3M Science. Applied to Life.™

Socioeconomic Status and Health Care Delivery System Performance

3M Clinical and Economic Research

Richard F. Averill, MS
Ronald E. Mills, PhD

November 2021

Table of Contents

Executive Summary

Extensive research has demonstrated that an individual's socioeconomic status (SES) impacts the health care services they receive, health outcomes, patient satisfaction and physician perception of the care and treatment needed. This study evaluated the impact of SES on the performance of health care delivery systems using nine performance measures in four categories:

- **Population:** per capita admissions, per capita emergency department visits
- **Post-Acute Care**: readmissions, return emergency department visits
- **Quality:** inpatient complications, surgical mortality
- **Service Volume:** hospital admissions from the emergency department, admissions to a post-acute care facility, ambulatory visits

The SES component of the Social Vulnerability Index was used to measure SES in 3,140 counties in the United States. Counties were ranked by SES and then assigned to SES percentiles. 2018 Medicare fee-for-service claims data for beneficiaries located in each county was used to evaluate delivery system performance using the nine performance measures.

Delivery system performance in each SES percentile was evaluated by comparing actual delivery system performance for the beneficiaries living in the counties in each SES percentile to a risk-adjusted expected performance using the national average rate for each performance measure as a benchmark. Substantial differences in performance were observed for beneficiaries in the counties comprising the lowest SES quartile in comparison with the performance experienced by beneficiaries residing in counties in the highest SES quartile:

- Delivery system performance in low SES counties was higher than expected and in high SES counties was lower than expected for the population, post-acute care, and quality measures.
- For service volume measures, the converse was observed with delivery system performance in low SES counties being lower than expected and in high SES counties being higher than expected.

The population, post-acute care and quality measures are negative events that a well-functioning health care delivery system should seek to minimize. Beneficiaries in low SES counties have more per capita admissions and emergency department visits, more readmission and post-discharge returns to the emergency department, more inpatient complications, and higher surgical mortality than beneficiaries in high SES counties. These negative events indicate that the health care delivery system is not functioning as intended thereby creating heath care equity concerns.

Performance on the service volume measures can result from under- or overuse of these service with multiple possible root causes including implicit bias, health insurance limitations, and maldistribution of health care services. Irrespective of the underlying root cause, beneficiaries in low SES counties are less like to be admitted from the emergency department for low-severity medical care, less likely to be admitted to a skilled nursing facility or to a rehabilitation facility following hospital discharge and have fewer physician or care management visits than beneficiaries in high SES counties.

When hospitals were ranked by the average SES percentile of the county of residence for patients admitted to the hospital and by the equity component of the Lown Institute Hospitals Index, the

pattern of performance differences across hospitals was relatively consistent with geographic SES results.

Based on substantial delivery system performance differences across SES populations, targeted payment policy reforms have the potential to create financial incentives for improving the functioning of the health care delivery system and improve health equity in low socioeconomic areas.

Beneficiaries in low SES counties have more per capita admissions and emergency department visits, more readmission and post-discharge returns to the emergency department, more inpatient complications, and higher surgical mortality than beneficiaries in high SES counties.

Background

The Biden administration has established health care equity as a major priority:

> "The [CMS] Innovation Center will embed equity in every aspect of its [value based] models by seeking to include more providers serving low- and modest-income, racially diverse, and/or rural populations." [1]

There is extensive research that demonstrates that an individual's socioeconomic status (SES) impacts health care services provided,[2,3] health outcomes,[4,5,6] patient satisfaction[7] and physician perception.[8] In addition, individuals with low SES often have less comprehensive health insurance coverage.

The Centers for Disease Control and Prevention (CDC) has developed the Social Vulnerability Index (SVI)[9] at the state, county, and census tract level to help "public health officials and local planners better prepare communities to respond to emergency events such as severe weather, floods, disease outbreaks, or chemical exposure." The SVI is composed of four subsections, which the CDC refers to as themes:

- Socioeconomic Status
- Household Composition & Disability
- Minority Status & Language
- Housing Type & Transportation

Each theme is composed of multiple factors. For example, four factors impact the socioeconomic status theme:

- below poverty
- unemployed
- income
- no high school diploma

For each factor within a theme, the CDC assigns a percentile rank to the census tracts, with a higher percentile ranking indicating greater vulnerability. These percentiles for individual factors are then

summed and the sums used to determine theme-specific percentile rankings at the state, county, and census tract level.

Objective

The objective of this study is to evaluate the impact of SES on the performance of health care delivery systems. Delivery system performance was evaluated using nine performance measures in four categories:

- **Population**: per capita admissions, per capita emergency department visits
- **Post-Acute Care**: readmissions, return emergency department visits
- **Quality**: inpatient complications, surgical mortality
- **Service Volume**: hospital admissions from the emergency department, admissions to a post-acute facility, per capita ambulatory visits

The SVI Socioeconomic Status theme (SVI SES) was used to measure SES in 3,140 U.S. counties. The SVI SES at the census tract level could not be used because the geographic location of Medicare beneficiaries reported on claims data could not be mapped to the census tract level. In the context of the CDC SVI SES theme, greater vulnerability and a lower socioeconomic status is indicated by a higher SVI SES percentile. This report reordered the SVI SES values to improve readability so that lower SVI SES values equate to a lower socioeconomic status and higher values indicate a higher socioeconomic status.

> The SES component of the Social Vulnerability Index was used to measure SES in 3,140 counties in the United States. Counties were ranked by SES and then assigned to SES percentiles.

Performance Measures

To the extent possible, the study selected performance measures and risk adjustment methods that are actively being used for regulatory purposes such as health care payment. The methodologies collectively referred to as potentially preventable events (PPEs) were included as performance measures:

- Potentially Preventable Admissions (PPAs)[10,11]
- Potentially Preventable Emergency Department Visits (PPVs)[10,12]
- Potentially Preventable Readmissions (PPRs)[13]
- Potentially Preventable Return Emergency Department Visits (PPREDs)
- Potentially Preventable Complications (PPCs)[14]

The PPAs and PPVs were risk adjusted using Clinical Risk Groups (CRGs)[15] and the PPRs, PPREDs and PPCs were risk adjusted using All Patient Refined Diagnosis Related Groups (APR DRGs).[16] The APR DRGs, which include severity of illness and risk of mortality subclasses, are assigned at hospital admission and at discharge. The PPE measures, the CRGs and APR DRGs have substantial regulatory applications and have undergone the scrutiny associated with any regulatory implementation. Appendix A details the number of Medicaid and major commercial payers using

the PPE measures, CRGs and APR DRGs. These methodologies have been widely utilized in health care and evaluated in the medical literature. Appendix B contains a bibliography of articles and reports about PPE, CRG and APR DRG applications.
An integral component of each PPE measure is the identification of those patients whose clinical circumstances are such that there is reasonable likelihood the PPE could have been avoided (referred to as "at-risk" patients). For example, a patient discharged for coronary bypass surgery is considered at risk for a potentially preventable readmission for a complication of the surgery, such as a surgical site infection, but is not considered at risk for a readmission for appendicitis because the appendicitis is not considered potentially preventable.

For each of the PPEs, there is an in-depth specification of the clinical circumstances under which the PPE would be considered potentially preventable. Identifying a PPE as potentially preventable does not mean that it is preventable for a specific patient. It means if there were a systematic pattern of higher-than-expected occurrence of the PPE, there would be concerns about quality of care or delivery system effectiveness. Essentially, the occurrence of a PPE is an end manifestation or outcome of an underlying quality or delivery system problem.

In addition, a measure of 30-day post-inpatient procedure mortality was utilized.[17] Like the PPEs, the 30-day post inpatient procedure mortality only includes at-risk beneficiaries whose clinical circumstances make patient mortality an unexpected event so that a systematic pattern of higher-than-expected mortality would raise concerns regarding quality of care or delivery system effectiveness.

The PPEs and the 30-day post-inpatient procedure mortality measure are negative events which a well-functioning delivery system should seek to minimize. When rates of these measures are higher than expected, it indicates a delivery system that is not functioning as intended.

The PPEs and the 30-day post-inpatient procedure mortality measure are negative events which a well-functioning delivery system should seek to minimize. When rates of these measures are higher than expected, it indicates a delivery system that is not functioning as intended.

Three measures of service volume were also evaluated:

- non-surgical, low-severity admissions from the emergency department
- 4-day post-acute admission to a skilled nursing or rehabilitation facility[18]
- per capita ambulatory physician and care management visits

Unlike the PPEs and the 30-day post-inpatient procedure mortality measure, service volume measures can have multiple interpretations. A lower-than-expected service volume rate could be caused by underutilization (a quality-of-care problem) and a higher-than-expected rate could be caused by overutilization (unnecessary expenditures). By simultaneously evaluating the PPEs, surgical mortality and the service volume measures, health care facilities can achieve more targeted insights into potential quality and delivery system problems. For example, a lower-than-expected rate of per capita ambulatory visits in the context of higher-than-expected rates of per capita hospital admissions and emergency department visits would raise questions concerning access to primary care.

Table 1 contains a summary overview of the PPEs, surgical mortality and the service volume measures. Appendix C contains a more detailed description of each of the PPEs, the 30-day post-inpatient procedure mortality measure and each of the service volume measures.

Table 1: Description of Performance Measures

Performance Measure	Methodology	At Risk	Risk Adjustment
Population			
Hospital Admissions	Potentially Preventable Admissions (PPAs)	PPA potentially preventable logic	Clinical Risk Groups (CRGS)
ED Visits	Potentially Preventable Emergency Department Visits (PPVs)	PPV potentially preventable logic	Clinical Risk Groups (CRGS)
Post-acute Care			
Readmissions (PPRs)	PPR within 30 days of hospital discharge	PPR potentially preventable logic	Discharge APR DRG with Severity of Illness Subclasses
Return ED Visits (PPRED)	PPRED within 30 days of hospital discharge	PPRED potentially preventable logic	Discharge APR DRG with Severity of Illness Subclasses
Quality			
Inpatient Complications (PPCs)	One or more PPCs during a hospital admission	PPC potentially preventable logic	Admission APR DRG with Severity of Illness Subclasses
Inpatient Surgical Mortality	Death within 30 days of an inpatient procedure	Excludes Admission APR DRG Risk of Mortality Level 4	Admission APR DRG with Risk of Mortality Subclasses
Service Volume			
Hospital Admission from the ED	Short Stay Non-Surgical Hospital Admissions from the Emergency Department	Excludes Admission APR DRG Severity of illness Level 3 and 4	Admission APR DRG with Severity of Illness Subclasses
Post Hospital Discharge Facility Admission	Admission to a skilled nursing or rehabilitation facility within four days of hospital discharge	Excludes Patients with discharge status inconsistent with PAC Admission	Discharge APR DRG with Severity of Illness Subclasses
Ambulatory Visits	Any ambulatory visit with an Evaluation and Management code	Excludes inpatients and emergency department visits	Clinical Risk Groups (CRGS)

Risk Adjustment and Expected Values

The nine performance measures were risk adjusted using APR DRGs or CRGs. Appendix C contains a more detailed description of the two methodologies. Both methods of risk adjustment are categorical clinical models. A categorical clinical model is composed of mutually exclusive and exhaustive clinically meaningful risk categories. Each beneficiary can be assigned to only a single risk category. A categorical clinical model allows the rate of occurrence of a performance measure in each risk category to be compared to the rate of occurrence of the performance measure in a reference population (norm) such as a national database.

A national norm for each performance measure was calculated by summing the actual value of each performance measure in each risk category across all Medicare beneficiaries at risk (referred to as the national norm value for the performance measure) and then computing the mean rate per at-risk beneficiary. For each performance measure, the expected value (E) for any subset of beneficiaries (e.g., beneficiaries in low SES counties) is the number of at-risk beneficiaries in each risk category times the national norm value for the risk category summed overall risk categories (indirect rate standardization.) The difference between the actual value (A) and the expected value (E) represents good performance if (A-E) is negative (A<E) and poor performance if (A-E) is positive (A>E). %(A-E)/E is the percent by which the actual performance is lower than expected (%(A-E)/E is negative) or higher than expected (%(A-E)/E is positive). Comparison to a reference norm is critical because even the best performing delivery systems providing optimal care will have an underlying rate of performance issues.

Computing a risk-adjusted expected value in this way assures the comparison to actual performance is based on a performance level that is achievable and not based on an unattainable theoretical standard performance level. By limiting the determination of performance differences to beneficiaries at risk for a potentially preventable event, and by limiting the analysis to the difference between actual performance and expected performance based on a national risk-adjusted norm, the study identified differences in performance that should be amenable to change and are real opportunities for delivery system improvement.

Data

The study used data in the Medicare Standard Analytic Files (Limited Data Set (LDS)) for calendar years 2017 and 2018. The LDS files contain 100% of Medicare fee-for-service (FFS) claims data for inpatient, outpatient, skilled nursing facilities and home health agencies. The LDS carrier file contains Medicare FFS claims data for professional providers, including physicians, physician assistants, clinical social workers, and nurse practitioners for a random sample of five percent of Medicare beneficiaries. The LDS Master Beneficiary Summary File (MBSF) contains enrollment data on all Medicare beneficiaries enrolled in or entitled to Medicare within a given calendar year.

Claims data for 2018 was used for the hospital and emergency department measures and included only hospitals paid under the inpatient prospective payment system (IPPS). Beneficiaries were assigned to a county based on the residence of the beneficiary and not the location of the hospital where the beneficiary was treated.

For the population measures, it was necessary to build a complete longitudinal record of all FFS claims for each Medicare beneficiary. Because the LDS carrier file was limited to a five percent sample of Medicare beneficiaries, the data used for the population measures was limited to the beneficiaries in the LDS carrier file. The carrier file is a sample of all types of beneficiaries including beneficiaries in Medicare Advantage plans. To create a sample of just FFS beneficiaries, MBSF data was used to apply the following edits:

- Exclude beneficiaries who were not enrolled in both Medicare Part A and B for the full year (i.e., newly enrolled, disenrolled or reported died).
- Exclude beneficiaries who were enrolled in a managed care plan for one or more months.
- Exclude beneficiaries who were enrolled in hospice.

Calendar year 2017 was used to assign the CRG risk category to each beneficiary and calendar year 2018 was used to assign the population measures to each beneficiary. Depending on the hospital

performance measure, the admission APR DRG or discharge APR DRG was used with either the severity of illness subclasses or risk of mortality subclasses (see Table 1 for details).

The 2018 SVI percentiles for each of 3,140 U.S. counties for the SES theme were used to define the socioeconomic status of the county in which each beneficiary resided. Beneficiaries for whom there was no match for the county reported in the MBSF and no match in the SVI county data were excluded from the analysis (3.5% of beneficiaries).

Results

The results are displayed by counties in the SES quartiles plus the lower and upper 10% SES decile. Table 2 contains summary statistics for each of the SES percentiles. In contrast to high SES counties, the low SES counties have fewer beneficiaries per county, fewer hospitals, more dual eligible enrollees and more minority beneficiaries. The percent of dual eligible in low SES counties is nearly triple the percent of dual eligible in high SES counties. The percent of minorities in low SES counties is more than triple the percent of minorities in high SES counties.

The income eligibility limit for Medicaid varies from state to state and can be expressed as a percent of the federal poverty level (FPL). Each beneficiary was assigned the Medicaid eligibility limit for a family of three based on criteria for full Medicaid eligibility in the state in which they reside and expressed as a percent of the FPL for 2018.[19] In Table 2, the row labeled "Eligibility %FPL" contains the average Medicaid eligibility percent FLP for the beneficiaries in each SES percentile. Beneficiaries in counties with lower SES tend to live in states with a lower Medicaid eligibility income limit, making it more difficult to qualify for Medicaid from an income perspective.

Table 2: Summary statistics for counties by SES percentile

	Low SE Status				High SE Status	
Measure	SE SVI 0-10%	SE SVI 0-25%	SE SVI 25-50%	SE SVI 50-75%	SE SVI 75-100%	SE SVI 90-100%
Counties	314	785	785	785	785	315
Beneficiaries	2,375,138	7,050,145	16,917,507	19,853,911	16,778,787	7,054,670
Benef/County	7,564	8,981	21,551	25,292	21,374	22,396
Hospitals	193	546	962	1,007	773	317
% Dual Eligible	33.0	27.8	22.3	16.9	12.1	10.5
% White	67.9	72.5	74.0	81.8	85.0	87.2
% Black	18.3	18.1	14.2	9.8	5.6	4.6
% Hispanic	8.0	4.6	4.5	2.3	1.2	1.0
Eligibility %FPL	88.2	88.5	96.5	102.1	108.9	113.2

Performance Measures by SES Percentiles

Table 3 contains the %(A-E)/E for each performance measure for the counties in each of the SES percentiles. The bottom SES decile of 7.5 indicates that the number of potentially preventable hospital admissions is 7.5% higher than expected based on the risk-adjusted national rate. Conversely, the -4.5 in the top SES decile means that the number of potentially preventable hospital admissions is 4.5% lower than expected based on the risk-adjusted national rate. For ease of reading, performance above expected is shaded in red and below expected is shaded in green.

Table 3: %(A-E)/E for performance measures by SES percentile of counties

Measure	Low SE Status				High SE Status	
	SES 0-10%	SES 0-25%	SES 25-50%	SES 50-75%	SES 75-100%	SES 90-100%
Population						
Hospital Admissions (PPAs)	7.5	7.2	1.7	-2.0	-2.7	-4.5
ED Visits (PPVs)	3.3	3.3	1.0	0.9	-3.5	-6.1
Post-acute Care						
Readmissions (PPR)	6.1	4.0	3.0	-0.8	-4.1	-5.1
Return to ED (PPRED)	5.9	6.9	0.3	0.9	-4.2	-5.7
Quality						
Inpatient Complications (PPC)	1.8	1.4	1.5	-0.4	-1.7	-0.6
Surgical Mortality	6.3	8.1	0.0	1.9	-5.8	-9.3
Service Volume						
ED Admits	-10.5	-10.0	-0.3	0.7	4.7	7.6
PAC Facility Admissions	-12.8	-9.3	-2.1	1.6	4.3	6.6
Ambulatory Visits	-6.0	-6.5	-1.2	2.4	1.3	2.6

Beneficiaries in counties with lower SES experience higher-than-expected rates of PPEs and surgical mortality while beneficiaries in counties with higher SES experience lower-than-expected rates for these measures. The PPEs and surgical mortality are negative events which a well-functioning delivery system should seek to minimize. Beneficiaries in low SES counties have more per capita admissions and emergency department visits, more readmission and post-discharge returns to the emergency department, more inpatient complications, and higher surgical mortality than beneficiaries in high SES counties—all indicating that a health care delivery system is not functioning as intended, thereby creating heath care equity concerns.

For service volume measures, the converse is observed. Beneficiaries in counties with lower SES experience lower-than-expected rates of the service volume measures while beneficiaries in counties with higher SES experience higher-than-expected rates for these measures. Performance on service volume measures can reflect under- or overuse of these service with multiple possible root causes including implicit bias, health insurance limitations, and maldistribution of health care services. Irrespective of the underlying root cause, beneficiaries in low SES counties are less likely to be admitted from the emergency department for low severity medical care, less likely to be admitted to a skilled nursing facility or to a rehabilitation facility following hospital discharge and have fewer physician or care management visits than beneficiaries in high SES counties.

Geographic Concentration of Low SES Counties

Only 11.6% of all beneficiaries live in the 25% of counties that comprise the bottom SES quartile. The counties in the bottom SES quartile are highly concentrated in the three southern census regions (South Atlantic, East South Central and West South Central).* The southern region contains 80.5% of counties in the bottom SES quartile and 61.6% of all beneficiaries who live in counties in the bottom SES quartile.

Because the counties in the bottom SES quartile are so concentrated in the southern region, Table 4 compares measure performance in the bottom and top quartile for the southern region against

* FL, GA, SC, NC, VA, WV, DC, MD, DE, KY, TN, AL, MS, TX, OK, AR, LA

the rest of the nation. For the bottom SES quartile, the national and southern performance measure results are consistent, but with the PPE and surgical mortality measure performance slightly more above expected and service volume results slightly more below expected for the southern region. The most significant difference is in surgical mortality which is 14.1% above expected for the southern region. Since the %(A-E)/E is based on a comparison to the nation's average rates, the results for the northern and western census regions were generally closer to expected than the national results reported in Table 3. For the top SES quartile, the national and southern performance measure results are generally consistent.

Table 4: %(A-E)/E for performance measures by SES percentile of counties for southern census regions versus the north and west census regions

	Low SES				High SES		
Measure	US	South	N & W		US	South	N & W
Population							
Hospital Admissions	7.2	8.0	5.6		-2.7	1.2	-4.0
ED Visits	3.3	4.1	1.7		-3.5	-0.9	-4.3
Post-acute Care							
Readmissions	4.0	3.9	4.3		-4.1	-3.9	-4.2
Return to ED	6.9	8.3	4.4		-4.2	-3.8	-4.4
Quality							
Inpatient Complications	1.4	1.8	0.8		-1.7	-7.4	0.2
Surgical Mortality	8.1	14.1	-3.1		-5.8	-0.9	-7.5
Service Volume							
ED Admits	-10.0	-13.2	-3.5		4.7	2.1	5.7
PAC Facility Admissions	-9.3	-10.8	-6.5		4.3	-2.3	6.4
Ambulatory Visits	-6.5	-6.8	-6.1		1.3	10.3	-1.8

Hospital Performance Across SES Populations

The analysis focused on the impact of SES on delivery system performance across geographic areas. Six of the measures can be used to evaluate performance of individual hospitals: PPRs, PPCs, PPREDs, surgical mortality, PAC facility admissions and low severity admissions from the Emergency Department (ED). The study computed the average SES percentile of the county of residence for patients admitted to individual hospitals. Hospitals were then ranked based on the average SES percentile of their patients from highest to lowest. The bottom 25th percentile contains hospitals with the greatest percent of patients from counties with a low SES.

In addition to the SES ranking of hospitals, the equity component of the Lown Institute Hospitals Index was also assigned to each hospital.[20] Developed by the Lown Institute, a nonpartisan research group, the Lown Institute Hospitals Index measures hospital social responsibility by examining and ranking performance across health outcomes, value and equity.

The equity component of the Lown Index is based on the following factors:

- **Inclusivity**: race, income, education
- **Pay Equity**: executive compensation versus worker compensation
- **Community Benefit**: charity care, community investment, Medicaid volume

Although the Lown Index includes some aspects of SES, it offers a broader characterization of the role a hospital plays in the community. The Lown Index assigns hospitals an A-D equity rating with A being the highest equity hospitals and D being the lowest equity hospitals. The performance measures are computed for hospitals in the 2018 data. The Lown Index for hospitals in 2020 was utilized. Due to hospital closures, openings, mergers, demergers and reclassifications, 11.6% of hospitals were not included in both the 2020 Lown index and the 2018 claims data and were excluded from the analysis.

Table 5 contains the %(A-E)/E for the six hospital performance measures for the 0-25 and 75-100 SES percentiles of hospitals and the Lown Index A and D rated hospitals. A Lown equity A rating would be expected to result in higher engagement with low SES populations.

Table 5: %(A-E)/E for performance measures by SES percentile of hospitals and by Lown Institute Index equity rating of hospitals

	Low SES	High Equity		Low Equity	High SES
Measure	SES 0-25%	Lown A		Lown D	SES 75-100%
Post-acute Care					
Readmissions (PPR)	4.5	5.9		-2.5	-4.2
Return to ED (PPRED)	7.2	4.8		-9.5	-3.1
Quality					
Inpatient Complications (PPC)	-0.5	1.6		3.3	-0.1
Surgical Mortality	15.4	5.8		-13.6	-7.2
Service Volume					
ED Admits	-9.5	-6.6		18.0	4.1
PAC Facility Admissions	-4.6	0.0		-0.3	6.4

As shown in Table 5, the hospital SES percentile and Lown Index rating were consistent with each other and with the geographic SES results in Table 3 for PPRs, PPREDs, surgical mortality and low severity admissions from the ED. Hospitals with the greatest percent of patients from counties with low SES (the bottom 0-25th percentile) and hospitals with a Lown Index A rating (high equity) had higher-than-expected performance for PPRs, PPREDs and surgical mortality but lower-than-expected performance for low severity admissions from the ED. For example, surgical mortality was 15.4% higher than expected for hospitals with the greatest percent of patients from counties with low SES, and 5.8% higher than expected for hospitals with a Lown Index equity A rating. For PAC facility admissions, the hospital SES results were consistent with the geographic SES results but showed no performance difference with the Lown Index rating. Only one measure—PPCs—revealed some inconsistencies with the geographic SES results, but PPC performance differences were very small for the geographic SES results, hospital SES results and Lown Index rating. While SVI SES and the Lown Index are similar, they measure different aspects of a hospital's performance. 40.7% of the Lown Index A-rated hospitals were in the bottom 0-25th percentile for SES and 54.3% of the Lown Index D-rated hospitals were in the top 75-100 percentile for SES. Overall, the pattern of performance is relatively consistent for the geographic SES results, hospital SES results and Lown Index rating. This consistent pattern of performance for low SES beneficiaries is an illustration of the health equity issues in the health care delivery system.

Discussion

The data in Table 3 demonstrates that health care delivery system performance is different for low SES and high SES geographic regions. The PPE and surgical mortality measures are limited to beneficiaries at risk for these potentially preventable events. Performance differences are also limited to the difference between actual performance and expected performance based on comparison to the national risk-adjusted rate. This two-tier filtering of beneficiaries for identifying performance differences is very different than comparing raw rates of measures like admissions and readmissions. As a result, performance differences identified in this study should be amenable to change and represent significant opportunities for delivery system improvement.

The performance issues identified for low SES geographic regions reflects health care delivery systems that are not functioning as intended, thus creating heath care equity concerns. Solutions will inevitably require greater financial investment in low SES areas. There are two approaches to providing greater financial investment in these areas:

- Incorporate SES factors into the risk adjustment methodology thereby increasing the risk-adjusted payment levels for beneficiaries from low SES areas.
- Incorporate a SES geographic payment adjustment factor into the payment system.

The first option is a beneficiary-specific payment adjustment and the second is a payment adjustment based on geographic area. The intent of both approaches would be allocation of additional funds to providers to improve delivery system effectiveness (e.g., open more primary care clinics). There is no guarantee, however, that the additional funds would be used for such purposes.

If risk adjustment methodologies incorporated SES factors, performance problems associated with care provided to lower SES beneficiaries would essentially be hidden, making poor performance (e.g., higher readmission rates) appear acceptable for these beneficiaries. If hospitals are to achieve improved performance for lower SES beneficiaries, it is essential that areas of poor performance be highlighted and not hidden within the risk adjustment methodology.

The geographic area specific payment adjustment would be similar to the Disproportionate Share Hospital (DSH) payment adjustment in IPPS. Unlike the DSH payment adjustment, however, the additional SES funding should be contingent on performance improvement based on core performance measures such as those used in this report. Given the varying success of some value-based incentive programs,[21] such an incentive-based approach would need to be carefully designed and incorporate the attributes of successful payment reform initiatives.[22]

The performance issues identified for low SES geographic regions reflects health care delivery systems that are not functioning as intended, thus creating heath care equity concerns. Solutions will inevitably require greater financial investment in low SES areas.

Based on substantial delivery system performance differences across SES populations, targeted payment policy reforms have the potential to create financial incentives for improving health care delivery system performance and health equity in low socioeconomic areas.

SES was identified at the county level. Many counties are composed of fairly diverse SES populations. For example, the median family income in Fairfield County, Connecticut varies by a factor seven across the cities and towns in the county.[23] Because the analysis was performed at the county level and not the census tract level, the results likely underestimate the magnitude of performance differences associated with SES.

Summary and Conclusions

Prior research has established that an individual's socioeconomic status impacts the amount, type and quality of health care services they receive. The socioeconomic status component of the CDC Social Vulnerability Index was used to rank 3,140 counties across the U.S. Using nine measures of performance, health care delivery system effectiveness was evaluated for low socioeconomic status and high socioeconomic status geographic regions. The study found that low SES counties were disproportionately located in the three southern census regions. For negative events such as an avoidable hospital admission or surgical mortality, beneficiaries experience higher-than-expected rates if they reside in counties with lower SES. For service volume measures such as ambulatory physician and care management visits, beneficiaries in counties with lower SES experience lower-than-expected rates. When hospitals were ranked by the average SES percentile of the county of residence for patients admitted to the hospital and by the equity component of the Lown Institute Hospitals Index, the pattern of performance difference was relatively consistent with the geographic SES results. The performance issues identified for low SES geographic regions indicates that the health care delivery system is not functioning as intended in low SES counties thereby creating heath care equity concerns. Targeted payment policy reforms have the potential to provide financial incentives to improve the functioning of the health care delivery system in low socioeconomic areas.

References

[1] Brooks-LaSure, C., Fowler, E., Seshamani, M. & Tsai, D. (2021, August 12). Innovation at the Centers for Medicare and Medicaid Services: A vision for the next 10 years. *Health Affairs Blog*. https://www.healthaffairs.org/do/10.1377/hblog20210812.211558/full/

[2] Agency for Healthcare Research and Quality (AHRQ). (2013, May). *National Healthcare Disparities Report 2014*. U.S. Department of Health and Human Services. https://www.ahrq.gov/research/findings/nhqrdr/index.html

[3] Begley, C., Basu, R., Lairson, D., Reynolds, T., Dubinsky, S., Newmark, M., Barnwell, F., Hauser, A. & Hesdorffer, D. (2011, February 14). Socioeconomic status, health care use, and outcomes: Persistence of disparities over time. *Epilepsia*, *52* (5), 957-964. https://doi.org/10.1111/j.1528-1167.2010.02968.x

[4] Janati, A., Matlabi, H., Allahverdipour, H., Gholizadeh, M. & Abdollahi, L. (2011). Socioeconomic status and coronary heart disease. *Health Promotion Perspectives*, *1* (2), 105-110. https://doi.org/10.5681/hpp.2011.011

[5] Agardh, E., Allebeck, P., Hallqvist, J., Moradi, T. & Sidorchuk, A. (2011, June). Type 2 diabetes incidence and socio-economic position: A systematic review and meta-analysis. *International Journal of Epidemiology*, *40* (3), 804-818. https://doi.org/10.1093/ije/dyr029

[6] Bernheim, S.M., Spertus, J.A., Reid, K.J., Bradley, E.H., Desai, R.A., Peterson, E.D., Rathore, S.S., Normand, S.T., Jones, P.G., Rahimi, A. & Krumholz, HM. (2007, February). Socioeconomic disparities in outcomes after acute myocardial infarction. *American Heart Journal 153* (2), 313-319. https://doi.org/10.1016/j.ahj.2006.10.037

[7] Foraker, R.E., Rose, K.M., Chang, P.P., McNeill, A.M., Suchindran, C.M., Selvin, E. & Rosamond, W.D. (2011, November). Socioeconomic status and the trajectory of self-rated health. *Age and Ageing, 40* (6), 706-711. https://doi.org/10.1093/ageing/afr069

[8] Bernheim, S.M., Ross, J.S., Krumholz, H.M. & Bradley, E.H. (2008, Jan-Feb). Influence of patients' socioeconomic status on clinical management decisions: a qualitative study. *Annals of Family Medicine, 6* (1), 53-59. https://doi.org/10.1370/afm.749

[9] Centers for Disease Control & Prevention (CDC). (2020, January 31). *CDC SVI 2018 Documentation*. CDC Agency for Toxic Substances and Disease Registry (ATSDR). https://www.atsdr.cdc.gov/placeandhealth/svi/documentation/SVI_documentation_2018.html

[10] Goldfield N., Kelly W.P., Patel K. (2012, Oct-Dec). Potentially Preventable Events: An actionable set of measures for linking quality improvement and cost savings. *Quality Management in Health Care, 21* (4), 213-219. https://doi.org/10.1097/qmh.0b013e31826d1d3a

[11] Averill, R.F., Fuller, R.L. & Mills, R.E. (2021, January). *Geographic variation in hospital admission rates in the Medicare population.* 3M Clinical and Economic Research. https://multimedia.3m.com/mws/media/2044671O/geographic-variation-hospital-admission-rates.pdf

[12] Averill, R.F., Fuller, R.L. & Mills, R.E. (2021, March). *Geographic variation in hospital emergency department visits in the Medicare population.* 3M Clinical and Economic Research.

https://multimedia.3m.com/mws/media/2044668O/geographic-variation-emergency-department-visits.pdf.

[13] Goldfield N.I., McCullough E.C., Hughes, J.S., Tang, A.M., Eastman, B., Rawlins, L.K. & Averill, R.F. (2008, Fall). Identifying potentially preventable readmissions. *Health Care Financing Review, 30* (1), 75-91. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4195042/

[14] Hughes, J.S., Averill, R.F., Goldfield, N.I., Gay, J.C., Muldoon, J., McCullough, E.C. & Xiang, J. (2006, Spring). Identifying potentially preventable complications using a present on admission indicator. *Health Care Financing Review 27* (3), 63-82. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4194950/

[15] Hughes, J.S., Averill, R.F., Eisenhandler, J., Goldfield, N.I., Muldoon, J., Neff, J.M. & Gay, J.C. (2004, January). Clinical Risk Groups (CRGs): A classification system for risk-adjusted capitation-based payment and health care management. *Medical Care, 42* (1):81-90. https://doi.org/10.1097/01.mlr.0000102367.93252.70

[16] Averill, R.F., Goldfield, N.I., Muldoon, J., Steinbeck, B.A. & Grant, T.M. (2002, January). A closer look at All-Patient Refined DRGs. *Journal of AHIMA, 73* (1):46-49.

[17] Averill, R.F., Fuller, R.L. & Mills, R.E. (2020, September). *Surgical mortality as a measure of hospital quality*. 3M Clinical and Economic Research. https://multimedia.3m.com/mws/media/2044672O/surgical-mortality-hospital-quality.pdf

[18] Averill, RF, Fuller, RL, Mills, RE. (2021, June). *Geographic variation in post-acute care facility admissions*. 3M Clinical and Economic Research. https://multimedia.3m.com/mws/media/2051382O/report-geographic-variation-in-post-acute-care-facility-admissions.pdf.

[19] Kaiser Family Foundation *Medicaid Income Eligibility Limits for Parents, 2002-2021.* https://www.kff.org/medicaid/state-indicator/medicaid-income-eligibility-limits-for-parents/?currentTimeframe=0&selectedDistributions=january-2018&selectedRows=%7B%22states%22:%7B%22all%22:%7B%7D%7D,%22wrapups%22:%7B%22united-states%22:%7B%7D%7D%7D&sortModel=%7B%22colId%22:%22Location%22,%22sort%22:%22asc%22%7D

[20] Saini, V., Brownlee, S., Gopinath, V., Smith, P., Chalmers, K. & Garber, J. (2021). *2021 Methodology Lown Institute Hospitals Index for Social Responsibility*. The Lown Institute. https://lownhospitalsindex.org/wp-content/uploads/2021/09/2021_Methodology_9-21-21.pdf

[21] U.S. Government Accountability Office. (2015, October 1). *Hospital value-based purchasing: Initial results show modest effects on Medicare payments and no apparent change in quality-of-care trends.* https://www.gao.gov/products/gao-16-9

[22] Averill, R., Hughes, J. & Goldfield, N. (2011, April). Paying for outcomes, not performance: Lessons from the Medicare inpatient prospective payment system. *The Joint Commission Journal on Quality and Patient Safety, 37* (4), 184-192.

[23] List of Connecticut locations by per capita income. (2021, October 29). In *Wikipedia*. https://en.wikipedia.org/wiki/List_of_Connecticut_locations_by_per_capita_income#:~:text=Counties%20%20%20%20Rank%20%20%20,%20%20%2484%2C170%20%206%20more%20rows%20

Appendix A: State Medicaid Agencies and Major Commercial Payers Utilizing the Performance Measures and Risk Adjustment Methodologies for Payment or Reporting

Methodology	Payment	Reporting	Application
Measures			
Potentially Preventable Admissions (PPAs)	10	3	Per Capita Admissions in a Population
Potentially Preventable Emergency Department Visits (PPVs)	9	4	Per Capita Emergency Department Visits in a population
Potentially Preventable Readmissions (PPRs)	12	11	Identification of Readmissions following Hospital Discharge
Potentially Preventable Return Emergency Department Visits (PPREDs)	0	1	Identification of ED Visits following Hospital Discharge
Potentially Preventable Complications (PPCs)	5	4	Identification of Complications for inpatients
Risk Adjustment			
All Patient Refined DRGs (APR DRGs)	40	4	Inpatient Risk Adjustment
Clinical Risk Groups (CRGs)	10	6	Population Risk Adjustment

Appendix B: Bibliography of Publicly Available Articles and Reports – PPAs, PPVs, PPCs, PPRs, PPREDs, CRGs, APR DRGs

All articles and reports are publicly available and are listed in chronological order. The opinions and conclusions in these articles and reports are solely those of the authors.

Potentially Preventable Admissions (PPAs)

Articles, Reports, and Book Chapters

Fuller RL, Clinton S, Goldfield NI, Kelly WP. Building the affordable medical home. J Ambul Care Manage. 2010;33(1):71-80.

Goldfield N, Kelly W, Patel K. Potentially Preventable Events: an actionable set of measures for linking quality improvement and cost savings. Qual Manage Health Care. 2012;21(4):213-219.

Millwee B, Goldfield N, Averill R, Hughes J. Payment system reform: one state's journey. J Ambul Care Manage. 2013;36(3):199-208.

Medicare Payment Advisory Commission. Feasibility of measuring population-based outcomes: potentially preventable admissions and emergency department visits. Online Appendix 3A in Report to the Congress: Medicare and the Health Care Delivery System. Washington, DC: MedPAC, June 2014.

3M Health Information Systems. The 3M Value Index Score: Measurement and Evidence. Murray, UT: 3M HIS, 2015.

Bernstein AB. Potentially Preventable Events: Comparing Medicaid and Privately Insured Populations. Presentation to the Medicaid and CHIP Payment and Access Commission. Washington, DC: MACPAC, Dec. 15, 2015.

Minnesota Department of Health. An Introductory Analysis of Potentially Preventable Health Care Events in Minnesota. St. Paul. MN: MNDOH, 2015.

Minnesota Department of Health. An Introductory Analysis of Potentially Preventable Health Care Events in Minnesota: Supplemental Technical Information. St. Paul. MN: MNDOH, 2015.

DuBard CA. Key Performance Indicators of Cost and Utilization for Medicaid Recipients Enrolled in Community Care of North Carolina. N C Med J. 2016;77(4):297-300.

Quinn K, Weimar D, Gray J, Davies B. Thinking about clinical outcomes in Medicaid. J Ambul Care Manage. 2016;39(2).

Florida Agency for Health Care Administration. Analysis of Potentially Preventable Healthcare Events of Florida Medicaid Enrollees: July 2015 to June 2016. Tallahassee, FL: AHCA, Winter 2017.

Florida Agency for Healthcare Administration. Analyzing Potentially Preventable Healthcare Events of Florida Medicaid Enrollees. Tallahassee, FL: AHCA, Spring 2017.

Myers & Stauffer. Cost Effectiveness Study Report for Mississippi Coordinated Access Network (MississippiCAN). Report to the Mississippi Division of Medicaid. Windsor, CT: Myers & Stauffer, 2017.

University of Florida, Institute for Child Health Policy. Texas Medicaid Managed Care and CHIP Smmary of Activities and Trends in Healthcare Quality. Tallahassee, FL: ICHP, 2017.

Florida Agency for Health Care Administration. Analysis of Potentially Preventable Healthcare Events of Florida Medicaid Enrollees 2015-2016 and 2016-2017. Tallahassee, FL: AHCA, Winter 2018.

North Carolina Department of Health and Human Services. Plan for Implementation of Hospital Quality Outcomes Program and PHP Quality Outcomes Program. Report to the Legislature. Raleigh, ND: NCDHHS, Sept. 28, 2018.

Fuller RL, Goldfield NI, Hughes JS, McCullough EC. Nursing home compare star rankings and the variation in potentially preventable emergency department visits and hospital admissions. Popul Health Manage. Epub ahead of print. July 30, 2018.

Millwee B, Goldfield N, Turnipseed J. Achieving improved outcomes through value-based purchasing in one state. Am J Med Qual. 2018;33(2):162-171.

Millwee B, Quinn K, Goldfield N. Moving toward paying for outcomes in Medicaid. J Ambul Care Manage. 2018;41(2):88-94.

Florida Agency for Health Care Administration. Analysis of Potentially Preventable Healthcare Events of Florida Medicaid Enrollees 2015-2016 and 2016-2017. Tallahassee, FL: AHCA, Winter 2018.

Texas External Quality Review Organization. Quality, Timeliness, and Access to Health Care for Texas Medicaid and CHIP Recipients: Summary of Activities Calendar Year 2017. Austin, TX: Texas EQRO, n.d.

Websites

Pennsylvania Department of Human Services. Hospital Assessment Initiative. Fiscal Year (FY) 2018-2019 Hospital Quality Incentive (HQI) Program Statewide Results. Web document at https://www.dhs.pa.gov/providers/Documents/Hospital%20Assessment%20Initiative/c_292435.pdf.

Pennsylvania Department of Human Services. Hospital Assessment Initiative. Hospital Quality Incentive (HQI) Program State Fiscal Year (SFY) 2017-2018 Q&As. Web document at https://www.dhs.pa.gov/providers/Documents/Hospital%20Assessment%20Initiative/c_266647.pdf.

3M Health Information Systems. 3M Patient Classification Methodologies. Webpage: www.3m.com/his/methodologies.

Texas Health and Human Services Commission. www.thlcportal.com.

Superior Health Plan. www.superiorhealthplan.com/providers/resources/provider-programs/3m-his.html.

Superior Health Plan. 3M Health Information Systems. Available at https://www.superiorhealthplan.com/content/dam/centene/Superior/Provider/PDFs/SHP_20195046-3M-HIS-Resource-Guide-P-508-03202019.pdf

Superior Health Plan. 3M Health Information Systems Prospective Dashboard User Guide. Available at https://www.superiorhealthplan.com/content/dam/centene/Superior/Provider/PDFs/SHP_20173928-3M-HIS-Dashboard-Training-P-05312018.pdf.

Potentially Preventable Emergency Department Visits (PPVs)

Articles, Reports, and Book Chapters

Goldfield N, Kelly W, Patel K. Potentially Preventable Events: an actionable set of measures for linking quality improvement and cost savings. Qual Manage Health Care. 2012;21(4):213-219.

Millwee B, Goldfield N, Averill R, Hughes J. Payment system reform: one state's journey. J Ambul Care Manage. 2013;36(3):199-208.

Medicare Payment Advisory Commission. Feasibility of measuring population-based outcomes: potentially preventable admissions and emergency department visits. Online Appendix 3A in Report to the Congress: Medicare and the Health Care Delivery System. Washington, DC: MedPAC, June 2014.

3M Health Information Systems. The 3M Value Index Score: Measurement and Evidence. Murray, UT: 3M HIS, 2015.

Bernstein AB. Potentially Preventable Events: Comparing Medicaid and Privately Insured Populations. Presentation to the Medicaid and CHIP Payment and Access Commission. Washington, DC: MACPAC, Dec. 15, 2015.

Minnesota Department of Health. An Introductory Analysis of Potentially Preventable Health Care Events in Minnesota. St. Paul. MN: MNDOH, 2015.

Minnesota Department of Health. An Introductory Analysis of Potentially Preventable Health Care Events in Minnesota: Supplemental Technical Information. St. Paul. MN: MNDOH, 2015.

Burns & Associates. External Quality Review of Indiana's Hoosier Lose Year Healthwise Program and Healthy Indiana Plan for The Review Year Calendar Year 2014. Report to the Indiana Office of Medicaid Policy and Planning. Phoenix, AZ: Burns & Associates, 2016.

Quinn K, Weimar D, Gray J, Davies B. Thinking about clinical outcomes in Medicaid. J Ambul Care Manage. 2016;39(2).

Florida Agency for Health Care Administration. Analysis of Potentially Preventable Healthcare Events of Florida Medicaid Enrollees: July 2015 to June 2016. Tallahassee, FL: AHCA, Winter 2017.

Florida Agency for Healthcare Administration. Analyzing Potentially Preventable Healthcare Events of Florida Medicaid Enrollees. Tallahassee, FL: AHCA, Spring 2017.

University of Florida, Institute for Child Health Policy. Texas Medicaid Managed Care and CHIP Summary of Activities and Trends in Healthcare Quality. Tallahassee, FL: ICHP, 2017.

Myers & Stauffer. Cost Effectiveness Study Report for Mississippi Coordinated Access Network (MississippiCAN). Report to the Mississippi Division of Medicaid. Windsor, CT: Myers & Stauffer, 2017.

Florida Agency for Health Care Administration. Analysis of Potentially Preventable Healthcare Events of Florida Medicaid Enrollees 2015-2016 and 2016-2017. Tallahassee, FL: AHCA, Winter 2018.

Fuller RL, Goldfield NI, Hughes JS, McCullough EC. Nursing home compare star rankings and the variation in potentially preventable emergency department visits and hospital admissions. Popul Health Manage. Epub ahead of print. July 30, 2018.

Millwee B, Quinn K, Goldfield N. Moving toward paying for outcomes in Medicaid. J Ambul Care Manage. 2018;41(2):88-94.

Millwee B, Goldfield N, Turnipseed J. Achieving improved outcomes through value-based purchasing in one state. Am J Med Qual. 2018;33(2):162-171.

North Carolina Department of Health and Human Services. Plan for Implementation of Hospital Quality Outcomes Program and PHP Quality Outcomes Program. Report to the Legislature. Raleigh, ND: NCDHHS, Sept. 28, 2018.

Burns & Associates. External Quality Review of Indiana's Care Programs: Hoosier Healthwise, Hoosier Care Connect and HIP Review Year Calendar 2017. Report to the Indiana Office of Medicaid Policy and Planning. Phoenix, AZ: Burns & Associates, 2019.

Florida Agency for Health Care Administration. Analysis of Potentially Preventable Healthcare Events of Florida Medicaid Enrollees 2015-2016 and 2016-2017. Tallahassee, FL: AHCA, Winter 2018.

New York Department of Health. DSRIP PAOP Meeting June 24, 2019. Presentation, available at www.health.ny.gov/health_care/medicaid/redesign/dsrip/paop/meetings/2019/docs/2019-06-24_pm-ff.pdf.

Texas External Quality Review Organization. Quality, Timeliness, and Access to Health Care for Texas Medicaid and CHIP Recipients: Summary of Activities Calendar Year 2017. Austin, TX: Texas EQRO, n.d.

Websites

3M Health Information Systems. 3M Patient Classification Methodologies. Webpage: www.3m.com/his/methodologies.

New York Department of Health--consumer information. https://health.data.ny.gov/.

Superior Health Plan. www.superiorhealthplan.com/providers/resources/provider-programs/3m-his.html.

Texas Health and Human Services Commission. www.thlcportal.com.

Excellus BlueCross BlueShield. Potentially Preventable Emergency Room Visits in New York State. Available at www.excellusbcbs.com/wps/wcm/connect/341d4367-74bd-48ef-b980-bffd2006ba44/ER+infographic-EX+FINAL+4-6-16.pdf?MOD=AJPERES&%20%20CACHEID=341d4367-74bd-48ef-b980-bffd2006ba44.

New York Department of Health. DSRIP Stories of Meaningful Change in Patient Health. Albany, n.d. Available at: www.health.ny.gov/health_care/medicaid/redesign/dsrip/2019/docs/stories.pdf.

Superior Health Plan. 3M HIS Prospective Dashboard User Guide. Available at https://www.superiorhealthplan.com/content/dam/centene/Superior/Provider/PDFs/SHP_20173928-3M-HIS-Dashboard-Training-P-05312018.pdf.

Superior Health Plan. 3M Health Information Systems Guide: Understanding the Domains and Metrics. Available at https://www.superiorhealthplan.com/content/dam/centene/Superior/Provider/PDFs/SHP_20195046-3M-HIS-Resource-Guide-P-508-03202019.pdf

Potentially Preventable Complications (PPCs)

Articles, Reports, and Book Chapters

Hughes JS, Averill RF, Goldfield NI, Gay JC, Muldoon J, McCullough E, Xiang J. Identifying potentially preventable complications using a present on admission indicator. Health Care Financ Rev. 2006;27(3):63-82.

Averill R, Vertrees J, McCullough E, Hughes J, Goldfield N. Redesigning the Medicare inpatient PPS to adjust payment for post admission complications. Health Care Financ Rev. 2006.

Averill R, Hughes J, Goldfield N, McCullough E. Hospital complications: linking payment reduction to preventability. Jt Comm J Qual Patient Saf. 2009;35(5):283-285.

Fuller RL, McCullough EC, Bao MZ, Averill RF. Estimating the costs of potentially preventable hospital acquired conditions. Health Care Financ Rev. 2009;30(4)17-32.

Fuller RL, Clinton S, Goldfield NI, Kelly WP. Building the affordable medical home. J Ambul Care Manage. 2010;33(1):71-80.

Fuller RL, McCullough EC, Averill RF. A new approach to reducing payments made to hospitals with high complication rates. Inquiry. 2011;48:68-83.

Lagoe RJ, Johnson PE, Murphy MP. Inpatient hospital complications and lengths of stay--a short report. BMC Research Notes. 2011;4(135).

Calikoglu S, Murray R, Feeney D. Hospital pay-for-performance programs in Maryland produced strong results, including reduced hospital-acquired conditions. Health Aff (Millwood). 2012;31(12):2649-2658

Goldfield N, Kelly W, Patel K. Potentially Preventable Events: an actionable set of measures for linking quality improvement and cost savings. Qual Manage Health Care. 2012;21(4):213-219.

Lagoe R, Bick J. Reducing hospital inpatient complications: A four year experience. Advances in Bioscience and Biotechnology. 2013;4:118-125.

Millwee B, Goldfield N, Averill R, Hughes J. Payment system reform: one state's journey. J Ambul Care Manage. 2013;36(3):199-208.

Texas Health and Human Services Commission. Potentially Preventable Complications in the Texas Medicaid Population SFY 2012. Austin, TX: HHSC, 2013.

Michlewski E, Patterson W, Conroy MB. New York State All Payer Hospital Inpatient Potentially Preventable Complication (PPC) Rates: 2009-2012. Statistical Brief No. 1. Albany, NY: New York Department of Health, 2014.

University of Florida, Institute for Child Health Policy. Potentially Preventable Complications in Texas Medicaid and CHIP Programs FY 2013. Report to the Texas Health and Human Services Commission. Tallahassee, FL: ICHP, 2014

Patel A, Rajkumar R, Colmers JM, Kinzer D, Conway PH, Sharfstein JM. Maryland's global hospital budgets--preliminary results from an all-payer model. N Engl J Med. 2015;373:1899-1901.

Averill RF, Hughes JS, Fuller RL, Goldfield NI. Quality improvement initiatives need rigorous evaluation: the case of pressure ulcers. Am J Med Qual. 2017;32(5):552-555. doi:10.1177/1062860616666672.

Fuller RL, Goldfield NI, Averill RF, Hughes JS. Is the CMS Hospital-Acquired Condition Reduction Program a valid measure of hospital performance? Am J Med Qual. 2016;32(3):254-260.

Quinn K, Weimar D, Gray J, Davies B. Thinking about clinical outcomes in Medicaid. J Ambul Care Manage. 2016;39(2).

University of Florida, Institute for Child Health Policy. Texas Medicaid Managed Care and CHIP Summary of Activities and Trends in Healthcare Quality. Tallahassee, FL: ICHP, 2017.

Maryland Health Services Cost Review Commission. Final Recommendation for the Maryland Hospital-Acquired Conditions Program for Rate Year 2020. Baltimore, MD: HSCRC, 2018.

Millwee B, Quinn K, Goldfield N. Moving toward paying for outcomes in Medicaid. J Ambul Care Manage. 2018;41(2):88-94.

Texas Department of State Health Services. Potentially Preventable Complications in Texas CY 2016 Report. Austin, TX: DSHS, 2018.

University of Florida, Institute for Child Health Policy. Hospital Quality-Based Program: Potentially Preventable Complications. Technical notes for state FY 2018. Tallahassee, FL: ICHP, 2019

Maryland Health Services Cost Review Commission. Final Recommendation for the Maryland Hospital Acquired Conditions Program for Rate Year 2018. Baltimore: HSCRC, 2016.

New York Department of Health. Delivery System Reform Incentive Payment (DSRIP) Amendment Request. Albany, NY: NYDOH, Sept. 17, 2019.

Texas External Quality Review Organization. Quality, Timeliness, and Access to Health Care for Texas Medicaid and CHIP Recipients: Summary of Activities Calendar Year 2017. Austin, TX: Texas EQRO, n.d.

Websites

3M Health Information Systems: Overview of the 3M patient classification methodologies, with a link to a separate PPC sub-page. www.3m.com/his/methodologies

New York Department of Health*:* Consumer information website with charts and data sets showing PPC performance by hospital for multiple years. https://health.data.ny.gov/

Texas Department of State Health Services: Reports on statewide all-payer PPC incidence. https://www.dshs.texas.gov/thcic/hospitals/Potentially-Preventable-Complications-Reports/

Texas Health and Human Services Commission: Interactive webpage on PPC performance by hospital, by service delivery plan, and by managed care plan, with data for multiple years. www.thlcportal.com

Potentially Preventable Readmissions (PPRs)

Articles, Reports, and Book Chapters

Medicare Payment Advisory Commission. Payment policy for inpatient readmissions. Chapter 5 in Report to the Congress: Promoting Greater Efficiency in Medicare. Washington, DC: MedPAC, June 2007.

Goldfield N, McCullough E, Hughes J, Tang A, Eastman B, Rawlins L, Averill R. Identifying potentially preventable readmissions. Health Care Financ Rev. 2008;30(1):75-91.

Feudtner C, Levin JE, Srivastava R, Goodman DM, Slonim AD, Sharma V, Shah SS, Pati S, Fargason C Jr, Hall M. How well can hospital readmission be predicted in a cohort of hospitalized children? A retrospective, multicenter study. Pediatrics. 2009;123(1):286-293.

Utah Department of Health. Potentially Preventable Hospital Readmissions. Health Status Update. Salt Lake City: Utah DOH,2010.

Vest JR, Gamm LD, Oxford BA, Gonzalez MI, Slawson KM. Determinants of preventable readmissions in the United States: a systematic review. Implement Sci. 2010;5:88.

Utah Department of Health. Readmissions to Utah Hospitals, 2005-2007. Salt Lake City,UT: 2010

Fuller RL, Clinton S, Goldfield NI, Kelly WP. Building the affordable medical home. J Ambul Care Manage. 2010;33(1):71-80.

Goldfield N. Strategies to decrease the rate of preventable readmission to hospital. CMAJ. 2010;182(6):538-539.

Boutwell AE, Jencks SF. It's Not Six of One, Half Dozen the Other: A Comparative Analysis of 3 Rehospitalization Measurement Systems for Massachusetts. AcademyHealth Annual Research Meeting; Seattle, WA. 2011.

Eisenhandler J, Averill R, Vertrees J, Quain A, Switalski J. A Comparison of the Explanatory Power of Two Approaches to the Prediction of Post Acute Care Resources Use. Report to CMS. Wallingford, CT: 3M Health Information Systems, 2011.

Goldfield N. How important is it to identify avoidable hospital readmissions with certainty? CMAJ. 2011;183(7):e368-369.

Barrett M, Raetzman S, Andrews R. Overview of Key Readmission Measures and Methods. 2012. HCUP Methods Series Report #2012-04. Rockbille, MD: AHRQ, 2012.

Fuller R, Goldfield N, Averill R, Hughes J. Inappropriate use of payment weights to risk adjust readmission rates. Am J Med Qual. 2012;27(1):341-344.

Goldfield N, Kelly W, Patel K. Potentially Preventable Events: an actionable set of measures for linking quality improvement and cost savings. Qual Manage Health Care. 2012;21(4):213-219.

Texas Health and Human Services. Potentially Preventable Readmissions in the Texas Medicaid Population, State Fiscal Year 2012. Austin, TX: HHSC, 2013.

Texas Health and Human Services Commission. Potentially Preventable Readmissions in the Texas Medicaid Population, State Fiscal Year 2012. Austin, TX: HSSC, 2013.

Averill R, Goldfield N, Hughes JS. Medicare payment penalties for unrelated readmissions require second look. Healthc Financ Manage. 2013(October):96-98.

Berry JG, Toomey SL, Zaslavsky AM, Jha AK, Nakamura MM, Klein DJ, Feng JY, Shulman S, Chiang VW, Kaplan W, Hall M, Schuster MA. Pediatric readmission prevalence and variability across hospitals. JAMA. 2013;309(4):372-380.

Davies S, Saynina O, Schultz E, McDonald KM, Baker LC. Implications of metric choice for common applications of readmission metrics. Health Serv Res. 2013;48:1978–1995.

Fuller RL, Atkinson G, McCullough EC, Hughes JS. Hospital readmission rates: the impacts of age, payer, and mental health diagnoses. J Ambul Care Manage. 2013;36(2).

Millwee B, Goldfield N, Averill R, Hughes J. Payment system reform: one state's journey. J Ambul Care Manage. 2013;36(3):199-208.

Quinn K, Davies B. Potentially Preventable Readmissions in Rhode Island. Cranston, RI: Xerox State Healthcare, 2014.

McCoy KA, Bear-Pfaffendof K, Foreman JK, Daniels T, Zabel EW, Grangaard LJ, Trevis JE, Cummings KA. Reducing avoidable hospital readmissions effectively: a statewide campaign. Jt Comm J Qual Patient Saf. 2014;40(5):198-204.

Stratis Health. RARE Campaign Exceeds Goals, Prevents 7,975 Avoidable Hospital Readmissions in Minnesota [news release]. Available at http://www.stratishealth.org/news/20140617.html.

3M Health Information Systems. The 3M Value Index Score: Measurement and Evidence. Murray, UT: 3M HIS, 2015.

Minnesota Department of Health. An Introductory Analysis of Potentially Preventable Health Care Events in Minnesota. St. Paul. MN: MNDOH, 2015.

Minnesota Department of Health. An Introductory Analysis of Potentially Preventable Health Care Events in Minnesota: Supplemental Technical Information. St. Paul. MN: MNDOH, 2015.

North Carolina Community Care Networks, Inc. Clinical Program Analysis. Report to the North Carolina Department of Health and Human Services. Raleigh, NC: NCCC, 2015

Borzecki AM, Chen Q, Restuccia J, Mull HJ, Shwartz M, Gupta K, Hanchate A, Strymish J, Rosen A. Do pneumonia readmissions flagged as potentially preventable by the 3M PPR software have more process of care problems? A cross-sectional observational study. BMJ Qual Saf. 2015;24:753-763.

DuBard CA, Jacobsen Vann JC, Jackson C. Conflicting readmission rate trends in a high-risk population: implications for performance measurement. Popul Health Manag. 2015;18:351–357

Fuller RL, Atkinson G, Hughes JS. Indications of biased risk adjustment in the Hospital Readmission Reduction Program. J Ambul Care Manage. 2015;38(1):39-47.

Gay JC, Agrawal R, Auger KA, Del Beccaro MA, Eghtesady P, Fieldston ES, Golias J, Han PD, McClead R, Morse RB, Neuman ML, Simon HK, Tejedor-Sojo J, Teufel RJ, Harris JM, Shah SS. Rates and impact of potentially preventable readmissions at children's hospitals. J Pediatr. 2015;166(3):615-619.e5

Jackson C, Shahsahehi M, Wedlake T, DuBard CA. Timeliness of outpatient follow-up: an evidence-based approach for planning after hospital discharge. Ann Fam Med. 2015:13(2):155-122.

Soong C, Bell C. Identifying preventable readmissions: an achievable goal or waiting for Godot? BMJ Qual Saf 2015;24:741–743. doi:10.1136/bmjqs-2015-004484

DuBard CA. Key Performance Indicators of Cost and Utilization for Medicaid Recipients Enrolled in Community Care of North Carolina. N C Med J. 2016;77(4):297-300.

Goldfield N, Averill R, Fuller R, Hughes J. Misinterpretation of meaning and intended use of potentially preventable readmissions. BMJ Qual Saf. 2015;25(3):207–8.

Lagoe R, Kronenberg P, Littau S. Readmissions by hospital inpatient service at the community level. Intern Med Rev. 2016;2.10.18103/imr.v2i9.234.

Nakagawa K, Ahn HJ, Taira DA, Miyamura J, Sentel TL. Ethnic comparison of 30-day potentially preventable readmissions after stroke in Hawaii. Stroke. 2016;47:2611-2617

Quinn K, Weimar D, Gray J, Davies B. Thinking about clinical outcomes in Medicaid. J Ambul Care Manage. 2016;39(2).

Florida Agency for Health Care Administration. Analysis of Potentially Preventable Healthcare Events of Florida Medicaid Enrollees: July 2015 to June 2016. Tallahassee, FL: AHCA, Winter 2017.

Florida Agency for Healthcare Administration. Analyzing Potentially Preventable Healthcare Events of Florida Medicaid Enrollees. Tallahassee, FL: AHCA, Spring 2017.

Medicare Payment Advisory Commission. Health Care Spending and the Medicare Program: A Data Book (June 2017). Washington, DC: MedPAC, 2017.

Medicare Payment Advisory Commission. Hospital inpatient and outpatient services. Chapter 3 in Report to the Congress: Medicare Payment Policy. Washington, DC: MedPAC, March 2017

Myers & Stauffer. Cost Effectiveness Study Report for Mississippi Coordinated Access Network (MississippiCAN). Report to the Mississippi Division of Medicaid. Windsor, CT: Myers & Stauffer, 2017.

University of Florida, Institute for Child Health Policy. Texas Medicaid Managed Care and CHIP Summary of Activities and Trends in Healthcare Quality. Tallahassee, FL: ICHP, 2017.

Burns & Associates. External Quality Review of Indiana's Care Programs: Hoosier Healthwise, Hoosier Care Connect and HIP 2.0 Review Year Calendar 2016. Report to the Indiana Office of Medicaid Policy and Planning. Phoenix, AZ: Burns & Associates, 2018.

Florida Agency for Health Care Administration. Analysis of Potentially Preventable Healthcare Events of Florida Medicaid Enrollees 2015-2016 and 2016-2017. Tallahassee, FL: AHCA, Winter 2018.

Medicare Payment Advisory Commission. Mandated report: The effects of the Hospital Readmissions Reduction Program. Chapter 1 in Report to the Congress: Medicare Payment Policy. (Washington, DC: MedPAC, June 2018)

North Carolina Department of Health and Human Services. Plan for Implementation of Hospital Quality Outcomes Program and PHP Quality Outcomes Program. Report to the Legislature. Raleigh, ND: NCDHHS, Sept. 28, 2018.

Texas Department of State Health Services. Potentially Preventable Readmissions in Texas: Calendar Year 2016 Report. Austin, TX: DSHS, 2018.

Fuller RL, Hughes JS, Goldfield NI, Averill RF. Will hospital peer grouping by patient socioeconomic status fix the Medicare hospital readmission reduction program or create new problems? Jt Comm J Qual Patient Saf. 2018;44:177-185.

McCoy RG, Peterson SM, Borkenhagen LS, Takahashi PY, Thorsteinsdottir B, Chandra A, Naessens JM. Which readmissions may be preventable? Lessons learned from a posthospitalization care transitions program for high-risk elders. Med Care. 2018;56(8):693–700.

Millwee B, Goldfield N, Turnipseed J. Achieving improved outcomes through value-based purchasing in one state. Am J Med Qual. 2018;33(2):162-171.

Millwee B, Quinn K, Goldfield N. Moving toward paying for outcomes in Medicaid. J Ambul Care Manage. 2018;41(2):88-94.

Mississippi Division of Medicaid. Quality Incentive Payment Program Potentially Preventable Readmissions Methodology Supplement. Jackson, MS: Mississippi Division of Medicaid, 2019. Available at https://medicaid.ms.gov/wp-content/uploads/2020/01/MS-QIPP-Readmissions-Methodology-Supplement-2019-09.pdf

New York Department of Health. DSRIP PAOP Meeting June 24, 2019. Presentation, available at https://www.health.ny.gov/health_care/medicaid/redesign/dsrip/paop/meetings/2019/docs/2019-06-24_pm-ff.pdf.

Averill RF, Fuller RL, Mills RE. Financial Impact of Geographic Variation in Hospital Quality Performance in Medicare. Murray, UT: 3M Health Information Systems, 2019.

Burns & Associates. External Quality Review of Indiana's Care Programs: Hoosier Healthwise, Hoosier Care Connect and HIP Review Year Calendar 2017. Report to the Indiana Office of Medicaid Policy and Planning. Phoenix, AZ: Burns * Associates, 2019.

Florida Agency for Health Care Administration. Analysis of Potentially Preventable Healthcare Events of Florida Medicaid Enrollees 2015-2016 and 2016-2017. Tallahassee, FL: AHCA, Winter 2018.

Medicare Payment Advisory Commission. The effects of the Hospital Readmissions Reduction Program. Chapter 1 in Medicare and the Health Care Delivery System. Report to Congress. Washington, DC: MedPAC, June 2018.

New York Department of Health. Delivery System Reform Incentive Payment (DSRIP) Amendment Request. Albany, NY: NYDOH, Sept. 17, 2019.

Calsolaro V, Antognoli R, Pasqualetti G, Okoye C, Aquilini F, Cristofano M, Briani S, Monzani F. 30-day potentially preventable hospital readmissions in older patients: clinical phenotype and health care related risk factors. Clin Interv Aging. 2019;14:1851–1858.

Mississippi Division of Medicaid. DOM to phase in quality incentive payment program (QIPP) for hospitals. MS Medicaid Provider Bulletin. 2019;25(3):pp. 1-2

New York Department of Health. Hospital Inpatient Potentially Preventable Readmission (PPR) Rates by Hospital (SPARCS): Beginning 2009 [webpage]. https://healthdata.gov/dataset/hospital-inpatient-potentially-preventable-readmission-ppr-rates-hospital-sparcs-beginning.

Maryland Health Services Cost Review Commission. Final Recommendation for the Readmission Reduction Incentive Program for Rate Year 2022. Baltimore, MD: HSCRC, March 2020

Averill RF, Fuller RL, Mills RE. Geographic Variation in Hospital Quality Performance in Medicare by Disease and Procedure Categories. Supplement to the report: Financial Impact of Geographic Variation in Hospital Quality Performance in Medicare. Murray, UT: 3M Health Information Systems, 2020.

Zafar SN, Shah AA, Nembhard C, Wilson LL, Habermann EB, Raoof M, Wasif N. Readmissions after complex cancer surgery: analysis of the Nationwide Readmissions Database. J Oncol Pract. 2018;14(6):e335-345

Lindsey M, Patterson W, Ray K, Roohan P. Potentially Preventable Hospital Readmissions among Medicaid Recipients with Mental Health and/or Substance Abuse Health Conditions Compared with All Others: New York State, 2007. Statistical Brief No. 3. Albany, NY: NY Department of Health,n.d.

Patterson W, Lindsey M. Potentially Avoidable Hospitalizations: New York State Medicaid Program, 2009. Statistical Brief #6. Albany, NY: NY Department of Health, n.d.

New York Department of Health. DSRIP Stories of Meaningful Change in Patient Health. Albany, n.d. Available at: www.health.ny.gov/health_care/medicaid/redesign/dsrip/2019/docs/stories.pdf.

Texas External Quality Review Organization. Quality, Timeliness, and Access to Health Care for Texas Medicaid and CHIP Recipients: Summary of Activities Calendar Year 2017. Austin, TX: Texas EQRO, n.d.

Websites

3M Health Information Systems. 3M Patient Classification Methodologies. Webpage: www.3m.com/his/methodologies

Florida Agency for Health Care Administration--consumer information. www.floridahealthfinder.gov

New York Department of Health--consumer information. https://health.data.ny.gov/

Ohio Department of Medicaid Modernize Hospital Payments. https://medicaid.ohio.gov/RESOURCES/Reports-and-Research/-Modernize-Hospital-Payments

Texas Department of State Health Services--readmissions. www.dshs.texas.gov/thcic/hospitals/Potentially-Preventable-Readmission-Reports/

Texas Health and Human Services Commission. www.thlcportal.com

Superior Health Plan. 3M Health Information. Available at https://www.superiorhealthplan.com/content/dam/centene/Superior/Provider/PDFs/SHP_20195046-3M-HIS-Resource-Guide-P-508-03202019.pdf

Superior Health Plan. 3M HIS Prospective Dashboard User Guide. Available at https://www.superiorhealthplan.com/content/dam/centene/Superior/Provider/PDFs/SHP_20173928-3M-HIS-Dashboard-Training-P-05312018.pdf

Potentially Preventable Return Visits to the Emergency Department (PPREDs)

Articles, Reports, and Book Chapters

Averill RF, Fuller RL, Mills RE. Financial Impact of Geographic Variation in Hospital Quality Performance in Medicare. Murray, UT: 3M Health Information Systems, 2019. Available at www.3mhiscer.com.

Mississippi Division of Medicaid. Quality Incentive Payment Program Potentially Preventable Readmissions Methodology Supplement. Jackson, MS: Mississippi Division of Medicaid, 2019. Available at https://medicaid.ms.gov/wp-content/uploads/2020/01/MS-QIPP-Readmissions-Methodology-Supplement-2019-09.pdf

Averill RF, Fuller RL, Mills RE. Geographic Variation in Hospital Quality Performance in Medicare by Disease and Procedure Categories. Supplement to the report: Financial Impact of Geographic Variation in Hospital Quality Performance in Medicare. Murray, UT: 3M Health Information Systems, 2020.

Averill RF, Fuller RL, Mills RE. Geographic Variation in Hospital Admission Rates in the Medicare Population. Murray, UT: 3M Health Information Systems, 2021. Available at www.3mhiscer.com.

Websites

3M Health Information Systems: 3M Patient Classification Methodologies. Webpage: www.3m.com/his/methodologies

Clinical Risk Groups (CRGs)

Articles, Reports, and Book Chapters

Goldfield N, Averill R, Eisenhandler J, Hughes JS, Muldoon J, Steinbeck B, Bagadia F. The prospective risk adjustment system. J Ambul Care Manage. 1999;22(2):41-52.

National Association of Children's Hospitals and Related Institutions. Summary Description of Clinical Risk Groups (CRGs). Washington, DC: NACHRI; 2000.

Medicare Payment Advisory Commission. Report to the Congress: Improving Risk Adjustment in Medicare. Washington, DC: MedPAC, November 2000.

Goldfield N, Averill R, Eisenhandler J. Payment and provider profiling of episodes of illness of clinical illnesses involving rehabilitation. J Outcome Meas. 2000;4(3):706-720.

Majeed A, Bindman AB, Weiner JP. Use of risk adjustment in setting budgets and measuring performance in primary care I--how it works. BMJ 2001;323:604–607.

Bethell C, Read D. Approaches to Identifying Children and Adults with Special Health Care Needs: A Resource Manual for State Medicaid Agencies and Managed Care Organizations. Report to CMS. Available at www.childhealthdata.org. 2002.

Neff JM, Sharp VL, Muldoon J, Graham J, Popalisky J, Gay JC. Identifying and classifying children with chronic conditions using administrative data with the Clinical Risk Group classification system. Ambul Pediatr. 2002;2(1):71-79.

Averill RF, Goldfield NI, Eisenhandler J, Muldoon JH, Hughes JS, Neff JM, Gay JG, Gregg LW, Gannon DE, Shafir BV, Bagadia FA, Steinbeck BA. Development and evaluation of Clinical Risk Groups. In: Goldfield N, Delivering High-Quality Cost-Effective Health Care to All: The Scientific and Political Ingredients for Success. Northampton, MA: Artichoke Publications, 2004.

Goldfield N, Eisenhandler J, Gay G, McCullough E, Bao M, Neff J, Muldoon J, Hughes J, Mills R. Development of an episode of illness classification for population management using pharmacy data. Dis Manag. 2004;5(3).

Hughes JS, Averill RF, Eisenhandler J, Goldfield NI, Muldoon J, Neff JM, Gay JC. Clinical Risk Groups (CRGs): a classification system for risk-adjusted capitation-based payment and health care management. Med Care. 2004;42(1):81-90.

Neff JM, Sharp VL, Muldoon J, Graham J, Myers K. Profile of medical charges for children by health status group and severity level in a Washington State health plan. HSR. 2004;39(1):73-90.

Berlinguet M, Preyra C, Dean S. Comparing the Value of Three Main Diagnostic Based Risk Adjustment Systems. Ottawa: ON: Canadian Health Services Research Foundation, 2005.

Neff JM, Sharp VL, Popalisky J, Fitzgibbon T. Using medical billing data to evaluate chronically ill children over time. J Am Care Manage. 2006; 29(4):283-290.

Maine Health Information Center. Children in Out-of-Home Placement in New Hampshire Health Status, Utilization, Payments, and Preventive Visits, State Fiscal Year 2007. (Concord, NH: DHHS, 2009)

Bernstein RH. New arrows in the quiver for targeting case management: high-risk versus high-opportunity case identification. J Ambul Care Manage. 2007;30(1):39-51.

Alberta Health Quality Council. 2009 Measuring and Monitoring for Success. Calgary, AB: AHQC, 2009.

Kelly WP, Wendt SW, Vogel BB. Guiding principles for payment system reform. J Ambul Care Manage. 2010;33(1):29-34.

Neff JM, Clifton H, Park KJ, Goldenberg C, Popalisky J, Stout JW, Danielson BS. Identifying children with lifelong chronic conditions by using hospital discharge data. Acad Pediatr. 2010;10(6):417-423.

Eisenhandler J, Averill R, Vertrees J, Quain A, Switalski J. A Comparison of the Explanatory Power of Two Approaches to the Prediction of Post Acute Care Resources Use. Report to CMS. Wallingford, CT: 3M Health Information Systems, 2011.

New Hampshire Department of Health and Human Services. New Hampshire Medicaid Annual Report State Fiscal Year 2010. Concord, NH: DHHS, 2011.

Children's Hospital Association. Defining Children with Medical Complexities. Alexandra, VA: CHA, 2013.

3M Health Information Systems. The Impact of Disability Measures on Expected Medicare Payments and Expected Provider Charges for Event-Based Episodes that Include Post-Acute Care. Salt Lake City, UT: 3M HIS, 2013.

Medicare Payment Advisory Commission. Approaches to bundling payment for post-acute care. Chapter 3 in Report to the Congress: Medicare and the Health Care System. Washington, DC: MedPAC, June 2013.

Onpoint Health Data. Children's Health Insurance Programs in New Hampshire: Access, Prevention, Care Management, Utilization, & Payments (State Fiscal Year 2011). Report to DHHS. Concord, NH: DHHS, 2013

Schone E, Brown RS. Risk Adjustment: What Is the Current State of the Art, and How Can It Be Improved? Princeton, NJ: Robert Wood Johnson Foundation, 2013

Vertrees J, Averill R, Eisenhandler J, Quain A, Switalski J, Gannon D. The Ability of Event-Based Episodes to Explain Variation in Charges and Medicare Payments for Various Post Acute Service Bundles. Report to MedPAC. Wallingford, CT: 3M Health Information Systems, 2013.

Vigen G, Coughlin S, Duncan I. Measurement and Performance Healthcare Quality and Efficiency: Resources for Healthcare Professionals. Third update. Society of Actuaries, 2013.

Berry J, Hall M, Hall DE, Kuo DZ, Cohen E, Agrawal R, Mandl KD, Clifton H, Neff J. Inpatient growth and resource use in 28 children's hospitals. JAMA Pediatrics. 2013;167(2):170-177.

Fuller R, Goldfield N, Averill R, Eisenhandler J, Vertrees J. Adjusting Medicaid managed care payments for changes in health status. Med Care Res Rev. 2013;70(1):68-83.

Lion KC, Rafton SA, Shafii J, Brownstein D, Michel E, Tolman M, Ebel BE. Association between language, serious adverse events, and length of stay among hospitalized children. Hosp Pediatr. 2013;3(3): 219-225. https://doi.org/10.1542/hpeds.2012-0091

Vertrees J, Averill R, Eisenhandler, J, Quain, A, Switalski J. Bundling Post-Acute Care Services into MS-DRG Payments. Medicare Medicaid Res Rev. 2013;3(3):E1-E19

3M Health Information Systems. The 3M Value Index Score: Measurement and Evidence. Murray, UT: 3M HIS, 2015.

Johnson TL, Brewer D, Estracio R, Vlasimsky T, Durfee MJ, Thompson KR, Everhart RM, Rinehart DJ, Batal H. Augmenting predictive modeling tools with clinical insights for care coordination. eGEMs (Generating Evidence & Methods to Improve Patient Outcomes). 2015;3(1).

All Patient Refined Diagnosis Related Groups (APR DRG)

Articles, Reports, and Book Chapters

Jones P. A case study in APR DRGs: the Greater Southeast Community Hospital Experience. Manage Care Q. 1994;2(3):48-56.

Averill RF, Muldoon JH, Vertrees JC, Goldfield NI, Mullin RL, Finneran EC, Zhang MC, Steinbeck B, Grant T. The evolution of case mix measurement using Diagnosis Related Groups. In: Goldfield N. Physician profiling and risk adjustment. 2nd ed. Gaithersburg, MD: Aspen; 1999. p. 391-454.

Franklin PD, Legault JP. Using data to evaluate hospital inpatient mortality. J Nurs Care Qual. 1999;14(1):55-66.

Muldoon J. Structure and performance of different DRG classification systems for neonatal medicine. Pediatrics. 1999;103(1 Suppl E):302-18.

Goldfield N, Averill R. On "Risk-adjusting acute myocardial infarction mortality: are APR DRGs the right tool?" Health Serv Res. 2000;34(7):1491-1495; discussion 1495-1498.

Romano PS, Chan BK. Risk-adjusting acute myocardial infarction mortality: are APR DRGs the right tool? Health Serv Res. 2000;34(7):1469-1489

Averill RF, Goldfield NI, Muldoon J, Steinbeck BA, Grant TM. A closer look at All-Patient Refined DRGs. J AHIMA. 2002;73(1):46-49.

Lorenzoni I, Cisbani I, Manzoli I, Fantini MP. The evaluation of neonatal case mix using Medicare DRG and APR DRG classification systems. Italian Journal of Pediatrics. 2002;28:225-229.

Fantini MP, Cisbani L, Manzoli L, Vertrees J, Lorenzoni I. On the use of administrative databases to support planning activities. The case of the evaluation of neonatal casemix in the Emilia-Romagna region using DRG and APR DRG classification systems. Eur J Public. 2003;13(2):138-145.

Shen Y. Applying the 3M All Patient Refined Diagnosis Related Groups Grouper to measure inpatient severity in the VA. Med Care. 2003;41(6 Suppl):II103-10

Zhan C, Miller MR. Excess length of stay, charges, and mortality attributable to medical injuries during hospitalization. JAMA. 2003;290(14):1868-1874.

Sedman AB, Bahl V, Bunting E, Bandy K, Jones S, Nasr SZ, Schulz K, Campbell DA. Clinical redesign using All Patient Refined Diagnosis Related Groups. Pediatrics. 2004;114;975-969.

Fontaine P, Licoppe C, D'Andrea R. International-Refined (IR-DRG) versus 3M All Patient Refined DRG (APR DRG) to describe and predict costs of patients in 42 Belgium hospitals. Proceedings, WHO Family of International Classifications, Tokyo Meeting. http://www3.who.int/icd/tokyomeeting/documentlist (June 2005), P2-9.

Medicare Payment Advisory Commission. Physician-Owned Specialty Hospitals. Report to Congress. Washington, DC: MedPAC, March 2005.

Davis MP, Walsh D, LeGrand SB, Lagman RI, Harrison SB, Rybicki L. The financial benefits of acute inpatient palliative medicine: an inter-institutional comparative analysis by All Patient Refined-Diagnosis Related Group and case mix index. J Support Oncol. 2005;3(4):313-316.

Pirson M, Martins D, Jackson T, Dramaix M, Leclercq P. Prospective casemix-based funding, analysis and financial impact of cost outliers in All-Patient Refined Diagnosis Related Groups in three Belgian general hospitals. Eur J Health Econ. 2006;7(1):55-65.

Pirson, M., Dramaix, M., Leclercq, P., Jackson, T.: Analysis of cost outliers within APR-DRGs in a Belgian general hospital: two complementary approaches. Health Policy. 2006;76(1):13–25.

Wynn BO, Scott M. Evaluation of Severity-adjusted DRG Systems: Addendum to the Interim Report. Santa Monica, CA: RAND, 2007.

Fay MD, Jackson DA, Vogel BB. Implementation of a severity-adjusted diagnosis-related groups payment system in a large health plan: implications for pay for performance. J Ambul Care Manage. 2007;30(3):211-217.

Hayes KJ, Pettengill J, Stensland J. Getting the price right: Medicare payment rates for cardiovascular services. Health Aff (Millwood). 2007;26(1):124-136.

Baram D, Daroowalla F, Garcia R, Zhang G, Chen JJ, Healy E, Riaz SA, Richman P. Use of the All Patient Refined-Diagnosis Related Group (APR-DRG) Risk of Mortality score as a severity adjustor in the medical ICU. Clin Med Circ Respirat Pulm Med. 2008;2:19–25.

Baram D, Daroowalla F, Garcia R, Zhang G, Chen JJ, Healy E, Riaz SA, Richman P. Use of the All Patient Refined-Diagnosis Related Group (APR-DRG) Risk of Mortality score as a severity adjustor in the medical ICU. Clin Med Insights Circ Respir Pulm Med. 2008;2:(1-25).

Quinn K. New directions in Medicaid payment methods for hospital care. Health Aff (Millwood). 2008;27(1):269-80.

Talsma A, Bahl V, Campbell D. Exploratory analyses of the "failure to rescue" measure: evaluation through medical record review. J Nurs Care Qual. 2008;2(3):202-210.

Averill R, McCullough E, Hughes J, Goldfield N, Vertrees J, Fuller R. Redesigning the Medicare inpatient PPS to reduce payments to hospitals with high readmission rates. Health Care Financ Rev. 2009;30(4):1-15.

Feudtner C, Levin JE, Srivastava R, Goodman DM, Slonim AD, Sharma V, Shah SS, Pati S, Fargason C Jr, Hall M. How well can hospital readmission be predicted in a cohort of hospitalized children? A retrospective, multicenter study. Pediatrics. 2009;123(1):286-293.

Kernisan LP, Lee SJ, Boscardin WJ, Landefeld CS, Dudley RA. Association between hospital-reported Leapfrog safe practices scores and inpatient mortality. JAMA. 2009;301(13):1341-1348.

Kozower BD, Ailawadi G, Jones DR, Pates RD, Lau CL, Kron IL, Stukenborg GJ. Predicted risk of mortality models: surgeons need to understand limitations of the University HealthSystems Consortium models. J Am Coll Surg. 2009;209(5):551-556

Lavernia CJ, Laoruengthana A, Contreras JS, Rossi MD. All-Patient Refined Diagnosis-Related Groups in primary arthroplasty. J Arthroplasty. 2009 Sep;24(6 Suppl):19-23.

Goldfield N. The evolution of diagnosis-related groups (DRGs): from its beginnings in case-mix and resource use theory, to its implementation for payment and now for its current utilization for quality within and outside the hospital. Qual Manage Health Care. 2010;19(1)3-16.

Kelly WP, Wendt SW, Vogel BB. Guiding principles for payment system reform. J Ambul Care Manage. 2010;33(1):29-34.

Shahian M, Wolf RE, Iezzoni LI, Kirle L, Normand ST. Variability in the measurement of hospital-wide mortality rates. New Engl J Med. 2010;363(26):2530-2539.

Puget Sound Health Alliance. 2011 Report: Use of Resources in High-Volume Hospitalizations. https://wahealthalliance.org/wp-content/uploads/2013/11/puget_sound_health_alliance_resource_use_report_2011.pdf

Mills R, Butler R, McCullough E, Bao M, Averill R. Impact of the transition to ICD-10 on Medicare inpatient hospital payments. Medicare Medicaid Res Rev. 2011;2(2);E1-E13.

Quinn K, Davies B. Variation in Payment for Hospital Care in Rhode Island. Report to the Office of Health Insurance Commissioner. Cranston, RI: Xerox State Healthcare; 2012.

Myers RP, Hubbard JN, Shaheen AAM, Dixon E, Kaplan GG. Hospital performance reports based on severity adjusted mortality rates in patients with cirrhosis depend on the method of risk adjustment. Ann Hepatol. 2012;11(4):526-535

Shine D. Risk-adjusted mortality: problems and possibilities. Comput Math Methods Med

Iezzoni, LI. Coded data from administrative sources. In Iezzoni LI, ed., Risk Adjustment for Measuring Healthcare Outcomes. 4th ed. Chicago: Health Administration Press, 2013

Vertrees J, Averill R, Eisenhandler J, Quain A, Switalski J, Gannon D. The Ability of Event-Based Episodes to Explain Variation in Charges and Medicare Payments for Various Post Acute Service Bundles. Report to MedPAC. Wallingford, CT: 3M Health Information Systems, 2013.

Vigen G, Coughlin S, Duncan I. Measurement and Performance Healthcare Quality and Efficiency: Resources for Healthcare Professionals. Third update. Society of Actuaries, 2013.

Xerox State Healthcare. Medi-Cal DRG Project Policy Design Document. Report to the California Department of Health Care Services. Atlanta: Xerox, 2013.

Berry JG, Toomey SL, Zaslavsky AM, Jha AK, Nakamura MM, Klein DJ, Feng JY, Shulman S, Chiang VW, Kaplan W, Hall M, Schuster MA. Pediatric readmission prevalence and variability across hospitals. JAMA. 2013;309(4):372-380.

Mull HJ, Chen Q, O'Brien WJ, Shwartz M, Borzecki AM, Hanchate A, Rosen AK. Comparing 2 methods of assessing 30-day readmissions: what is the impact on hospital profiling in the Veterans Health Administration? Med Care. 2013;51(7):589-96.

Pirson M, Schenker L, Martins D, Duong D, Chale JJ, Leclerq P. What can we learn from international comparisons of costs by DRG? Eur J Health Econ. 2013;14(1):67-73.

Vertrees J, Averill R, Eisenhandler, J, Quain, A, Switalski J. Bundling Post-Acute Care Services into MS-DRG Payments. Medicare Medicaid Res Rev. 2013;3(3):E1-E19

Averill R, Fuller R. Low-cost outliers as alternatives to the two-midnight rule. Healthc Financ Manage. 2014(December)

McCullough EC, Sullivan C, Banning P, Goldfield NI, Hughes JS. Challenges and benefits of adding laboratory data to a mortality risk adjustment method. Qual Manage Health Care. 2011;20(4):253-262.

Quinn K. After the revolution: DRGs at age 30. Ann Intern Med. 2014;160:426-429.

Quinn K, Davies B. Applicability of Hospital-Specific Relative Value (HSRV) DRG Weights. Memorandum to California Department of Health Care Services. West Sacramento, CA: Xerox State Healthcare, 2015.

Mellinger JL, Richardson CR, Mathur AK, Volk ML. Variation among United States hospitals in inpatient mortality for cirrhosis. Clin Gastroenterol Hepatol. 2015;13(3):577-584.

Mills R, Bulter R, Averill R, McCullough E, Fuller R, Bao, M. The impact of the transition to ICD-10 on Medicare inpatient hospital payments. J AHIMA. 2015(February).

Quinn K. The 8 basic payment methods in health care. Ann Intern Med. 2015;163(4):300-306.

Villwock JA, Goyal P. Early versus delayed treatment of primary epistaxis in the United States. Int Forum Allergy Rhinol. 2014;4:69–75.

Wissoker D, Garrett B. Designing a Unified Prospective Payment System for Postacute Care. Contractor report. Washington, DC: MedPAC, 2016

Averill RF, Fuller RL. Implementing a site-neutral PPS. Healthc Financ Manag. 2016(April).

Fuller RL, Averill RF, Muldoon JH, Hughes JS. Comparison of the properties of regression and categorical risk-adjustment models. J Ambul Care Manage. 2016;39(2):157-165.

Fuller RL, Averill RF, Muldoon JH, Hughes JS. Response to commentaries on “Comparison of the properties of regression and categorical risk-adjustment models.” J Ambul Care Manage. 39(2):175-177. doi:10.1097/JAC.0000000000000147.

Leyenaar JK, Ralston SL, Shieh M, Pekow PS, Mangione-Smith R, Lindenauer PK. Epidemioology of pediatric hospitalizations at general hospitals and freestanding children's hospitals in the United States. J Hosp Med. 2016;11(11):743-749.

Medicaid and CHIP Payment and Access Commission. Comparing Medicaid Hospital Payment Across States and to Medicare. Washington, DC: MACPAC, 2017.

California Department of Health Care Services. Review of SFYs 2013-14 and 2014-15 Utilization and Payment. Sacramento, CA: DHCS, 2017.

Navigant Inc. Arkansas DRG Conversion Plan. Report to the Arkansas Department of Human Services. Chicago: Navigant, 2017.

Alaska Department of Health and Social Services. AK DHSS Annual Medicaid Reform Report FY 2018. Anchorage, AK: DSS, 2018.

Fuller R. An Analysis of Real Price Effects Resulting from Charge Setting Practices in the US Hospital Sector. Highland, MD: Jayne Koskinas Ted Giovanis Foundation for Health and Policy, 2018.

Marks T, Gifford K, Perlin S, Byrd M, Beger T. Factors Affecting the Development of Medicaid Hospital Payment Policies--Findings from Structured Interviews in Five States. Report to MACPAC. Lansing, MI: HMA, 2018.

Medicaid and CHIP Payment and Access Commission. State Medicaid Payment Policies for Inpatient Hospital Services. Available at https://www.macpac.gov/publication/macpac-inpatient-hospital-payment-landscapes/

Fuller RL, Hughes JS, Goldfield NI, Atkinson G. Are we confident of across-hospital mortality comparisons? Am J Med Qual. 2018;33(6):662-664.

McCormick PJ, Lin HM, Deiner SG, Levin MA. Validation of the All Patient Refined Diagnosis Related Group (APR-DRG) risk of mortality and severity of illness modifiers as a measure of perioperative risk. J Med Syst. 2018;42(5):81.

Deschepper M. Using standard available hospital-wide data in the interpretation and prediction of outcome indicators. Doctoral dissertation, Ghent University. Faculty of Medicine and Health Sciences; 2019.

Averill RF, Fuller RL, Mills RE. Financial Impact of Geographic Variation in Hospital Quality Performance in Medicare. Murray, UT: 3M Health Information Systems, 2019.

Medicare Payment Advisory Commission. The effects of the Hospital Readmissions Reduction Program. Chapter 1 in Medicare and the Health Care Delivery System. Report to Congress. Washington, DC: MedPAC, June 2018.

U.S. Agency for Health Care Research and Quality. AHRQ Quality Indicators: Quality Indicator Empirical Methods. Rockville, MD: AHRQ, 2019.

Fuller RL, Hughes JS, Atkinson G, Aubry BS. Problematic risk adjustment in National Healthcare Safety Network Measures. Am J Med Qual. 2019:1-8.

Lawrence YR, Golan T, Urban D, Hammer L, Amit U, Catane R, Bar J, Goldstein J, Symon Z, Urban G. Effect of hospital volume on mortality rates amongst neutropenic cancer patients within the United States. J Clin Onc.2016;34:15_sup 6600\

Souza J, Santos JV, Canedo VB, Betanzos A, Alves D, Freitas A. Importance of coding co-morbidities for APR-DRG assignment: focus on cardiovascular and respiratory diseases. Health Inf Manag. 2019; doi: 10.1177/1833358319840575. [Epub ahead of print]

Averill RF. Fuller RL, Mills RE. Surgical Mortality as a Measure of Hospital Quality. Murray, UT: 3M Health Information Systems, 2020.

Fuller R, Hughes J. DNR orders known at the time of admission can improve hospital mortality ratings [abstract]. HSR. 2020;55(51):96

Websites

Washington Health Alliance. Inpatient Spending Trends in Washington State (February 2020). Webpage: https://www.wacommunitycheckup.org/highlights/inpatient-spending-trends-in-washington-state-february-2020/

Washington Health Alliance. Variation of Pricing for Inpatient Treatments in Washington State. 2019. webpage: https://www.wacommunitycheckup.org/highlights/variation-of-pricing-for-inpatient-treatments-in-washington-state/

Illinois DRG Pricing Calculator. https://www.illinois.gov/hfs/MedicalProviders/hospitals/hospitalratereform/Pages/default.aspx

Montana Medicaid Inpatient Pricing Calculator. https://medicaidprovider.mt.gov/01#186035117-fee-schedules---hospital---apr-drg

RI Medicaid APR-DRG Pricing Calculator. http://www.eohhs.ri.gov/ProvidersPartners/GeneralInformation/ProviderDirectories/Hospitals.aspx

3M Health Information Systems. 3M Patient Classification Methodologies. Webpage: www.3m.com/his/methodologies

Arizona Health Care Cost Containment System. AZ APR-DRG Pricing Calculator FY 2020. Available at: www.azahcccs.gov/PlansProviders/RatesAndBilling/FFS/APRDRGrates.html

Colorado Department of Health Care Policy and Financing. Inpatient Hospital Payment. [Webpage]. https://www.colorado.gov/pacific/hcpf/inpatient-hospital-payment

Connecticut Department of Social Services. Medicaid Hospital Reimbursement. Webpage: www.ctdssmap.com/CTPortal/Hospital%20Modernization/tabId/143/Default.aspx

District of Columbia Department of Health Care Finance. Rates and Reimbursements. Webpage: https://dhcf.dc.gov/page/rates-and-reimbursements

Indiana Department of Health. Hospital Discharge Data [webpage]. www.in.gov/isdh/20624.htm

Minnesota Department of Human Services. Payment Methodology for Inpatient Hospitals. Webpage: https://mn.gov/dhs/partners-and-providers/policies-procedures/minnesota-health-care-programs/provider/types/payment-methodology-for-inpatient-hospitals.jsp

Mississippi Division of Medicaid. Inpatient Hospital Payment Method for Mississippi Medicaid [webpage]. https://medicaid.ms.gov/providers/reimbursement/

Texas Medicaid and Healthcare Partnership. Acute Care Hospital Reimbursement [webpage]. http://www.tmhp.com/resources/rate-and-code-updates/acute-care-hospital-reimbursement

Washington HealthCareCompare [webpage]. https://www.wahealthcarecompare.com/

Wisconsin Department of Health Services. ForwardHealth Rates and Weights [webpahe]. https://www.forwardhealth.wi.gov/WIPortal/Tab/42/icscontent/Provider/Medicaid/hospital/drg/drg.htm.spage#

California Department of Health Care Services. https://www.dhcs.ca.gov/provgovpart/Pages/DRG.aspx

Florida Agency for Health Care Administration--consumer information. www.floridahealthfinder.gov

Illinois Department of Healthcare and Family Services. www.illinois.gov/hfs/MedicalProviders/MedicaidReimbursement/Pages/DRGHICalcuWorksheet.aspx

New York Department of Health--consumer information. https://health.data.ny.gov/

New York Department of Health--Medicaid. https://www.health.ny.gov/facilities/hospital/reimbursement/apr-drg/

Indiana Medicaid Diagnosis-Related Group Inpatient Reimbursement. https://www.in.gov/medicaid/providers/669.htm

Ohio Department of Medicaid Hospital Payment Policy. https://medicaid.ohio.gov/Provider/ProviderTypes/HospitalProviderInformation/HospitalPaymentPolicy

North Carolina Community Care Networks, Inc. Clinical Program Analysis. Report to the North Carolina Department of Health and Human Services. Raleigh, NC: NCCC, 2015

Berry JG, Hall M, Cohen E, O'Neill M, Feudtner C. Ways to identify children with medical complexity and the importance of why. J Pediatr. 2015;167(2):229-237. HSR. 20014;39(1):73-

DuBard CA, Jacobsen Vann JC, Jackson C. Conflicting readmission rate trends in a high-risk population: implications for performance measurement. Popul Health Manag. 2015;18:351–357

Jackson C, Shahsahehi M, Wedlake T, DuBard CA. Timeliness of outpatient follow-up: an evidence-based approach for planning after hospital discharge. Ann Fam Med. 2015:13(2):155-122.

Jones C, Finison K, McGraves-Lloyd, Tremblay T, Mohlman MK, Tanzman B, Hazard M, Maier, Samuelson J. Vermont's community-oriented all-payer medical home model reduces expenditures and utilization while delivering high-quality care. Popul Health Manag. 2015. DOI: 10.1089/pop.2015.0055.

Neff JM, Clifton H, Popalisky J, Zhou C. Stratification of children by medical complexity. Acad Pediatr. 2015;15(2):191-196.

Pfister DG, Rubin DM, Elkin EE, Neill US, Duck E, Radzyner M, Bach PB. Risk adjusting survival outcomes in hospitals that treat patients with cancer without information on cancer stage. JAMA Oncol. 2015;1(9):1303-1310.

Quinn K. The 8 basic payment methods in health care. Ann Intern Med. 2015;163(4):300-306.

Florida Agency For Healthcare Administration. Analyzing the Disease Burden of Florida Medicaid Enrollees Using Clinical Risk Groups. Tallahassee, FL: AHCA, Winter 2016.

Hileman G, Steele S. Accuracy of Claims-Based Risk Scoring Models. Schaumburg, IL: Society of Actuaries, 2016.

DuBard CA. Key Performance Indicators of Cost and Utilization for Medicaid Recipients Enrolled in Community Care of North Carolina. N C Med J. 2016;77(4):297-300.

Fuller RL, Goldfield N. Paying for on-patent pharmaceuticals: limit prices and the emerging role of a pay for outcomes approach. J Ambul Care Manage. 2016;39(2):143-149.

Fuller RL, Goldfield N. Response to commentaries on "Paying for on-patent pharmaceuticals: limit prices and the emerging role of a pay for outcomes approach". J Ambul Care Manage. 2016;39(2):155-156.

Fuller RL, Hughes JS, Goldfield NI. Adjusting population risk for functional health status. Popul Health Manage. 2016;19(2):136-144.

Gareau S, Lopez-De Fede A, Loudermilk BL, Cummings TH, Hardin JW, Picklesimer AH, Crouch E, Covington-Kolb S. Group prenatal care results in Medicaid savings with better outcomes: a propensity score analysis of CenteringPregnancy participation in South Carolina. Matern Child Health J. 2016;20(7):1384–1393.

Juhnke C,Bethge S, Mühlbacher AC. A review on methods of risk adjustment and their use in integrated healthcare systems. Int J Integr Care. 2016;16(4):1–18

Mohlman MK, Tanzman B,Finison K, Pinettte M, Jones C. Impact of medication-assisted treatmernt for opioid addiction on Medicaid expenditures and health services utilization rates in Vermont. J Subst Abuse Treat. 2016;67: 9–14

Finison K , Mohlman M, Jones C, Pinette M, Jorgenson D, Kinner A, Tremblay T, Gottlieb D. Risk-adjustment methods for all-payer comparative performance reporting in Vermont. BMC Health Serv Res. 2017;17.

Bednar WR, Axene JW, Liliedahl RL. An Analysis of End-of-Life Costs for Terminally Ill Medicare Fee-for-Service (FFS) Cancer Patients. Schaumburg, Society of Actuaries, 2018.

Fuller RL, Goldfield NI, Hughes JS, McCullough EC. Nursing home compare star rankings and the variation in potentially preventable emergency department visits and hospital admissions. Popul Health Manage. Epub ahead of print. July 30, 2018.

Averill RF, Fuller RL, Mills RE. Financial Impact of Geographic Variation in Hospital Quality Performance in Medicare. Murray, UT: 3M Health Information Systems, 2019.

Connecticut Department of Social Services. Connecticut State Innovation Model Operational Plan Award Year 4. Hartford, CT: DSS, 2019.

Vermont Agency of Human Services. Annual Report on The Vermont Blueprint for Health. Report to the Legislature. Burlington, VT; Agency of Human Services, 2020

Vermont Agency of Human Services. Community Health Profiles [webpage]. https://blueprintforhealth.vermont.gov/community-health-profiles.

Andrews AL, Bettenhausen J, Hoefgen E, Richardson T,Macy ML; Zima BT, Colvin J; Hall M; Shah SS, Neff NM, Auger KA. Measures of ED Utilization in a National Cohort of Childen. Am J Manag Care. 2020;26(6):267-272.

3M Health Information Systems. 3M Patient Classification Methodologies. Webpage: www.3m.com/his/methodologies.

Vermont Agency of Human Services. Hub and Spoke Profiles [webage]. Annual Report on The Vermont Blueprint for Health. Report to the Legislature. Burlington, VT; Agency of Human Services, 2020

Superior Health Plan. 3M Health Information. Available at https://www.superiorhealthplan.com/content/dam/centene/Superior/Provider/PDFs/SHP_20195046-3M-HIS-Resource-Guide-P-508-03202019.pdf

Superior Health Plan. 3M HIS Prospective Dashboard User Guide. Available at https://www.superiorhealthplan.com/content/dam/centene/Superior/Provider/PDFs/SHP_20173928-3M-HIS-Dashboard-Training-P-05312018.pdf

Appendix C: Description of Performance Measures and Risk Adjustment Methods

Performance Measures

Potentially Preventable Admissions

Potentially Preventable Admissions (PPAs) are hospital admissions that can often be avoided. There are six broad categories of PPAs:

- Admissions for chronic disease management that could potentially have been managed in the outpatient setting (e.g., asthma)
- Admissions for acute diseases that could potentially have been managed in the outpatient setting (e.g., viral pneumonia)
- Admissions for a procedure that can be done in an outpatient setting (e.g., cardiac catheterization for non-acute disease such as atherosclerosis)
- Admissions for a procedure for which there is a less invasive alternative procedure (e.g., percutaneous coronary angioplasty with a stent instead of coronary bypass surgery)
- Admissions for a procedure that research has shown to be prone to overuse (e.g., spinal procedures for back pain)
- Admissions that could potentially have been avoided for residents of a residential care facility such as a skilled nursing facility (e.g., trauma due a fall)

The most prevalent PPAs are for medical management of chronic and acute diseases. These hospital admissions may result from hospital or ambulatory care inefficiency, lack of adequate access to outpatient care, or inadequate coordination of ambulatory care services. In many cases PPAs are for flare-ups of chronic conditions (e.g., heart failure) for which adequate monitoring and follow-up, such as proper medication management, could have avoided the need for hospitalization.

Potential preventability is assessed relative to the care given in the immediate period preceding a hospital admission (months). Conditions that require an extended period of coordinated and integrated care are not considered potentially preventable. For example, an admission for renal failure is not considered a PPA because it is not preventable unless appropriate care has been given for several years before the admission making it is difficult to judge potential preventability based solely on the care given in the immediate period preceding the admission. Preventability is also assessed based on the relative acuteness of the reason for the admission. For example, an admission for a cardiac catheterization is considered potentially preventable for patients with a diagnosis of coronary atherosclerosis, but not preventable for patients with an acute myocardial infarction or unstable angina. Medicare beneficiaries living in residential care facilities such as a SNF or nursing home generally are expected to be receiving a higher level of coordinated care than beneficiaries living at home. Many conditions such as fever, urinary tract infections, metabolic disturbances and pneumonia can often be managed in a residential care facility, thereby avoiding the need for hospitalization. Other conditions such as diseases of the skin and injuries due to falls should be more readily avoided in a residential care facility setting. In determining whether an admission is potentially preventable, PPAs apply a broader list of conditions that are considered potentially preventable when a beneficiary is living in a residential care facility. For more detail, download the 3M Clinical and Economic Research report, *Geographic variation in hospital admission rates in the Medicare population*. https://multimedia.3m.com/mws/media/2044671O/geographic-variation-hospital-admission-rates.pdf

Potentially Preventable Emergency Department Visits

Potentially Preventable ED Visits. (PPVs) are ED visits that can often be avoided. There are five broad categories of PPVs:

- ED visits for chronic disease management that could potentially have been managed in the outpatient setting (e.g., asthma)
- ED visits for minor acute conditions that could potentially have been managed in the outpatient setting (e.g., constipation)
- ED visits for signs and symptoms that do not require urgent care (e.g., lumbago)
- ED visits for minor trauma (contusions)
- ED visits that could potentially have been avoided for residents of a residential care facility such as a skilled nursing facility (e.g., trauma due to a fall)

The most prevalent PPVs will be for minor trauma and pain. These hospital emergency department visits may result from lack of access to adequate primary care or inadequate coordination of ambulatory care services. PPVs also include chronic conditions (e.g., hypertension) for which adequate monitoring and follow-up, such as proper medication management, could have avoided the need for an ED visit. A comprehensive evaluation of potentially preventable ED visits can provide a more complete assessment of the continuity of care and of the functioning of the health care delivery. For more detail, download the 3M Clinical and Economic Research report, *Geographic variation in hospital emergency department visits in the Medicare population*. https://multimedia.3m.com/mws/media/2044668O/geographic-variation-emergency-department-visits.pdf

Potentially Preventable Complications

Potentially Preventable Complications (PPCs) are harmful events (accidental laceration during a procedure) or negative outcomes (hospital acquired pneumonia) that may result from the process of care and treatment rather than from a natural progression of underlying disease. There are 57 PPCs that encompass the full range of complications. For each PPC, the patients considered at risk for the PPC and the clinical circumstances under which the PPC could be consider potentially preventable are specified. Any patient who had one or more PPCs during their hospital stay is considered to have a PPC. For more detail, visit: https://apps.3mhis.com/docs/Groupers/PPCs/methodology_overview/grp381_ppc_meth_overview.pdf

Potentially Preventable Readmissions

Potentially Preventable Readmissions (PPRs) are return hospitalizations within 30 days following a prior hospitalization. PPRs may result from deficiencies in the process of care (readmission for a surgical wound infection) or inadequate post-discharge follow-up (prescription not filled) rather than unrelated events that occur post discharge (broken leg due to trauma). Readmissions may result from actions taken or omitted during the initial hospital stay, such as incomplete treatment or poor care of the underlying problem, or from poor coordination of services at the time of discharge and afterwards, such as incomplete discharge planning or inadequate access to care. The admissions considered at risk for a PPR and the clinical circumstances under which a subsequent readmission is considered potentially preventable are specified in the PPR logic. A PPR is assigned to any admission that was followed by one or more potentially preventable readmissions during the

30 days following a hospital discharge. For more detail, visit: https://multimedia.3m.com/mws/media/1684594O/3m-potentially-preventablereadmissions-methodology-overview.pdf

Potentially Preventable Return Emergency Room Visits Following Hospital Discharge

Potentially preventable return emergency room visits following hospital discharge (PPREDs) are return ED visits within 30 days following a prior hospitalization. PPREDs are identified using a modification of the PPR methodology to determine discharges at risk and potentially preventable ED visits. Similar to PPRs, PPREDs may result from deficiencies in the process of care (ER visit for a post-op infection) or inadequate post discharge follow-up (no primary care follow-up) rather than unrelated events that occur post discharge (trauma). Return ED visits may result from actions taken or omitted during the initial hospital stay, such as incomplete treatment or poor care of the underlying problem, or from poor coordination of services at the time of discharge and afterwards, such as incomplete discharge planning, or inadequate access to care. A PPRED is assigned to any patient who had at least one PPREDs during the 30 days following a hospital discharge. For more detail, download the 3M Clinical and Economic Research Report, *Geographic variation in hospital quality performance in Medicare.* https://multimedia.3m.com/mws/media/1776317O/3m-his-medicare-regional-variation-case-study.pdf

Post-acute Care Facility Admission

The post-acute care (PAC) facility admission identifies patients who were admitted to a skilled nursing facility or rehabilitation facility within 4 days following a hospital discharge. Hospital discharges considered at risk are restricted to discharges for which home care may be a viable alternative to care provided in an institution. Patients for whom the hospital's intended PAC plan of care is inconsistent with a PAC facility admission (e.g., a patient with a discharge status of discharge to hospice) or a patient who has an unanticipated event during the PAC four-day window (e.g., a patient with a discharge status of home but who was admitted to hospice on the second day before being admitted to a PAC facility on the fourth day following hospital discharge) were excluded from the PAC facility admission measure. By eliminating such ambiguous situations, the patients included in the PAC facility admission measure represent patients whose anticipated post-hospital discharge plan of care is consistent with a PAC facility admission. Download the report *Geographic variation in post-acute care facility admissions* at: https://multimedia.3m.com/mws/media/2051382O/report-geographic-variation-in-post-acute-care-facility-admissions.pdf

Hospital Admissions from the Emergency Department

The Emergency Department (ED) Admit measure identifies hospital admissions that are a low-severity medical admission from the ED. Patients who died, who were admitted for surgical procedures, who were admitted for conditions that are inherently high risk (e.g., AMI), who were at high severity (admission APR DRG severity of illness 3 or 4), who were covered by medical necessity considerations (e.g. behavioral health) and who had a length of stay of more than three days are excluded from the ED Admit measure. The ED visits that were not excluded are the at-risk-population for the ED Admit measure and represent low severity medical admissions (chest pain, upper respiratory infections, etc.) for which outpatient care may be a viable option. For the at-risk ED visits, the ED Admit rate is the sum of ED visits that were admitted divided by the sum of ED visits that were admitted plus the ED visits that were not admitted.

Surgical Mortality

The surgical mortality measure is based on a 30-day post-procedure time period that includes in hospital and community deaths. Patients for whom a hospital was not considered reasonably responsible for the patient outcome, such as patients who left against medical advice, were transferred in, were in critical condition at the time of admission (APR DRG admission risk of

mortality level 4), were admitted for conditions that inherently have a high risk of mortality (extensive third-degree burns) or had a clinically unrelated readmission (a PPR) during the 30-day post-procedure period were excluded. However, hospitals were considered responsible for mortality during any clinically related readmissions (non PPRs) in the 30-day post-procedure period. Surgical patients who were not excluded are the at-risk-population for the 30-day post procedure measure. Download the 3M Clinical and Economic Research report *Surgical mortality as a measure of hospital quality* at: https://multimedia.3m.com/mws/media/2044672O/surgical-mortality-hospital-quality.pdf

Ambulatory Visits

The ambulatory visit measure is the per capita number of physician or care management encounters. The encounters are identified by the reporting of an Evaluation and Management (E&M) code on a professional service fee-for-service claim for services deliver in specific sites of service. Encounters that have a site of service of a residential facility or that do not include care management services were excluded including hospital inpatient, emergency department, ambulatory surgery center, skilled nursing facility, inpatient rehabilitation facility, ambulance, immunization center and laboratory. Encounters that have a site of service of physician office, hospital outpatient clinic, home, assisted living, nursing home and other clinics and outpatient facilities were included.

Risk Adjustment Methods

All Patient Refined DRGs

All Patient Refined Diagnosis Related Groups (APR DRGs) are a categorical clinical model that is composed of base DRGs that are subdivided into four severity of illness level based on the extent of physiologic decompensation or organ system loss of function and four risk of mortality subclasses. The underlying clinical principles of APR DRGs are that the severity of illness and risk of morality are highly dependent on the patient's underlying clinical problems, and that patients with high severity of illness and risk of mortality are usually characterized by multiple serious illnesses. In the APR DRGs, the assessment of the severity of illness and risk of mortality of a patient is specific to the base APR-DRG to which a patient is assigned. In other words, the determination of the severity of illness and risk of mortality is disease specific. In APR DRGs, high severity of illness and risk of mortality are primarily determined by the interaction of multiple diseases. Patients with multiple comorbid conditions involving multiple organ systems represent difficult-to-treat patients who tend to have poor outcomes. The APR DRG is computed at the time of admission and at the time of discharge. For more detail, visit: https://apps.3mhis.com/docs/Groupers/All_Patient_Refined_DRG/Methodology_overview_GRP041/grp041_aprdrg_meth_overview.pdf

Clinical Risk Groups

The Clinical Risk Groups (CRGs) are a categorical clinical model that assigns each individual in a population to a single mutually exclusive risk group that relates the clinical and demographic characteristics of an individual to their outcomes and healthcare resource use. CRGs describe the health status and burden of chronic illness of individuals and are subdivided into up to six severity of illness levels. Each CRG and severity subgroup is used to describe the health status of groups of individuals with a similar burden of chronic illness. Individuals with severe chronic disease in multiple organ systems are the patients who are most difficult to treat, experience poorer outcomes, and consume a disproportionate share of health care resources.

The CRGs (Version 2.1) are composed of 332 base CRGs that describe the beneficiary's most significant chronic conditions and explicit severity levels that distinguish differences in disease burden due to severity of illness resulting in 1,414 individual CRGs. The individual CRGs are aggregated into nine health statuses ranging from catastrophic to healthy:

Status 1 – Healthy
Status 2 – History of Acute Disease e.g., Chest Pain
Status 3 – Single Minor Chronic Disease e.g., Migraine
Status 4 – Minor Chronic Disease in Multiple Organ Systems e.g., Migraine and BPH
Status 5 – Single Dominant or Moderate Chronic Disease e.g., CHF
Status 6 - Dominant or Moderate Chronic Disease in Multiple Organ Systems, e.g., CHF, COPD
Status 7 - Dominant Chronic Disease in Three or More Organ Systems, e.g., CHF, COPD, DM
Status 8 - Malignancy, Under Active Treatment, e.g., Lung Cancer
Status 9 - Catastrophic Conditions, e.g., Major Organ Transplant

Based on the severity levels of the chronic conditions that comprise each status, beneficiaries in the nine statuses are assigned a severity level between one and six resulting in 53 aggregated CRG risk categories. The CRGs are a transparent system with a definition manual available for inspection. For an overview of the methodology, visit: https://apps.3mhis.com/docs/Groupers/Clinical_Risk_Grouping_CRG/methodology_overview/grp401_crg_v2.2_meth_overview.pdf

Health Information Systems
575 West Murray Boulevard
Salt Lake City, UT 84123 U.S.A.
800 367 2447

www.3m.com/his

Published 11/21