, the Area Deprivation Index (ADI) variable is imputed with the mean value by zip code for any records with missing ADI information. Immediately following the imputation, the ADI variable is standardized so that it has a mean value of 0 and a standard deviation of 1.

In the next section of Step 2, new indicator variables are created that will be used in the PAI modeling step: init_black (black race indicator) and init_med (Medicaid coverage indicator). In development, HSCRC and Mathematica tested multiple specifications for Poisson models to estimate the association between readmissions and the key PAI input variables: black race indicator, Medicaid coverage indicator, and standardized ADI value. In one set of specifications, three separate models were run to estimate the association of each of the input variables with readmissions separately. In the second specification, all three input variables and their interaction terms are included in a single model to predict readmissions. This specification takes into account the likely correlation between the input variables, and also allows for a more

flexible way to estimate the association of these factors with readmission. For this reason, HSCRC decided to estimate PAI and later the disparity gap using the single, interacted model. PAI scores for selected combinations of race, Medicaid status and ADI are shown in Figure below.

Raw PAI score for combination of Medicaid status, race, and ADI value.

ADI	Medicaid	Black	Raw PAI Score
Mean	No	No	REFERENCE
Mean	Yes	No	2.52
Mean	No	Yes	1.48
Mean	Yes	Yes	3.72
Mean + 1SD	No	No	1.30
Mean + 1SD	Yes	No	3.36
Mean + 1SD	No	Yes	2.34
Mean + 1SD	Yes	Yes	4.53

The program calculates predicted values for each model specification, and then standardizes those values – these standardized values are the PAI estimates. As noted above, the PAI values from the single, interacted model are used in the remainder of the calculations.

In the remainder of Step 2, new variables are created which are used in the Step 3 Disparity Gap model. Three variables--soiRisk_centd, age_yrs_centd, sex_centd –are created by centering individual values around the mean of the original variable (severity of illness, age in years, and gender, respectively). PAI_Z_hospMean is the average PAI value at the hospital-level, and PAI_Z_hospCentd is the individual PAI value centered around the hospital average.

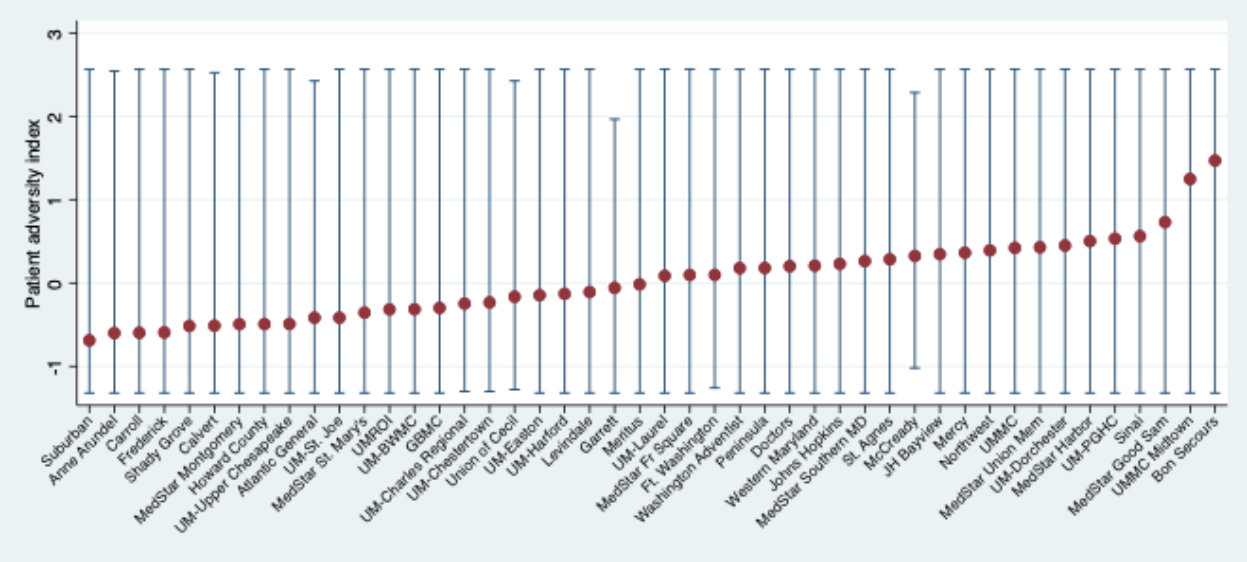
Step 3: Calculate Disparity Gap Measure

Step 3 starts out by limiting the dataset to discharges only for the year of interest (for instance, 2018). Using the limited dataset, a Poisson model is run with unplanned 30-day readmissions as the outcome and the centered variables created at the end of Step 2 as predictors. The model specification includes hospital-level fixed effects, and allows the relationship between PAI and readmissions to vary by hospital. The SAS procedure PROC GLIMMIX is used to calculate fixed effects and a random intercept and random slope for PAI_Z_hospCentered for each hospital. Using the fixed intercept, random slope, and random intercept to measure risk, the disparity gap is calculated as the slope characterizing the relationship between PAI and readmission risk at a given hospital. . For display purposes, the slope may be used to calculate readmission rates at one standard deviation above and below the hospital-specific mean value, along with a risk difference, which describes the gap between low- and high-PAI patients on the same scale as the readmission rate.

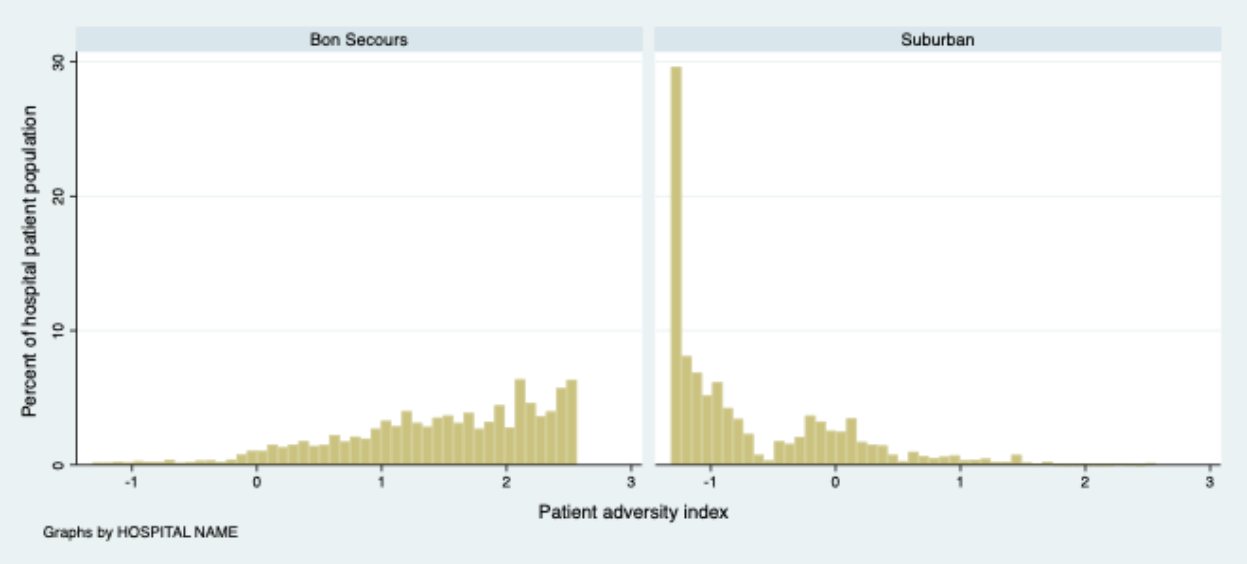
Appendix VII. Modeling of PAI and Disparity Gap

Below are several figures that provide preliminary modeling of the PAI and disparity gap measure.

Figure below shows the range of the Patient Adversity Index by hospital with the average PAI score indicated by the red dot. This illustrates that in general all hospitals see patients with both high and low PAI, although the average PAI for hospitals varies.



The figure below further shows that there is overlapping PAI distributions at two hospitals with differing mean PAI scores.



This table provides preliminary data on the mean PAI value and 2018 disparity gap metric. These values will be updated once policy is finalized and v37 grouper data is available.

Hospital ID	Hospital	Mean PAI	Base Year Disparity Gap
210001	Meritus	0.056	4.223
210002	UMMC	0.397	3.142
210003	UM-PGHC	0.508	2.424
210005	Frederick	-0.594	2.941
210006	UM-Harford	-0.091	3.614
210008	Mercy	0.315	2.962
210009	Johns Hopkins	0.203	2.672
210010	UM-Dorchester	0.493	2.848
210011	St. Agnes	0.268	3.153
210012	Sinai	0.508	2.452
210013	Bon Secours	1.398	3.616
210015	MedStar Fr Square	0.140	3.401
210016	Washington Adventist	0.222	1.959
210017	Garrett	0.066	1.995
210018	MedStar Montgomery	-0.492	4.107
210019	Peninsula	0.222	2.421
210022	Suburban	-0.707	3.381
210023	Anne Arundel	-0.622	3.519
210024	MedStar Union Mem	0.379	3.896
210027	Western Maryland	0.369	2.660
210028	MedStar St. Mary's	-0.333	3.982
210029	JH Bayview	0.386	3.691
210030	UM-Chestertown	-0.201	2.454
210032	Union of Cecil	-0.098	3.394
210033	Carroll	-0.583	4.707
210034	MedStar Harbor	0.529	3.578
210035	UM-Charles Regional	-0.250	2.863
210037	UM-Easton	-0.119	2.427
210038	UMMC Midtown	1.176	2.848
210039	Calvert	-0.499	2.629
210040	Northwest	0.359	3.447
210043	UM-BWMC	-0.296	2.925
210044	GBMC	-0.323	2.842
210045	McCready	0.460	3.042
210048	Howard County	-0.498	3.194
210049	UM-Upper Chesapeake	-0.488	3.340
210051	Doctors	0.170	2.287
210055	UM-Laurel	0.095	3.192
210056	MedStar Good Sam	0.668	2.609
210057	Shady Grove	-0.510	2.978
210058	UMROI	-0.352	2.628
210060	Ft. Washington	0.066	2.490
210061	Atlantic General	-0.399	2.551
210062	MedStar Southern MD	0.240	2.759
210063	UM-St. Joe	-0.431	2.945
210064	Levindale	-0.118	3.267